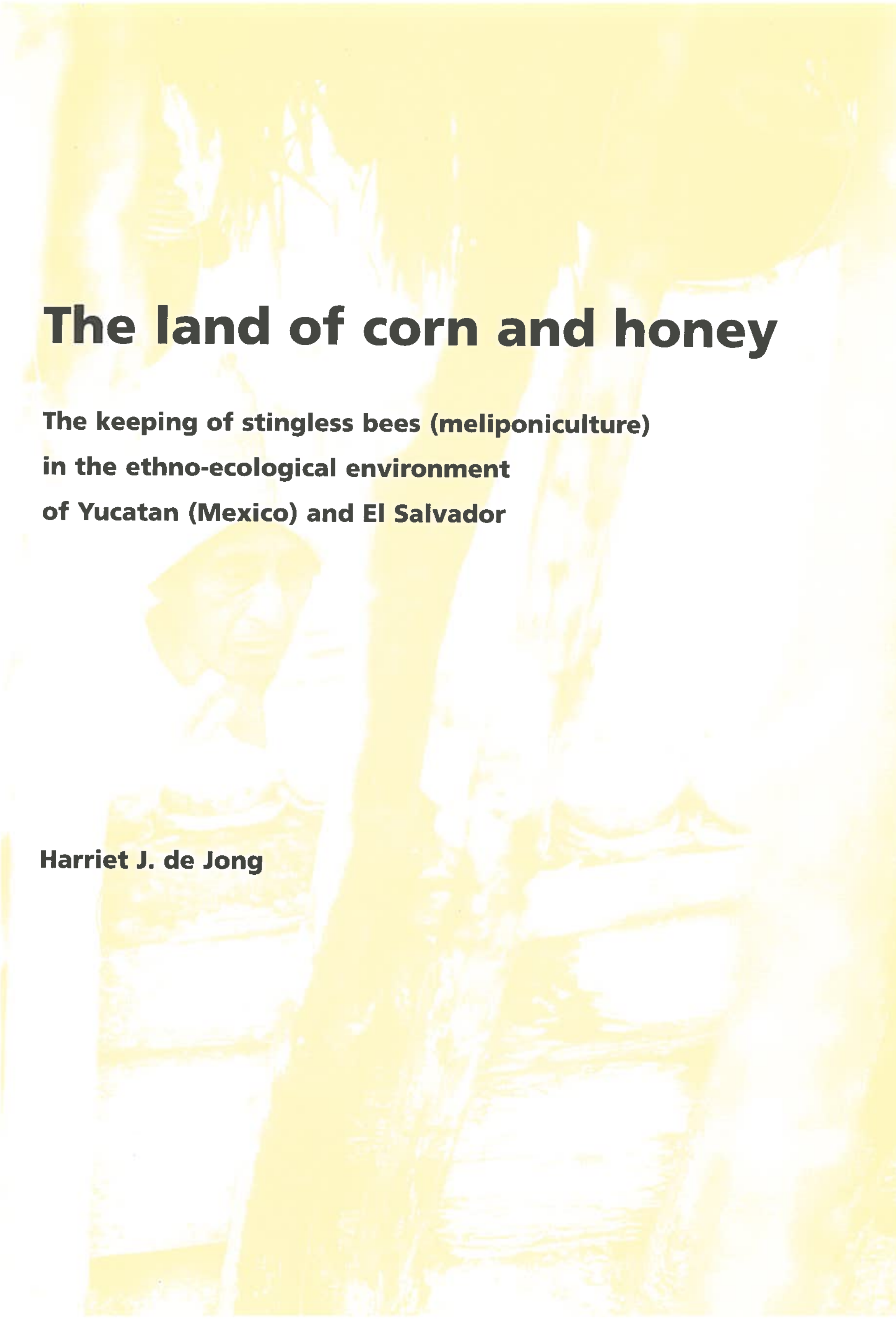

The land of corn and honey

The keeping of stingless bees (meliponiculture) in the ethno-ecological environment of Yucatan (Mexico) and El Salvador

Harriet J. de Jong

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Het land van maïs en honing:
Het houden van angelloze bijen (meliponicultuur) in de etno-ecologische omgeving van Yucatán (México) en El Salvador
(met een samenvatting in het Nederlands)

La tierra del maíz y de la miel
La crianza de las abejas sin aguijón (la meliponicultura) en el medio ambiente etno-ecológico de Yucatán (México) y El Salvador
(con un resumen en Español)

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In the second year of my Master's degree course in anthropology, during a fieldwork training period, I stayed in the Spanish village of Valero, in the Sierra de Francia, known for its many beekeepers. One way or another, the subject of my report became beekeeping, though I hadn't yet been seriously 'stung'. Paradoxically, that was accomplished by the stingless bees of Costa Rica, during the final research project for my degree. However, this only happened after the bee-man himself, Dr. Rinus Sommeijer, injected me - like so many others before - with an enormous dose of enthusiasm for meliponine bees.

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When the Maya want to protect a child from certain spirits or persons - for example, family members who seem to be well-intentioned, but who are believed to embody a bat which sucks a little blood every time they give a kiss -, they conceal the child's identity by means of a ceremony called *k'ex*, 'change'. The child is given a new name. A similar transformation occurs in this dissertation where, for privacy reasons, some of the names used are pseudonyms.

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Prologue - the Dinner for the Bees

Shafts of early-morning sunlight pierce the wall of upright poles, patterning the floor with golden streaks. At the centre crouches the shaman Don Hipólito, kindling the firewood he gathered at sunrise. Four chickens hang from the doorknob, heads down, their feet trussed with twine. It is seven o'clock and we have gathered for the *U Hanli Kab*, the dinner for the gods of the stingless bees. Don Hipólito is preparing *balche'*, mead, which is to be offered during the ceremony. Somewhere in the room he finds strips of bark from the *Balche'* tree. *Balche'* is as essential to the shamanistic rituals as is the *sastun*, the divining crystal that Don Hipólito keeps wrapped in a cloth, away from the curious gaze of the uninitiated, for only he may use this window upon the spirit world. As he boils the bark in a big casserole of steaming water, a pungent aroma fills the air. When enough of the essence has been released, he pours in half a litre of the precious honey harvested from the stingless bees known as *Xunan kab* (*Melipona beecheii*). He stirs the mixture for ten minutes. Meanwhile, his wife Doña Teresa shuffles into the dwelling and, with an air of indifference, wrings the chickens' necks one by one. Their twitching is short-lived. The day before, Doña Teresa prepared six kilograms of *nixtamal*, corn kernels boiled with a little mineral lime. In the backyard, two young granddaughters of Don Hipólito and Doña Teresa wash the *nixtamal*. They also pluck the chickens and wash them, first with detergent and then with orange juice. Meanwhile, Jacinta Pool May (my field-assistant) peels some garlic. The women work together, preparing all the food for the ceremonial dinner. Don Hipólito has preparations of his own. When the *balche'* is ready, he uses two calabashes, one small, the other large, to pour off the brew into a new pan. When this vessel is full, he wraps it in a beautifully embroidered cloth. At the domestic altar, specially festooned for the event with flowers and streamers, he consecrates the *balche'*. He says a prayer in front of an image of *La Virgen Guadalupe*, but nobody pays much attention. Then Doña Teresa burns the garlic in the fire. She carefully spreads the smoke into every nook and cranny, for she must expel all evil spirits that may be lurking in the house. Don Hipólito checks whether he has the 28 calabashes he needs to contain the offerings to the gods that are to be present at the dinner. He finds his set incomplete and leaves to fetch some more. At around ten o'clock, the chickens are ready to be cooked on the fire. Then it's time for a break. Don Hipólito has returned with some more calabashes, and Doña Teresa takes a well-deserved rest from all the hard work. In the course of the morning, more and more guests have dropped in. We smoke cigarettes and a bottle of Xtabentun honey-liquor is passed around, loosening tongues. Doña Teresa starts reminiscing about her childhood:

"After my mother died, I lived with my younger brothers and sisters. My father was never at home in those days, so I harvested the honey. I also worked in the *milpa* [corn patch] and went to hunt in the forest. I killed different kinds of deer: *yuuk'*, *cerecke* and *chiik'*. I hunted lots of animals. [...] We children just had to make the best living we could. Every time we went to the *milpa* we brought home lots of honey. One day, my uncle followed me and my sisters, because he had been wondering: 'They are still pure women, who is giving them the honey?' So he had decided to shadow us. He was afraid that a man was going with us and giving us the honey. I did everything men usually do. I even killed a *sak xikín* [an ocelot]."

The idea of Doña Teresa harvesting the honey of stingless bees causes great hilarity among all those present, not least Don Hipólito. His wife goes on to tell of other things she did while still unmarried that are normally the preserve of men. After the break, the preparations for the ritual continue. Don Hipólito builds an altar-table near the beehives he keeps in his homestead. By about noon, everything is ready.

With the sun at its zenith, Don Hipólito's first words of prayer rise to the sky, invoking the gods. While he disperses the smoke of incense and sprinkles mead to the four corners of the altar, to its centre and to the sky, he invites *Kun K'u*, chief of the rain gods, and the *Yumtzilob*, the spirits of the forest, to descend and partake of the dinner. Most of his words of supplication, though, are directed at *Yumbil Dios*, Almighty God. He holds his divining crystal up to the flame of a candle several times to ensure that all the gods have taken their seats. He informs them that he keeps five hives of *Xunan kab*, the 'Lady bee', and asks that his charges be protected against their enemies, in their earthly travails and when they journey to celestial *Xmaben* to collect divine honey. After half an hour of prayer, there is a break in the proceedings. Don Hipólito leaves the gods to enjoy their offerings for a quarter of an hour while he sits near the altar smoking a cigarette and telling jokes. Then he prays for another fifteen minutes or so before directing all the deities back to their proper places in the sky, in the reverse order of their invitation. Once all the deities have departed, Don Hipólito, his family and the other guests can sit down to eat.

Note: The preparations for this ceremony are described in detail in Section 5.4.7 *et seq.*

1 Landscapes and mindscapes[1]: meliponiculture, environment and culture

Bees have been important to humankind and their environment since the beginning of recorded history,[2] yet it is not widely known that there are honey-producing, social bees which are incapable of stinging. These Meliponinae, commonly referred to as 'stingless bees', are native to the tropical Americas and have been bred by Mesoamerican indigenous peoples since pre-Hispanic times. On the Yucatan peninsula, the honey and the wax of stingless bees were two of the most important tradable commodities during the pre-Hispanic and early colonial eras respectively. To this day, the indigenous peoples of the region continue to keep such bees wherever the environment permits, despite the fact that an introduced species (*Apis mellifera*) produces far more honey and wax. This dissertation examines the importance of meliponiculture (the keeping of stingless bees) to the Maya of Mexico's Yucatan peninsula, the ethnic group to which Don Hipólito and his relatives belong, and compares it with the situation among keepers of stingless bees in El Salvador. In this dissertation, I describe meliponiculture from an anthropological viewpoint and explore the interaction between bees and humans in relation to the environment.

Stingless bees are social insects: they live in colonies, 'build their own houses' and 'raise their children'; they have castes on which labour division is based; they gather, store and steal food and fight for resources and survival with other colonies. This social behaviour of bees, so similar to the ways of humans, has drawn the attention of many people of different cultures down the ages. Observations of how bees live and interact in their natural environment, along with acquired knowledge on how to breed them and harvest their produce, have been handed down from generation to generation by means of story, symbolism, ritual, and practical instruction. In this way, meliponiculturalists have accumulated and benefited from generations of experience in

[1]This term was first used in the anthropological literature by Croll and Parkin (1992).

[2]A Spanish rock painting in the Araña cave (Bicorp, Valencia) indicates that humans took honey from hives in the late Palaeolithic period (Ransome [1937] 1986: 21).

the keeping of stingless bees, while continuing to learn from their own observations. The study of meliponiculture and all that relates to it, in particular the knowledge of the beekeepers themselves, can contribute to scientific understanding of the behaviour of the Meliponinae. However, because that knowledge is passed from generation to generation by culturally specific means, much of it seems unclear, even arcane, to outsiders. The various beekeeping practices are so closely intertwined with cultural practices that they cannot be viewed separately from them.

Europeans introduced the bee species *A. mellifera* to the Americas in the 19th and 20th century. Recently, so-called 'Africanized' bees (a sub-species) have invaded the region with such success that most of the European honeybee colonies have become Africanized to some extent. As a result of certain biological characteristics of these non-native bees and technological advances in their breeding (apiculture), they are able to produce far more honey and wax than any of the meliponine species. Apiculture is currently practised throughout Central America and Mexico, where it is an important economic activity. The Yucatan peninsula, one of the world's four largest honey-producing regions (Echazaretta 1997), is a beekeeping centre *par excellence*. All the honey it exports is made by the introduced honeybees. Why then, with apiculture so manifestly successful on the peninsula, should it be necessary to pay any attention to the far less familiar practice of meliponiculture? The answer to this question lies beyond pure economics, in cultural and ecological fields.

Evidently, the value of stingless bees to the indigenous peoples who continue to keep them goes beyond the quantities of honey and wax they produce. From brief descriptions by authors of different disciplines, we learn that the honey and other products of meliponine bees are locally used in healing and ritual practices and that a mystical value is ascribed to the bees themselves and their products (Landa [1566] 1992; Roys 1969; Favre 1968; Schwarz 1948; Thompson 1927-32). Steggerda, for example, wrote:

> "One woman in Piste [Yucatan] wept when her husband's bees fought and killed each other, because she believed it to be a sign that he would soon die. Although her husband remained alive, her son-in-law died within four days" (1941: 59).

Beekeepers visit their bees frequently 'to reassure them of their interest', and any bee that is accidentally killed is folded in a leaf and buried (Weaver & Weaver 1981: n.19). Redfield and Villa Rojas noted that beekeepers would only move their hives on Saturdays, for only on that day of the week were all the bees assumed to be 'at home'.

The authors themselves cryptically added: "Indeed, it is by observing the bees that one may tell that it is Saturday" (1934: 117, 146). These observations, which refer exclusively to stingless bees, seem rather mysterious at first glance and even on close scrutiny, for they neither provide an explanation of these practices nor shed much light on the significance of the bees and their breeding to the people involved. They do, however, give us a glimpse of just how important the Meliponinae are to their keepers.

Recent research shows that meliponine bees and meliponiculture play an important role in local ecosystems (Biesmeijer 1997; Roubik 1989). Generally speaking, breeding stingless bees is one of the few ways in which forest and other wild vegetation can be utilized without trees being felled. Far from depleting the environment, moreover, beekeeping sustains it through pollination. In addition, as some species of stingless bees pollinate the crop plants that humans cultivate (e.g. tomatoes, several species of squash, coffee, avocado and others - Martínez-Hernández *et al.* 1993), traditional beekeeping may contribute to higher yields of these crops. Furthermore, meliponine bees should inspire the interest of people far beyond the ethnic groups that keep them: after all, preserving the remaining tropical forests has become a matter of worldwide concern. Meliponine bees play an important role in pollinating the vegetation that occurs in their natural ranges. Flowering plants (angiosperms), known to have first appeared in the Early Cretaceous period, attract insects by producing nectar and pollen. As the pollination systems of angiosperms improved and by a process of co-evolution, some insect species became specifically associated with certain of these plants. There are numerous meliponine species in Central America and Mexico: in Costa Rica alone, for example, 60 distinct species have been reported (Dr. M.J. Sommeijer, personal communication). Intimate relations have developed between the various Meliponinae and flowering plants. These plant-bee interactions are essential to the preservation of ecological equilibrium in the tropical Americas. Meliponine bees help to conserve the biological diversity of flora and fauna which still exists in the region (Martínez-Hernández *et al.* 1993: 3-4). Recent studies have confirmed that, whereas the introduced *A. mellifera* and the Africanized sub-species are very aggressive plant-visitors, they are less suited to the pollination of certain neo-tropical plants. Collectively, meliponine bees pollinate such plants more effectively because of their bio-diversity; particularly variations in their body size and behavioural characteristics. For example, the so-called 'hovering behaviour' of certain flower-visiting stingless bees is an important pollinating feature (Dr. M.J. Sommeijer, personal communication). *A. mellifera*, especially the Africanized sub-species, is thought to displace native pollinators and is probably partly responsible for the observed decline in the diversity of the Meliponinae (Roubik 1978). Moreover, as *A. mellifera* is a less efficient pollinator of indigenous plants, perhaps its introduction has also led to the extinction of some tree species pollinated by the Meliponinae (Roubik: IBRA congress 1996, San Jose).

That meliponiculture is ecologically sustaining and manifestly important to indigenous peoples in itself justifies an investigation of how the system functions and what its precise value is to those peoples. Yet there is another, pressing reason to expedite such an investigation: the keeping of stingless bees is becoming increasingly rare. In many regions where the practice used to be commonplace, it has either been abandoned or is under serious threat. In regions where the practice still persists, people are facing a decline in the number of stingless bees in their breeding colonies and their general impoverishment in terms of honey and other produce stored. In several years' time, meliponiculture will be practically extinct in those regions too. The implications are not difficult to imagine: the vast store of indigenous knowledge relating to stingless bees and their breeding will fade away while regional bio-diversity and crop yields will most likely decline. The tragedy looming is that, by the time we fully understand how significant meliponiculture is for the environment and modes of human subsistence, it may be too late to save the practice from total extinction. Much traditional knowledge has already been lost. The process of decline has already resulted in some serious losses. A thorough scientific study of meliponiculture can give important insights into the problems encountered by breeders. Even just listing the problems may contribute in some way to halting or reversing the decline and may also add to the general body of knowledge relating to environmental maintenance, albeit to a very modest extent.

1.1 Objectives

The prime objective of this dissertation is to describe the system of meliponiculture currently practised among communities in El Salvador (El Brujo, El Limo and La Criba) and among Maya communities on the Yucatan peninsula (Xmaben and Tepich). The background for these descriptions is formed by recent biological research on meliponine bees. Some social geographers and anthropologists who, in the past two or three decades, have investigated apiculture and meliponiculture and their practice have assumed that the emergence of the latter was an exclusively cultural phenomenon, and that its current decline can be attributed solely to economic factors, beekeepers having opted for the more productive, imported bee species. I believe that these assumptions require urgent revision. Although they are based on sound theoretical approaches which prevailed in the two disciplines in those decades, in many respects they ignore the cumulative effects of socio-historical processes and environmental change resulting from human intervention. I argue, on the contrary, that meliponiculturalists do not choose to let their precious colonies of stingless bees die out, nor do they abandon the practice of breeding them for the sole reason that there is a more lucrative option. As apiculture and meliponiculture are practised for different purposes, these two systems of beekeeping are not incompatible from a cultural viewpoint. In this section, I propose an alternative approach to the scientific examination of meliponiculture that, far from excluding the processes taking place in communities, requires their accurate description. This approach stems from the recent anthropological debate on the interaction between nature and society. Human actions and intervention in the environment result in a modified landscape. These modifications in turn affect, in this particular case, the bee species that are kept and bred in homesteads. Taking as my starting point the view that contemporary meliponiculture is the result of complex interactions between: 1) stingless bees, with their specific characteristics; 2) cultural aspects of the communities that keep them; and 3) environmental aspects of the areas the insects and their keepers inhabit, and that all such interactions can be described, I attempt to answer the crucial question - why is meliponiculture declining so swiftly in Central America and Mexico? I argue that it would be too simplistic to ascribe this decline solely to cultural factors or to environmental change, but that all possible factors must be considered and weighed before any conclusions can be drawn. This becomes particularly apparent when meliponiculture in El Salvador and Yucatan are compared. This dissertation, I hope, shows how valuable such a comprehensive and balanced theoretical approach can be to the study of particular cases.

1.2 Anthropological and socio-geographical studies of beekeeping

Several of the anthropologists and social geographers who have studied beekeeping practices have examined meliponiculture in Central America and Mexico. In combination, these sources form a history of how the keeping of stingless bees has been viewed by outsiders. Their work either reflects the broader theoretical perspectives of their times or constitutes a further exploration of existing themes. What follows is a brief overview of the available literature relating to meliponiculture, with the exclusion of purely biological studies. My aim here is not to be exhaustive, but to summarize certain theoretical approaches that are pertinent to beekeeping.[3]

A few socio-geographical studies have focused on the breeding of bees. The various lines of inquiry they follow are indicative of the prevailing discourses of their times. The first, Nordenskiold (1929), is couched in terms of the cultural area approach. Mapping descriptions of meliponiculture in existing literature, he found seven references for Central America and Mexico and eight for South America. On the basis of this evidence, he assumed that meliponiculture had originated within Central America and subsequently spread to South America. Consistently with this, Kent (1984) asserts that meliponiculture originated on the Yucatan peninsula and then spread within Mesoamerica. His argumentation relies on brief descriptions which suggest that the breeding of stingless bees was and still is more extensive in Yucatan than elsewhere, on early colonial and contemporary accounts of how the Yucatecan Maya honoured bee-gods with rituals, and on his own survey on the Nicoya peninsula of Costa Rica. He found that, in Costa Rica, meliponiculture was less deeply embedded in agricultural systems and human culture than it was in Yucatan. On the basis of literature, he concluded that such was the case in other parts of Mesoamerica as well. Kent accounts for the cultural area of Mesoamerica by referring to migrations of ethnic groups and cultural contact between groups. Although the Mesoamerica concept is still regarded as valid today (see Section 1.5), Kent's arguments relating to the geographical distribution and importance of meliponiculture are flawed in several respects. Most importantly, the fact that, in the modern era, meliponiculture is more sophisticated in Yucatan than elsewhere does not enable any conclusions to be made as to its origin. This is illustrated by the example of hieroglyphic writing, which originated among the Toltecs but reached its peak of development among the Maya (Miller & Taube 1993). Kent's conclusions are also impaired by unintentionally selective sampling. Surviving references to the keeping of stingless bees at and around the time of the Spanish conquest are too limited and too superficial to justify so firm a conclusion; even today, there is too little information on the distribution and importance of meliponiculture to support any such conclusion. We do not know how deeply embedded the keeping of stingless bees was, or still is, in the culture of Yucatan and other parts of Mesoamerica. That Kent did not find a coherent system of meliponiculture in

[3]The ethnographers who described meliponiculture in the early 20th century subscribed to the theories that were prevalent at that time. Although I occasionally refer to these authors (for example, in Section 1.9.1), their theoretical assumptions do not have much bearing on their descriptions of meliponiculture and are therefore of limited relevance to the main thrust of this dissertation.

contemporary Costa Rica is, arguably, more likely to have resulted from environmental change and the subsequent loss of cultural concepts than, as he concludes, from the fact that the Costa Rican indigenous communities did not attach much importance to meliponiculture or that the practice was not as firmly incorporated in agricultural life as it was in Yucatan. While it is true that the honey of stingless bees was exported from the peninsula to other parts of Mesoamerica, indicating that meliponiculture was more extensive in the former than in the latter, this cannot be adequately explained by cultural factors alone. However, Kent is correct in stating that the range of meliponiculture *roughly* corresponds to the Mesoamerican area.

A second socio-geographical line of inquiry is represented by the historical approach of Charles Calkins (1974). He focuses on an apparent dichotomy between secular and religious aims in beekeeping. He wonders whether the shift from robbing wild colonies in the forest towards domesticating bees was motivated by religious or economic factors (ibid.: 27). This kind of dualistic thinking has been criticized in anthropological discourse as a form of western ethnocentricity (Descola & Pálsson 1996; Croll & Parkin 1992 a & b), for people may simultaneously be motivated by religious beliefs and pursue economic ends. Calkins concentrates on apiculture because it has become economically more important. Trivializing meliponiculture as a mere "hobby" of the Maya, he hardly looks beyond its history and a few techniques (1974: 108, 118, 184). However, it is precisely the historical focus of his work that leads to valuable insights into the development of apiculture on the Yucatan peninsula. Calkins gives a detailed account of how the European *A. mellifera* was introduced to the peninsula, how the Yucatecan elite of Spanish descent first developed and financed apiculture while the Maya did the actual work with the stinging honeybees, and how the Maya eventually took over apiculture with Mexican government support.

How the Maya were able to adopt apiculture so successfully has been described in detail by the anthropologist Merrill-Sands (1984), who couches her work mainly in economic terms. She portrays the history of Maya beekeeping in the context of dependence theory, which explains why she focuses primarily on the Maya take-over of apiculture. However, she does acknowledge that, generally speaking, meliponi-culturalists have not automatically switched to apiculture, even though *A. mellifera* is more productive than *M. beecheii*:

"[...] my field data did not show that owners of hives of the indigenous bee were more predisposed to adopt the new stinging bee. If anything, the relationship was the opposite" (ibid: 241).

There are few other references to meliponiculture in Merrill-Sands' work. At one point, she stresses its non-commercial character in the modern era (ibid: 242).

A third line of inquiry, established by the social geographer Dixon, is in keeping with the prevailing theoretical assumptions of the eighties. Environmental aspects play a more central role in his work than they do in the studies described above, for he places beekeeping in an agro-ecological framework. In particular, he urges that:

"[...] farming systems should be approached as humanly controlled micro ecosystems mimicking nature" (1988: 3).

Not only does this statement appear to place humans outside nature, it is also indicative of over-optimistic assumptions regarding human capabilities. Although Dixon had also intended to study meliponiculture in the Rio Balsas basin (Guerrero State, Mexico), where he did his fieldwork, he found that it had become almost extinct. Since he views the environment as 'humanly controlled', it is not surprising that he accounts for the disappearance of meliponiculture in that area as if it were a conscious choice of the beekeepers:

"The most obvious change, however, has been the widespread decline in stingless beekeeping as honeybee keeping is quickly accepted by campesinos" (Dixon 1988: 91).

This conclusion appears to be at odds with the author's own descriptions of the local exchange of stingless bee honey and the medicinal and cultural value still attached to it (ibid.: 122, 125, 133, 167, 168, 186). Because Dixon found that meliponiculture had declined dramatically in the Rio Balsas basin, his work describes neither the contemporary importance of the practice nor indigenous knowledge relating to it. He stresses that cultural attitudes control ecosystems (ibid.: 133), but does not explain how. Despite his view that ethno-ecology influences the management of agricultural systems, he regards farming as a purely technical enterprise involving physical, chemical and energy inputs, choices of crops, etc. He claims that beekeeping is a leisure activity (ibid.: 133-4).[4] Nevertheless, the merit of this study in furthering an

[4]This is an erroneous assumption regarding the breeding of *A. mellifera*. The bees have to be tended, otherwise the colonies may suffer serious losses. In Yucatan, for example, during the annual period of major nectar flow, apiculturalists must visit their beehives at least once every two weeks. This task can take up to an entire day, depending on the number and location of the hives. If necessary and when possible, beekeepers hire others to carry out the task. Clearly, this is not a leisure activity but work. Even though Dixon remarks that beekeepers would be the last to describe beekeeping as a leisure activity, the fact that they often enjoy it seems to be sufficient justification for him to classify it as such. It would seem that Dixon regards work as

understanding of the role of beekeeping is beyond doubt. Dixon does not degrade beekeeping to a merely economic pursuit but considers the ecological and economic links between bees and plants, and between beekeeping and the physical components of agricultural systems (ibid.: 28). He also considers the biological characteristics of bees. As is customary in the field of agro-ecology, he stresses the importance of a holistic approach and studies apiculture in relation to its techniques, function and place within agricultural systems (ibid.: 9).

In the seventies and eighties, the ethnoscience approach came to the forefront with various researchers examining the place and importance of bees and other insects within the cognitive systems of indigenous groups (Jara-Gómez 1996, 1995; Berlin 1992; Posey & Camargo 1984; Posey 1987, 1983a, 1983b; Oltrogge 1981; Hugh-Jones 1979;). In this context, different aspects of indigenous knowledge are categorized as ethnobiology, ethnozoology, ethnoecology or ethnobotany, all pertaining to the ethnoscience of a particular indigenous group. Adherents to this approach argue that nature is perceived in terms of cultural images. Because we respond to these images, a proper understanding of indigenous knowledge and cognitive structures is crucial to the analysis of ecological relations (Ellen 1982: 206).[5] Pivotal to this approach are classification models in which the key terms that define the categories are emic. In general, these models are expressive of the society within which they are elaborated (Ellen & Reason 1979: 3). Many of the contributors to this approach who address beekeeping do not only describe how communities categorize insects within a broader system of classification but show how such models are embedded in cosmology and society. The categories stem from interpretations of natural phenomena and are a means of appropriating natural resources. The resulting emic view is only fully explicable with reference to the logic of a particular culture, although some general principles of classification may be discerned (Berlin & Kay 1969). However, the ethnoscience approach has serious limitations. As Vayda and Rappaport have noted, by concentrating only on perceived environments and cognitive models, there is a risk that one may fail to describe ecological processes and environmental relationships which are of critical importance though not the subject of cognition (Vayda & Rappaport, cited in Ellen 1982: 210).

To sum up, then, overemphasizing the economic value of beekeeping (Merrill-Sands

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something which, by definition, is not a source of pleasure (1988: 134).

[5]Ellen argues that, strictly speaking, the prefix 'ethno' is superfluous: "It conveys as much information to talk about the history of a group as to talk about its ethnohistory. Similarly, many of the traditional concerns of ethnobotany are reflected in the concerns of economic botany" (Ellen: 1982: 207).

1984; Calkins 1974) and viewing humans as if they were outsiders to nature who are capable of mimicking and controlling it (Dixon 1988) can hardly lead to a proper understanding of the role and significance of bees and beekeeping in Mexico and El Salvador. People may pursue ends beyond economic profit-making and they certainly act within nature while being unable to control every part of it, even though they may desire to do so. The cultural area and ethnoscience approaches do not ignore or trivialize the keeping of stingless bees. However, the former is mainly concerned with the geographical distribution of beekeeping while the latter describes the practice only in emic terms. These approaches alone do not provide an adequate theoretical basis for achieving the central aim of this dissertation: i.e. describing the interactions between culture and environment in the particular context of meliponiculture, while trying to find reasons for its unfortunate decline in recent years. In attempting to explain this decline, it is necessary to look beyond relationships in the bees' environment as perceived by beekeepers.

1.3 Contemporary understandings of nature and society

I now turn to how anthropologists currently view relationships between humans and their environment and between nature and culture, as these issues are relevant to my subsequent analysis of the material to be presented in the main body of this dissertation. Some have argued that the dichotomy between nature and culture, often evident in western scientific thinking, obstructs a clear understanding of ecological relations (Descola & Pálsson 1996; Croll & Parkin 1992; Ellen 1982). A less dualistic approach would enable us to consider beekeeping not as a human imitation of nature but as an inseparable part of it, and beekeepers as being involved in a reciprocal relationship with nature; it would enable us to reveal interactive processes. Such contemporary conceptions have evolved in reaction to earlier notions, which I now briefly examine.

The debate on interactions between nature and society has a long history and has been revived of late. Until quite recently, three main tendencies were apparent in anthropological discourse on the vexed question of whether environment or culture is preponderant in determining human behaviour. Environmental determinism emerged in the 19th century and is mainly associated with Ratzel. As the term implies, the environment is thought to determine human behaviour and adaptation strategies. In reaction to this approach, possibilism emerged in the early 20th century through the work of Frans Boas. Possibilism does not conceive of the environment as a dynamic force dictating how humans behave; on the contrary, it argues that environmental factors merely constrain human behaviour. In the work of those who take this approach, considering environmental factors seems to be just an obligatory or introductory exercise devoid of explanatory value. However, Ellen (1982: 28-30) argues that, although possibilism rejects environmental determinism, in itself it is ultimately deterministic because it sets limits to human behaviour. In contrast to these approaches, which to a greater or lesser degree stress the regulatory function of the environment, in the 1930s Julian Steward pioneered cultural ecology, in which culture, human societies and subsistence patterns are conceived of as adaptive processes - as humans adjusting to a given environment. The environment is no longer seen to be the main factor determining human behaviour; rather, culture itself is thought to engender the strategies which humans employ in adapting to their environment. In this sense, culture becomes the main factor determining human adaptation.[6] Claude Lévi-Strauss must be counted among those who view culture as decisive for the human environment, as he considers the dyadic structure of human thought to be the source of human culture and society. Phenomena of the natural environment are secondary to what is generated by the primary source, i.e. language, with which humans are thought to order their view of the world (Lévi-Strauss 1992).

However, as all three approaches hinge on the claim that one component is the cause and the other the effect, none of them can satisfactorily explain interactions between culture and the environment. Humans can adjust to their environment in a variety of ways, therefore environmental determinism cannot account for the interaction between society and habitat. Cultural determinists maintain that culture gives meaning to the environment and thus reduce adaptation to a process taking place inside the head. Ingold has criticized this view, arguing that "if all meaning is thus culturally constructed, then the environment on which it is imposed must originally be *empty* of significance" (Ingold 1992: 39). Keesing (1981: 156) argues that cultural

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[6]In the seventies, the sociobiologist Wilson (1978) argued that culture is genetically determined. The theory provoked a great deal of discussion within anthropological circles. Wilson seems to be correct in stating that the "hypothesis which has dominated social sciences for generations, that mankind has escaped its own genes to the extent of being entirely culture-bound" can no longer be defended (ibid.: 32). However, it is difficult to uphold that culture is genetically determined and, as Wilson states, we might wait a hundred years for this theory to be proven and the code of psycho-chemical interaction that governs human behaviour to be broken (1980: 300-301, cf. Ingold 1996: 18). Wilson argues that environments shape traits in humans; Ingold counters that environment itself does no such shaping, but that this is a function of what organisms seek to do in their environment (Ingold 1986: 22). As genes thus evolve in the context of interactions between an organism and its environment, genetic determinism seems an illusion.

ecologists often assume there is equilibrium and search for the functional interconnectedness of social, religious and economic forms of organization, as if these were relatively separate and stable in the long term. One of the inherent problems of such views is that either culture or nature is said to function quite independently of the other component without it being recognized that the components may influence each other.

Contemporary conceptions of interactions between environment and culture go beyond the question of whether one determines the other. It has been pointed out that such approaches are based on a false implicit dichotomy: i.e. the polarization of nature and culture (Descola & Pálsson 1996; Ingold 1992; Croll & Parking 1992; Ellen 1982). The rejection of a strict dichotomy is closely connected with how the organism is understood to function in its environment. The term 'organism' is originally derived from biology, and theories of that discipline have influenced perceptions in the field of anthropology. Darwinism and neo-Darwinism regard the environment and the organism as separate entities. Ingold (1989) clearly indicates the shortcomings and undesirable consequences of these theoretical approaches. In neo-Darwinism, the environment is conceived of as being independent of the organism, the latter having to adjust to changes that occur in the former. The environment thus constrains the organism. The organism is seen to be the outcome of a process which is already accomplished, i.e. the genetic adaptation that took place before the organism was born, and as existing conditionally upon external circumstances. Ingold summarizes this view with the sentence: "It is a matter of being, rather than becoming." Whereas neo-Darwinism is based on an "explicit order in which everything is closed to every other", he proposes an implicit order "in which everything ultimately is enfolded into everything else" (Ingold 1989: 215).

The strict separation between an organism and its environment, as upheld by neo-Darwinists, is reflected in anthropological approaches whereby either the environment is regarded as determinant of human behaviour or human adjustment is thought to be determined through culture. In both approaches, the two aspects are seen as separate entities. Contemporary conceptions, however, require neither the environment nor the organism to be envisaged as independent entities; instead, the relationship between the two is understood to be reciprocal. Organisms cannot exist without their environment, nor can the environment exist without the organisms it contains. The environment of an organism has multiple components, including conspecific organisms and other species, as well as the abiotic world and its physical features. However, such a definition still does not imply interactive development as suggested by the term co-evolution. In the process of co-evolution, two or more species undergo genetic change in response to the evolutionary pressures they exert on each other (Chapman & Reiss 1992: 274; Moran 1982: 32-33). In other words, an organism processes the historical development of the environment, which includes other species undergoing a similar process of historical evolution. In briefly referring to the relationship between bees and flowering plants in the introduction to this section, I implied that the evolution of such plants had influenced the evolution of bees and vice versa. The domestication of corn (*Zea mays*) also exemplifies such an interaction. Ever since corn was first cultivated in the Americas, people have been altering their environment and the reproductive system of the plant, which has come to depend for its reproduction on sowing by humans. Conversely, the cultivation of corn has enabled the peoples of Central America and Mexico to live sedentary lives.

1.4 The value of the culture-nature debate to the study of meliponiculture

As this is an anthropological not a biological dissertation, issues of genetics are well beyond its scope. However, certain conceptual aspects of the reciprocal or co-evolutionary approach to the culture-nature debate may be of great value in establishing theoretical principles for the study of meliponiculture. Some researchers recognize that every species has its own way of making a coherent system of the environment it shares with other species. This requires further explanation. On the basis of Von Uexküll's theory, Ingold (1992: 39-56) draws a distinction between nature, which he understands to be the "reality *of* the physical world of neutral objects apparent only to the detached, indifferent observer" (ibid.: 44), and the environment, in which the organism "fits elements of nature to itself, by ascribing functions to the objects it encounters and thereby integrating them into a coherent system of its own" (ibid.: 42), or, "the reality *for* the world constituted in *relation* to the organism or person whose environment it is" (ibid.: 44). Ingold goes on to argue that objects have 'affordances' (use-values) and, as humans involved in our environment, we detect some sort of information that leads to the perception of a particular affordance. He argues against orthodox cognitive anthropology, which portrays the world as if it has become meaningful only because humans have ascribed their own cultural meanings to it. Instead, he sees humans as engaged in a continuously developing relationship with their environment, creating it in the process of acting and producing. In this sense, the history of the environment is the history of all human and non-human activity that has contributed to its formation. Through the combination of action and perception, the environment becomes a constituent of the person. Action is 'the becoming of the environment', whereas perception is 'the becoming of the person'. In contrast to orthodox cognitive anthropologists, Ingold distinguishes not the real world from the imagined world but the action of perceiving from the action of imagining. He argues, furthermore, that language and culture are not necessary for we humans to act or to perceive in our environment, rather that they enable us to interpret actions and perceptions and make them explicit to others:

> "Thus whatever patterning, structure or meaning we find in what we perceive is contributed by our own minds. Seeing is qualitatively distinct from knowing, for whereas the former consists in the receipt, by the private human subject, of transitory and meaningless data, the latter consists in the ordering of these data into commonly held and enduring conceptual categories. Only then do we know what we see" (ibid.: 45).

By keeping stingless bees, humans establish a relationship between their colonies and the environment (though perhaps unintentionally). As humans perceive while acting in the environment, their perceptions and experiences are tested against their previously acquired cultural knowledge and established logic. Their cultural concepts may thus be confirmed, transformed or rejected. Not only is culture secondary to practical action, but conclusions formed on the basis of new experiences are weighed up against acquired knowledge and this, in turn, gives rise to the following action. Hence a continuous process of interaction is created. In the context of this dissertation, the pertinent question is: how, then, does culture influence the keeping of stingless bees?

I also wish to stress how important it is, when studying meliponiculture, to recognize that the relationship between organisms and their environment is reciprocal. As Ellen puts it: "Environmental correlations are, in fact, correlations between behaviour and products of that behaviour, in the form of a modified landscape" (1982: 14). This clears the way to studying the correlation between the behaviour of humans, how they alter their environment by means of agricultural practice, and how this influences the stingless bees they keep. Of course, the bees have their own environmental requirements: the conditions that are necessary for their survival. The other side of the reciprocal relationship is that the bees, in turn, may influence the agricultural system through pollination. Apart from its capacity to increase crop yields directly, pollination may have other subtle effects on the ecosystem in general and on agricultural practice in particular. Although the effects that the bees have on the human environment may be very important, this aspect of the process of reciprocity is only addressed incidentally in this dissertation, for it clearly belongs to the field of biology and requires other methods than those which I have employed. The most important function of such a theoretical approach is that the emphasis on reciprocity focuses the attention on processes and relations, rather than on 'a state of affairs'. Once the value of this is appreciated, beekeeping can be regarded as an activity in which a variety of processes and interactions converge. These can then be described and, hopefully, properly understood. Once it is recognized that human culture stems from interpretations derived from the environment and develops in a reciprocal relationship with that environment, culture and environment can be studied in relation to each other. Hornborg, who also bases his argument on Von Uexküll's theory, indicates an interesting consequence of such an assumption:

"Each organism in an ecosystem lives in its own subjective world (*Umwelt*) largely defined by its species-specific mode of perceiving the environment. The question of meaning [...] is therefore the crucial one to all living beings. [...] Once we recognize that human subjectivity, along with the subjectivity of all other species, is an aspect of the very constitution of ecosystems, we have a solid foundation for the conclusion that the destruction of meaning and the destruction of ecosystems are two aspects of the same process" (Hornborg 1996: 53).

People who practise meliponiculture deal with environmental conditions and biological characteristics of their stingless bees. The interactions between environmental conditions, the behaviour of bees, knowledge relating to bees, and beekeeping practices, are thus all aspects of the same system or process. The refusal to accept a dichotomy between nature and culture in no way presents an obstacle to describing and understanding the relationship between bees and food plants, the system of meliponiculture and how, for example, knowledge relating to bees influences practices; on the contrary, it allows us to attune ourselves to interactive processes. In other words, the environment can be described *for* the Yucatecan Maya and Salvadoran beekeepers on the one hand and *for* the stingless bees on the other hand, insofar as their environment is accessible to the 'disengaged observer'. Of course, there is no way of knowing exactly how beekeepers 'directly perceive the environment'; observations are necessarily restricted to how the beekeepers make their perceptions explicit. Moreover, the environment *for* the bees is only accessible by means of 'disengaged biological observations', or how biologists imagine that bees make a coherent system of their environment.[7] Others have called these different perceptions the emic and the etic views (Pike 1967: 37-42). However, the last thing I wish to imply here is that only

[7]Although biological research is contributing to a better understanding of the behaviour of stingless bees, there is far more knowledge of this kind relating to *A. mellifera*.

the etic view is rational or abstract. Indeed, both are theories of nature and the place of bees within it, that of beekeepers and that of biologists; both are abstractions which are derived from environments and which are tested against previously acquired knowledge. It is important to note that, although the emic and the etic views may be related to each other and may overlap in part, they are only fully explicable in terms of their own internal logic.[8] The advantage of examining and comparing the two views is that it discloses those relationships that are recognized in one but not in the other. The particular importance of this approach is that it may reveal why the cultivated colonies of stingless bees are declining so rapidly, which cannot be ascribed to a lack of concern on the part of meliponiculturalists, who care about their bees and try to protect them. The decline may be an indication that the system of meliponiculture has been disturbed somewhere along the line. By comparing the views of beekeepers and biologists, I hope to reveal where and how the delicate relations that constitute the system of meliponiculture have been disturbed.

Once it has been accepted that: 1) people alter the environment by acting; 2) environmental changes are reflected in human actions; and 3) such changes, in turn, influence other human activities in the same environment, the central objective of this dissertation can be broken down into more specific questions that are easier to address. What exactly are the methods of meliponiculture? How are they incorporated in a broader cultural system, and how does this system, in turn, influence the practice? More specifically: how do the meliponicultural activities described in this dissertation and elsewhere strengthen or weaken the trophic structures of the bees? How exactly do people alter the environment and what possible effects has this had, and does it still have, on contemporary meliponiculture?

1.5 'Mesoamerica': a regional perspective

In this dissertation, I describe meliponiculture from a regional perspective, focusing on El Salvador and Mexico's Yucatan peninsula. I originally chose those two areas because the Yucatecan Maya still attach great importance to their stingless bees, a fact which is

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[8]It must be emphasized that the biological view is not entirely unrelated to the traditional Maya view of beekeeping, especially that of the Yucatecan Maya. Many of the biological concepts are widely accepted among indigenous beekeepers and complement, or are even incorporated in, the traditional Maya view (see: de Jong 1997).

poorly understood by many outsiders, while the scientific community appears to know next to nothing about Salvadoran meliponiculture, except that it is still practised. It also seemed to me that these were not two isolated systems of meliponiculture, for both belong to the region known as Mesoamerica.

Map 1: Mesoamerica

The term 'Mesoamerica' (not to be confused with Middle or Central America) is used mainly by anthropologists and archaeologists to refer to part of the land mass now known as Central America and Mexico. Roughly speaking, and using modern geographical and political names, the region stretches from the Sinaloa river in northern Mexico to the Nicoya peninsula of Costa Rica and includes Guatemala, Belize and western strips of Honduras, El Salvador and Nicaragua (see Map 1). In the early 16th century, when the Spanish *conquistadores* arrived, the region was inhabited by diverse ethnic groups whose religious beliefs and practices are now regarded as an associated set. Despite the cultural links, these peoples were never politically united, but specific groups tried to gain political influence and dominion over others in Mesoamerica. At the time of the Spanish conquest, for example, the Toltecs ruled the Yucatecan Maya (Miller & Taube: 1993). In various historical eras, several waves of migration are known to have taken place in the region, enhancing cultural contacts and the assimilation of concepts and practices from other ethnic groups while enlarging the areas occupied. Around 1200 AD, the Pipil-Nicarao invaded the area now known as El Salvador and northern Nicaragua, driving the Chorotega into the Nicoya peninsula, which thus became the southernmost outpost of Mesoamerican culture (Fowler 1989: 35-36). The region's ecological diversity enabled groups in different areas to specialize in the processing and/or production of different commodities, which led to regional trading. Although the various peoples of the region would never have regarded themselves as united, archaeologists and anthropologists refer to them jointly as 'Meso-american' because they shared certain modes of belief and life, including: religious concepts; the use of a 360-day calendar, money and cement made by heating limestone or shells; a sport played with a rubber ball; the processing of cacao into a drink; and the cultivation of corn. From the early 16th century onwards, the Mesoamerican cultures were strongly affected by the Spanish conquest, migration and acculturation. Many of the former peoples are no longer recognizable as such, yet some of the characteristics regarded as uniquely Mesoamerican still persist among certain groups. Therefore, despite the dramatic changes that have occurred in the past five centuries, the region's indigenous ethnic groups may still be called 'Mesoamerican' to emphasize their common history and the surviving cultural similarities between some of them (Miller & Taube 1993).

On the Yucatan peninsula live people who speak modern Yucatecan Maya. In this dissertation, I frequently refer to them simply as 'the Maya'.[9] Once, Mayan culture extended south as far as the Chalchuapa area of north-west El Salvador, where the village of La Criba lies. According to Fowler, in the period 900-1200 AD or thereabouts, the Nahua-speaking Pipil[10], who migrated from Mexico to Central America, gained control over the area that had previously been occupied by the Chorti Maya or their allies. In the same period, the Pipil also gained control over other areas, such as that around Lake Güija in Metapán, which is near the mountains where the

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[9]It is standard linguistic practice to refer to Yucatecan Maya as 'Maya' and to all other related languages collectively as 'Mayan'. Individually, these related languages are referred to as, for example, Chorti Maya or Kiché Maya (see Hanks 1990: 523 note). In this dissertation, I follow this practice and generally use 'Maya', without an accompanying qualifier, as a noun (singular and plural), and as an adjective to refer exclusively to the people of Yucatecan Maya descent, their communities and all their cultural attributes.

[10]The name Pipil is derived from the Nahua word *pipiltin* ('children' or 'nobles'). The Pipil (who live in Guatemala, Honduras and El Salvador) spoke a variant of Nahua that came to be known as Nahuat. Formerly, the phonetic distinction between /tl/, /l/ and /t/ was used to distinguish three major dialectal 'chains' known as Nahuatl, Nahual and Nahuat. However, this classification system has been superseded by a system that classifies Nahua into three independent languages: Pochutec, Central American Pipil and Core Nahua. It is, however, recognized that there is a close relationship between Gulf or Isthmus Nahua and Central American Pipil (Fowler 1989: 1, 6-7).

villages of El Brujo and El Limo lie (Fowler 1989: 42).

As we have already seen in Kent's work, the geographical range of meliponiculture roughly coincides with the Mesoamerican region. Various contemporary ethnic groups in the region have strikingly similar meliponicultural practices and concepts. For example, although several species of stingless bees occur in the region, the vast majority of indigenous beekeepers choose to breed *Melipona beecheii*. The uses to which the honey of particular species are put also transcend local boundaries: there is the widespread use of the honey of *M. beecheii* to boost female fertility, to help women get pregnant. In addition, in different areas, people draw a link between the well-being of the beekeeper's family and his insect charges. Throughout the region, the breeding of stingless bees is not considered to be women's work, even though the hives are kept near the house, in the labour domain of the women. Several Mesoamerican ethnic groups use the same common names (sometimes nicknames) for particular meliponine species. In my own fieldwork in Yucatan (this publication) and Costa Rica (de Jong 1990), I have observed many similarities in the keeping of stingless bees. The common or related heritage of the region's ethnic groups may explain such cross-border correspondence.

The original aim of the present study was to compare the beekeeping systems of El Salvador and Yucatan, which would also involve correlating contemporary concepts with historical sources. Once in the field in El Salvador, however, the sad reality with which I was confronted forced me to revise my intentions. In the Sonsonate area of that country, where the Pipil are known to have kept stingless bees at the beginning of the 16th century, the practice had been abandoned. Around the archaeological site of Tazumal in the Chalchuapa area of north-west El Salvador, one or two people in almost every village still kept stingless bees, but never more than five colonies at a time, and these were only just sustained by scattered pockets of forest. Only in the far more extensive forests around the Montecristo Nature Reserve, in the provinces of Santa Ana and Chalatenango, did I find that meliponiculture was still of real importance to the indigenous inhabitants. The inhabitants of La Criba, El Limo and El Brujo are culturally heterogeneous and have recently been strongly influenced by the conversion of many of them to various forms of Protestantism (see introduction to Section 3). In contrast to the situation among the Yucatecan Maya, for whom meliponiculture seems, more or less, to have retained its place within the wider system of knowledge, the practice appears to have lost a lot of its coherence in El Salvador. In that country, the fragmentary state of meliponiculture and the knowledge system of which it forms a part closely resembles the situation encountered by Kent and by myself (de Jong 1990) in the Nicoya peninsula of Costa Rica. Comparing Yucatecan and Central American meliponiculture without reference to their local histories, as was done by Kent in the case of Costa Rica, therefore seemed too problematical. It would also have been irrelevant to compare contemporary concepts within a fragmented system to historical sources.

In the light of Hornborg's conclusion that "the destruction of meaning and the destruction of ecosystems are two aspects of the same process", a thorough comparative study of meliponiculture requires that environmental changes be considered. However, whereas vegetation is obviously of prime importance in sustaining beekeeping practices, it appears that deforestation alone cannot explain the current serious decline of meliponiculture in Central America and Mexico. Yucatan State, like El Salvador, lost most of its primary forest in the course of post-conquest history, as one cash crop succeeded the other in response to trends on international markets. Nevertheless, in most villages on the peninsula, several people still keep stingless bees in meliponaries of between one and 60 colonies.[11] Furthermore, the Yucatan peninsula, and in particular Yucatan State, is the world's leading honey-producing region, all the commercially produced honey being harvested from hives of *A. mellifera* (Villanueva & Colli-Ucan 1996: 65). These bees, like their stingless counterparts, depend on vegetation. Quintana Roo State, which includes Sian Ka'an nature reserve, has more forest than Yucatan State. Around the villages in both states, however, primary forest has become scarce. While it has been argued that Quintana Roo has not yet realized its full beekeeping potential (Echazaretta 1997: 95), meliponiculture is declining there too, with the remaining *M. beecheii* colonies becoming increasingly impoverished. It therefore seems that, although deforestation is generally an important factor in the decline and impoverishment of stingless-bee colonies, other factors may be contributing to the current problems facing breeders.

During my preparations for the fieldwork that was to address the initial objectives of this study, other questions arose which placed the regional perspective in a different light and lent it new significance. Why is it that, whereas both the Yucatan peninsula and El Salvador have suffered massive deforestation, meliponiculture still seems to be more important to the Yucatecan Maya than to their Salvadoran counterparts? What is

[11]Before I selected villages for my fieldwork, *Licenciado* Gonzáles Acereto of the *Universidad Autónoma de Yucatán* introduced me to beekeepers in several villages on the Yucatan peninsula (Citilkum, Kimbila, Uxpibil, Yalcoba, Chochola, Kopoman, Dzununcan, Maxkanu and Uxkab). Most of those villages had several keepers of stingless bees. I visited a beekeeper in the village of Kimbila several times and he provided information which is incorporated in this dissertation

causing meliponiculture to disappear more rapidly in El Salvador? Insofar as we can picture the situation in Mesoamerica around the time of the Spanish conquest, what, if anything, can be surmised about the reasons why Yucatan has been the most important beekeeping centre in the region ever since pre-Hispanic times? Does the limited information available enable us to look back and thus gain a better understanding of how beekeeping practices evolved within the regional environment, and to appreciate how human influence on that environment altered the interactions between bees and their habitat and affected the conditions under which bees are kept?

1.6 Domestication versus cultivation

Many of the existing works on beekeeping do not make any distinction between the domestication and the cultivation, or keeping, of bees.[12] However, in attempting to understand why meliponiculture has disappeared in some areas, this distinction may be of critical importance. Beekeepers who domesticate bees know how to multiply colonies by splitting the brood nest (for nest architecture, see Appendix I). Beekeepers who cultivate bees have no multiplication techniques; they merely remove wild colonies from the forest to a more convenient location. In this dissertation, references to keeping or cultivating bees do not necessarily imply that the beekeepers in question create daughter-colonies by splitting brood nests.

1.7 Geographical characteristics

1.7.1 Geographical characteristics of El Salvador

El Salvador is characterized by three distinct geological regions: the coastal lowland plain, the mountainous highlands of northern Central America, and the Central American volcanic axis. The latter dominates the regional topography; the lands adjoining this axis are among the most fertile in the Americas. The Montecristo area belongs to the Cordillera Alotepeque Metapán, which is a spur of the Chiquimula mountains and part of the Sierra Madre Guatemalteca. The range's highest peak, Cerro

[12]Foster (1942: 540-541) does distinguish domestication from cultivation. He identifies five phases which lead to the full domestication of bees.

Map 2: El Salvador

Pital, is 2730 metres above sea-level. The villages of El Brujo and El Limo lie in the intermediate elevations (1200-1800 metres) of the Montecristo area, which consists of high mountain tops and plateaux, mixed terrain of extremely high relief, and lower slopes, mountain bases and foothills. The village of La Criba is located in the volcanic region, at approximately 500 metres above sea-level (Guzman 1979).

As temperature variations in El Salvador are primarily a function of altitude, there are three distinct climatological zones corresponding to the topographical regions. Climatological data for the zones of the three villages studied are as follows (Köppen 1931; Guzman 1979):

1. La Criba: approx. 500 m above sea-level. Tropical lowland (to 800 m), Köppen classification:[13] *Aw-aig*. Dry season: November to late April. Mean temperature variation: 22-28°C. Mean annual precipitation: approx. 1400 mm
2. El Limo: approx. 900-1300 m above sea-level. Tropical warm savanna or temperate zone (800-1200 m), Köppen classification: *Aw-bif*. Dry season: November to April. Max. mean temperature: < 22°C. Mean annual precipitation: approx. 2400 mm
3. El Brujo: approx. 1500-1800 m above sea-level. Tropical or temperate zone (200-1800 m), Köppen classification: *Cw-bi*. Mean temperature variation (temperate zone - high plains and valleys): 16-20°C. Mean annual precipitation: approx. 2600 mm

The rainy season lessens nationwide in July and August, most rain falling at nighttime, and there is often a dry period of two to five weeks, the *veranillo* (little summer). September is the month of heaviest rainfall, which may account for 25% of the annual total. In the period from December to February, cold Arctic winds, the *nortes*, may blow and temperatures are the lowest of the year. The highest temperatures are in March and April (Guzman 1979).

The villages of El Limo and El Brujo are surrounded by very humid, lower montane forest (ibid.). The upper montane forest above 1800 metres can be described as cloud forest. Characteristic tree species in the forest around the villages include important

[13] *A* = temperature in coldest month exceeds 18°C; *C* = temperature in coldest month is between 3 and 18°C; *a* = temperature in warmest month exceeds 22°C; *b* = temperature in warmest month is less than 22°C, temperature exceeds 10°C for at least 4 months a year; *f* = humidity is virtually constant due to rain in all months; *g* = annual maximum temperature occurs before the summer solstice and the summer rainy season; *i* = isotherm, temperature difference between coldest and warmest months is less than 5°C; *w* = includes a dry season (Köppen 1931).

food plants for meliponine bees (e.g. *Bursera simaruba*, an unidentified species of *Spondias*, *Psidium guajava* and *Cedrela oderata*) and many other species which have yet to be assessed for their value to such bees (Fowler 1989: 85).[14] This type of forest is highly susceptible to deforestation by erosion because of the shallow soil, the rocky terrain and the extreme relief of the area. Once the slopes are deforested, only grasses re-occur. The families living in El Brujo comprise approximately 1225 persons spread over an estimated 3000 hectares (personal communication: A. Calderon, *Jefe de Promotores de Salud del Ministerio de Metapán*). With the exception of the small village core, the houses are in dispersed clusters, these typically lying a few hundred metres from each other. An unpaved road of 11 kilometres links El Brujo to the main Metapán-Anguiatú highway (the frontier with Guatemala). The village straddles the El Salvador-Guatemala frontier locally defined by the Rio Frio. Not far from El Brujo, on the other side of a mountain and deeper into Salvadoran territory, lies the village of El Limo. An unpaved road of about five kilometres leads from the centre of this village to the main Metapán-Anguiatú highway. El Limo has a population of about 900 (personal communication: A. Calderon). In the village core, the houses are quite tightly packed, though many more are spread out along the road.

An unpaved road of about three kilometres links the village of La Criba to the main road between Santa Ana and Candelaria de la Frontera. There are some 600 villagers, most of them living in houses that are very close together. Only a few houses are separated by cornfields. Adjoining the village is a patch of deciduous forest with species including *Ceiba* (*Ceiba* sp.), *Pochote* (*Zanthoxylum microcarpum*; *Ceiba aesculifolia*) *Quebracho* (*Lonchocarpus michelianus*), *Guanacaste* (*Enterolobium cyclocarpum*), *Laurel* (*Litsea glaucescens*), *Cedro* (*Zanthoxylum* sp.) *Roble* (*Quercus grandis*; *Quercus vicentensis*) *Caóba* (*Swietenia cirhata*), *Copalchí* (*Croton niveus*) and *Durazno* (*Prunus persica*).[15] The forested areas are not very susceptible to erosion and are therefore most suitable for agriculture.

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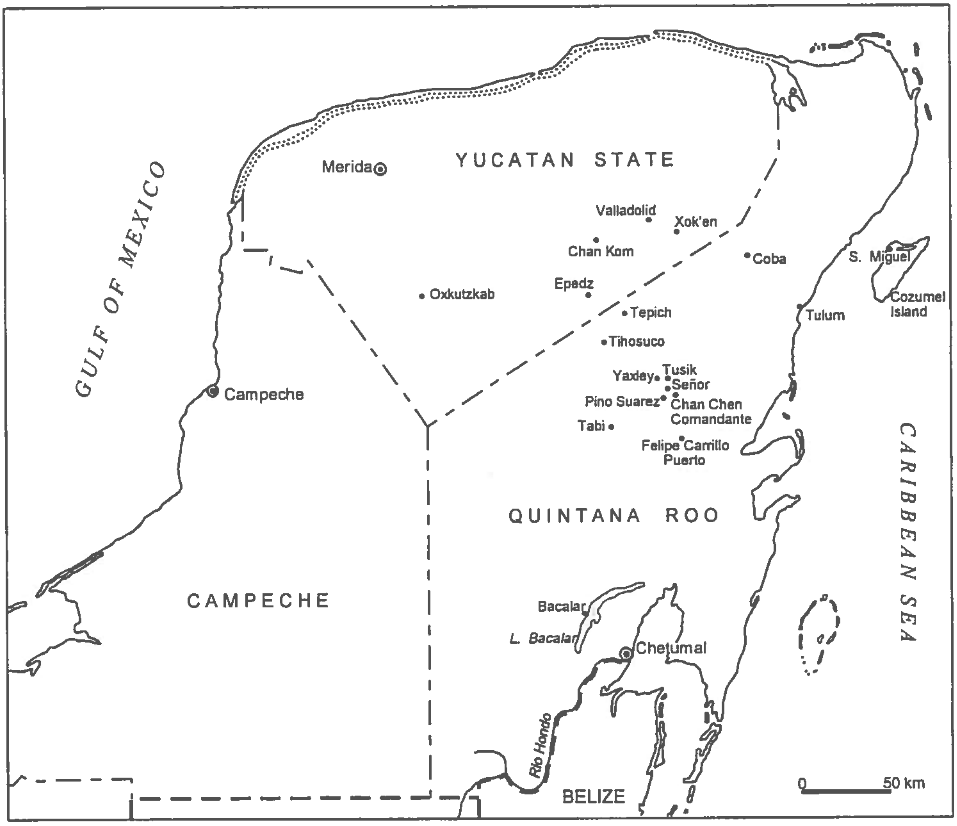
[14]For example, unidentified species of: *Pinus*, *Quercus*, *Perymenium*, *Nectandra*, *Inga*, *Juglans*, *Salix*, and *Clethra suaveolens*, *Liquidambar styraciflua*, *Ficus glabrata*, *Alnus acuminata* - now know as *Alnus ferruginea* -, *Buddleja cordata*, *Juniperus standleyi*, *Abies guatemalensis*, *Prunus guatemalensis* (Fowler 1989: Table 5.1, p.83).

[15]The scientific names of the plant species that were indicated by inhabitants of La Criba are based on Standley & Salvador Caldaron 1925.

Map 3: Yucatan



1.7.2 Geographical characteristics of the Yucatan peninsula

The Yucatan peninsula comprises three federal states: Yucatan on the north coast; Campeche on the west (Gulf of Mexico) coast and Quintana Roo on the east (Caribbean) coast. The peninsula is a limestone-capped shelf covered only with thin soils because of the lack of soil-forming minerals in the parent rock. The soils, predominantly of organic origin (Dachary & Arnaiz-Burne 1984: 10), are characterized by a complex distribution of types, which the Maya categorize according to fertility (Merrill-Sands 1984: 78-79). The peninsula is less vulnerable to soil erosion than other parts of Mexico and Central America. The limestone cap being extremely permeable, rainwater is rapidly absorbed and feeds underground rivers. Surface rivers and lakes are therefore scarce on the peninsula: there is only one lake of significant proportions (near Bacalar) and one sizeable river in the extreme south (Rio Hondo), which defines the border between Quintana Roo State and Belize. Water comes to the surface through natural sink-wells (*cenotes*), which are created when the limestone roof of an underground cavern collapses. The groundwater runs deeper in the southern part of the peninsula than in the north, the mean depth in Quintana Roo being approximately 12.5 metres (Dachary & Arnaiz-Burne 1984: 10-11). Over the vast majority of the peninsula, elevation does not vary by more than 30 metres, though the central hills in the area of Puuc include a peak of 275 m above sea-level.

Seasonal variations in temperature are small, due to the buffering effect of the sea and the flatness of the peninsula. The annual mean temperature is about 26°C, with a diurnal cycle between 17 and 42°C). The rainy season is approximately from May to October, interrupted by a short dry period in August. Most of the peninsula has a tropical dry and wet climate (Köppen classification: *Aw*, see Note 13 of this section). Rainfall increases significantly from north to south across the peninsula.

1. In the northern area, where the mean annual rainfall is about 400 to 600 mm, there are two types of forest: low deciduous and spiny low deciduous, with trees of 6 to 10 metres in height. In these forests, the typical plants are species of Cactaceas, Leguminosae, Polygonaceae and Convolvulaceae, and many are important sources of bee-food.

2. Rainfall on the central area has an annual mean of 600 to 800 mm. The forest is of the semi-deciduous, medium seasonal type, with trees of 10 to 20 metres and many Leguminosae, though less than in low deciduous forest. *Manilkara zapota*, *Pouteria sapota*, *Brosimum alicastrum* and species of Bromeliaceae and *Ficus* are typical of this forest type.

3. The southern part of the peninsula receives 800-1200 mm of rainfall annually; in some areas bordering on Guatemala or Belize, as much as 1500 mm. The forests are high or medium semi-evergreen, with 15 to 30-metre trees and many orchids and bromelias, though little herbaceous vegetation (botany course, *Universidad Autónoma de Yucatán*).

The *ejidos* (communal land-use areas) of Xmaben and Tepich are in central Quintana Roo State. Xmaben has four principal village communities: Yaxley, with approx. 150 inhabitants; Chan Chen Comandante, approx. 138; Pino Suarez, approx. 182; and Señor, approx. 2024 inhabitants (Murphy 1990). The *ejido* of Tepich includes the village of the same name, with approx. 2020 inhabitants, and has ranches scattered about its total area of 301,888 hectares (personal communication: the *delegado*, or elected representative, of Tepich). The main road from Felipe Carrillo Puerto to Valladolid passes through the villages of Tepich and Señor.

1.8 Outline of dissertation

This dissertation is structured around four basic themes:

a) the historical background of meliponiculture in Mesoamerica
b) the contemporary system of meliponiculture in El Salvador, as explained by beekeepers
c) the contemporary system of meliponiculture on the Yucatan peninsula of Mexico, as explained by Maya beekeepers
d) the sustainability of contemporary meliponiculture in the *ejido* of Tepich.

These themes are dealt with as follows:

a) Section 2 examines the geographical distribution and importance of meliponiculture in Mesoamerica before and during the colonial era, and changes that have occurred in its practice and the landscape since then. A key aspect is the introduction to the region of a foreign bee species (*A. mellifera*), which started to compete for floral resources with some of the native meliponine species. In this section, I argue that meliponiculture became less sustainable after the Spanish conquest as a result of changes in the relationship between land and people and, subsequently, in the agricultural system. In colonial and post-colonial Yucatan, history took a strikingly different course than in the rest of Mesoamerica. In particular, I discuss the effects that the mid-18th-century Caste War and later land reforms under the Cardenas government had on the relationship between land and people and on meliponiculture.

b) Section 3 describes the contemporary state of Salvadoran meliponiculture and its dramatic decline, which has gone hand-in-hand with the decrease in bio-diversity. I show that in some respects, however, meliponiculture is more important in El Salvador than in Yucatan.

c) Sections 4 to 8 examine the importance of meliponiculture for the Yucatecan Maya:

In Section 4, I describe how the Maya distinguish the wild from the domesticated domain, how they classify animals accordingly, and the place occupied in Maya society by stingless bees, particularly the species *M. beecheii*. An important question in this section is: how do the Maya organize nature into a coherent system and how do they appropriate the animals of that system?

In Section 5, I describe traditional methods of cultivating and domesticating stingless bees. In the final sub-section, I examine these methods against the background of meliponine characteristics as described by biologists.

In Section 6, I look at how beekeeping fits into the Maya organization of space and agricultural practices, which are briefly described. Of particular interest here is that, Maya society being structured on gender lines, the breeding of stingless bees appears to form an anomaly: although the colonies are kept in the labour domain of women, men take care of the insects and harvest their honey.

In Section 7, I describe how gender-based beekeeping fits into Maya society. Important issues here are the Maya concept of fertility, the value of corn and *M. beecheii* honey in this respect, as well as the roles of the moon and the earth. My aim is to show that men need corn and honey to maintain their exchange relationships with the gods, in order to accomplish the vital tasks of reproduction and the continuation of life.

In Section 8, I describe how meliponiculture fits into the Maya view of the cosmos. Two key questions are addressed: why do beekeepers link their own lives and destinies to those of the stingless bees? And why, even though these bees are so important to them, do they not intervene to prevent their imminent extinction?

d) Having described the Salvadoran and Maya systems of meliponiculture as explained by beekeepers, I turn, in Section 9, to the ecological sustainability of contemporary meliponiculture, with the *ejido* of Tepich as case study. Important issues include: the increasing urbanization of the *ejido*, the number of *A. mellifera* colonies in the village and *ejido*; the occurrence of food plants for meliponine bees in the homestead and among secondary vegetation in various stages of development, as well as the distances between the meliponaries and such plants.

1.9 Data collection and methodology

1.9.1 Historical sources

In Section 2, I refer extensively to various historical sources, which also provided the background information that is included in notes accompanying the ethnographic part of the study. The first people to have written about meliponiculture were probably the pre-Hispanic Maya of Yucatan themselves.[16] One of the few Maya hieroglyphic books to have escaped destruction during the Spanish conquest is the so-called Madrid Codex (kept in the Museo de América, Madrid), ten pages of which relate to the keeping of stingless bees (pp. 103-112). Several researchers have attempted to translate these pages, though most of the translations pre-date the recent important breakthroughs in interpreting Maya hieroglyphs (Brington 1895; Tozzer 1910; Bunge 1936; Cordan 1966). The later researchers conclude that the bee-pages are a kind of almanac: they list various ritual and practical actions to be performed, as well as days and the deities who govern them, an indication of whether the day in question would be auspicious or ill-omened for such actions (see, for example, Knorosov 1982). Some sections recently translated by Vail are briefly summarized by Wagner (1993: 168-174).[17]

The post-conquest sources which include references to beekeeping can be roughly divided into two categories: books written by Maya authors using the Roman alphabet, which are transcriptions and compilations of earlier Maya (hieroglyphic) texts and oral traditions probably dating back to the 16th century; and books written by people of European descent, including Catholic bishops and priests, travellers, etc. Most of the Maya texts were committed to paper in the 18th to the early 20th centuries and bear the hallmarks of European Christian influence. Examples include

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[16]The pre-Hispanic Yucatecan Maya used a hieroglyphic system to record their history, genealogies, ritual prescripts, world view and cosmology and to compose calendrical almanacs for the timing of rituals and other activities. Such records of important historical events and other knowledge have survived on buildings and pottery, and in accordion-folded books with pages of beaten bark. There must have been many such volumes, but almost all were destroyed by the *conquistadores*. Only four are known to have survived: the Dresden Codex, the Madrid Codex (or Codex Tro-Cortesianus), the Paris Codex and the more recently discovered Grolier Codex. Only the Madrid Codex includes information on beekeeping. Villacorta & Villacorta (1977) published the codices in monochrome.

[17]See also Vail, G. (1994) in: *Five hundred years after Columbus: proceedings of the 47th International Congress of Americanists*, Andrews, E.W & Oster Mozzillo (eds.), New Orleans Tulane University, Middle American Research Institute.

the *Ritual de los Bacabs*, which contains medicinal recipes including honey (Arzápalo Marín 1987), and the *Chilam Balam de Chumayel*, with several references to bees and what is probably a bee deity (Roys 1967: see also Section 8, Note 13 of this dissertation). The Codex Pérez (a post-conquest compilation in the Roman alphabet) and the *Chilam Balam de Maní* also include references to bees and beekeeping (Craine & Reindorp 1979: see also Section 7, Note 15 and Section 8, Note 35 of this dissertation). Wagner, who studied historical sources of information on beekeeping in greater detail than other researchers, cites references to bees and beekeeping in the *Chilam Balam* books of Kaua, Chan Kan, Nah, Tekax and Ixil (1993: 17). Furthermore, Roys (1939) translated documents from the Ebtun (Yucatan) archives, covering practically the entire colonial period and the first decade of independence, which include information on the inheritance of beehives (1939: see also Section 7, Note 6). These Maya texts are, of course, most valuable sources for studying the historical background of meliponiculture, and I refer to them when relevant in this dissertation.

The colonial sources can be further divided into first-hand and second-hand accounts. Fray Diego de Landa ([1566] 1992, 1959) briefly describes beekeeping and related ceremonies witnessed by him in the 16th century. However, Oviedo's *Historia General y Natural de las Indias, Islas y Tierra Firme del Mar Océaneo* [1559] is based on informants' reports. Bartolomé de las Casas also relied on informants when compiling his *Historia General* [1562], one of whom was Hernán Cortés. These sources refer to the keeping of stingless bees and occasionally describe practices, though very briefly. The *Relaciones Geográficas* (Paso y Troncoso 1939-1942) provide lists of tribute paid by the indigenous population to the Spanish colonial authorities. The particular value of these sources is that they shed light on the geographical distribution and extent of meliponiculture; they are therefore referred to in Section 2. (For further colonial sources on beekeeping in Yucatan and an assessment of their value, see Wagner 1993).

Scientists of various disciplines visited the region in the 19th and the early 20th century, for example Huber (Mexico, 1836) and Sapper (Central America, 1935 and later). They provide important information on the species of stingless bees that were kept in the area and on the spread of apiculture. In addition, Sapper cites observations made by Hartmann and Helmrich, who also travelled in the region, probably in the late 19th century. In the period from 1821 to 1888, Squier travelled widely in Central America, where he did archaeological work beside other, official duties. He translated García de Palacio's *Carta dirijida al Rey de España* ([1576] 1860) into English and added notes including some of the observations he made during his journeys. The work was re-printed in 1985 with additional editor's notes. Many 20th-century ethnographers have referred to meliponiculture (Villa Rojas 1978; Favre 1969; Wagner 1950; Foster 1942; Steggerda 1941; Redfield & Villa Rojas 1934; *et al.*). Most of their descriptions are very brief and, as contributions to science, differ in value, some being based on first-hand and others on second-hand accounts. These sources mainly refer to Mexican, often Yucatecan beekeepers. I frequently refer to Redfield and Villa Rojas (1934), for their work represents a major contribution to the study of beekeeping.

1.9.2 Ethnographic fieldwork

The most important information for this dissertation was provided by the beekeepers themselves. From February to September 1993, I did ethnographic fieldwork in El Salvador. First, I spent a few weeks in the village of La Criba, where it soon became clear that the keeping of stingless bees had become very uncommon. I then moved to El Limo and El Brujo, where I spent the rest of my Salvadoran fieldwork period. I went to the Yucatan peninsula in September 1993 and, while taking some relevant courses, visited villages in Yucatan State to meet beekeepers and to select villages for research in the Maya Zone of Quintana Roo State. My fieldwork there lasted from January to July 1994, in the *ejidos* of Xmaben and Tepich. In both El Salvador and Yucatan, I visited all the meliponiculturalists in the villages for structured interviews, selecting some of them for later, unstructured interviews. They kindly taught me their beekeeping methods. Despite my efforts, it proved to be too difficult to learn Maya to a satisfactory level in the time available, so two field assistants, Jacinta Pool May in Tepich and Marciela Chan Balam in Señor, helped me to translate the interviews. Although not being able to understand and speak Maya well enough to conduct interviews put me at a great disadvantage, my assistants proved to be invaluable in 'opening doors'. The unstructured interviews were recorded on tape. Once back in the Netherlands, I was able to organise the information into preliminary sections, analyse it and reformulate some questions to take back into the field. At that stage, the greater part of the Maya beekeeping system was still unclear to me. I therefore decided to return to Tepich only, to spend most of the time conducting unstructured interviews with shamans. Stingless bees are often kept by shamans, who need the honey of one of the meliponine species (*M. beecheii*) to perform their duties. This second fieldwork period in Yucatan, from January to May 1996, proved to be very useful, as people already knew me and I had a clearer idea of which questions to ask and which themes to explore. I was fortunate enough to be invited to ceremonies by some shamans, who allowed me to take photographs. One bee ceremony was recorded on video by Dr. M. J. Sommeijer of Utrecht University's Bee Research Department, and a prayer intoned by a shaman during another bee ceremony has been transcribed and translated.[18]

If a Maya shaman or *hmen*, 'he who knows', wishes to explain something important, he will often tell an illustrative story (*junp'eel cuento* or *junp'eel historia*), which may be based on experience or on a legend handed down from previous generations. Shamans (*hmenob*) also tell such stories during communal activities, including rituals and hunting and/or gathering expeditions. The content is more or less fixed, depending on the skill of the narrator, who may choose to make minor personal variations or embellishments. Such narratives are quite distinct from more general accounts, such as responses to questions raised during unstructured interviews. In this dissertation, I refer to these more or less fixed narratives as 'stories', as the shamans do. In all sections, the stories and literal responses to the interviewer's questions are reproduced as edited translations between double quotation marks. Such quotes are clearly distinguishable from the rest of the text, which is descriptive or discursive in nature, and is based on informants' explanations, my observations of practices and ceremonies, and the interpretation of such data. The ethnographic parts of the text incorporate relevant findings of recent studies on Maya society and culture by social scientists, linguists, archaeologists, etc.

1.9.3 Pollen samples, transects and identification of plant species

In 1996, the biologist A. Parra Canto helped me to study secondary vegetation complexes in the selected area of the Tepich *ejido*. First, we estimated the age of the vegetation from its height and stem or trunk diameters. We then made transects of vegetation complexes in successive developmental stages, counting individual plants to determine the incidence of each species. In February and April 1996, we also took pollen samples from hives of *M. beecheii*. *Licenciada* Parra Canto (now M.Sc.) examined

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[18]Although I occasionally refer to some parts of that prayer, I decided not to include it all in this dissertation for two reasons: firstly, the transcription and translation were too long and, secondly, part of the translation was lost as a result of technical problems.

the plants and pollen samples to identify their species.[19] The botanists E. Ucán and L. M. Ortegon assisted in identifying the plant species, while the palynologist R. Villanueva identified the pollen samples. These three experts work at the institute formerly known as CIQRO. Using a pedometer, I was able to map the village and measure distances from meliponaries to particular vegetation complexes. I asked the beekeepers (apiculturalists and meliponiculturalists) which of the plants found in the vegetation complexes are important food plants for *M. beecheii* and *A. mellifera*. In addition, I consulted the literature to check which of the plants in question are known to be visited by one or both of these species of bees. Unfortunately, there was not enough time to do a similar study in El Salvador.

1.9.4 Biology of meliponine bees

Bees were collected in the field and their species identified at Utrecht University's Bee Research Department. Dr. M. J. Sommeijer of that department and director of the '*Proyecto Regional de Apicultura y Meliponicultura* (PRAM, of the *Universidad Nacional de Costa Rica* and Utrecht University) co-operated closely with me in the research work, supervising the biological aspects and supplying much of the information on meliponine bees. Other biological background information for this study and dissertation was taken from various publications on meliponine bees (For a summary, see Appendix 1).

[19]The specimens which the biologist A. Parra Canto and myself collected have not been preserved, for these are very common plants on the peninsula and are included in the collections of herbaria. Plant species can be checked at the herbarium of the former *Centro de Investigaciones de Quintana Roo* (CIQRO), Chetumal, Quintana Roo State, now known as *Centro de Investigaciones Ecológicas del Sureste* (CIES).

2 Beekeeping and the environmental history of Central America and Mexico

In the previous section, I argued that it would be misleading to compare the systems of meliponiculture currently practised in Central America and Mexico without considering the region's recorded history; particularly that of the environment, which has undergone such dramatic change since the earliest surviving records were written. From several references to beekeeping by Spanish chroniclers we can conclude that, in the early colonial era, Yucatan was a beekeeping centre *par excellence* (see Section 2.1) and that meliponiculture (the cultivation of meliponine or stingless bees) was also widespread in other parts of Mesoamerica (see Section 2.2). Indeed, the colonial sources provide ample evidence that there was a well-established trade in the honey of stingless bees from Yucatan to other parts of Mesoamerica even before the *conquistadores* arrived in the region. Did the inhabitants of the peninsula become so prominent in beekeeping because they cultivated an especially productive meliponine species? Can the extent of meliponiculture during the region's early colonial history even be reliably deduced?

One thing is certain: the current picture is not bright, with meliponiculture drastically declining in some areas and long since abandoned in others. Can the causes of the decline be identified? In an attempt to answer this question, the present section addresses three important changes that have taken place in Yucatan and El Salvador since the region's recorded history began: the introduction of bee species foreign to tropical America (see Sections 2.3 & 2.4), changes in the habitat of the indigenous meliponine bees (see Section 2.5) and changes in the beekeepers' immediate environment (see Section 2.6). To ecologists, the term 'habitat' means the environment where a particular species lives and reproduces, which clearly comprises many different (micro-)habitats (Chapman & Reiss 1992). The Spanish conquest of Mesoamerica started a process of drastic and irrevocable change in the relationship between the region's indigenous inhabitants and their environment. Due to certain biological characteristics of meliponine bees, the resulting alteration of the landscape had major consequences for their cultivation. The main focus of this section is on the two areas where I did fieldwork for this dissertation: the Yucatan peninsula and western El

Salvador. These areas are of special interest when attempting to determine how the colonial impact on traditional beekeeping practices varied from place to place, for Yucatan was such an important centre of beekeeping and honey-trading, whereas El Salvador was, in many respects, typical of other parts of Mesoamerica. In Yucatan, the Spanish conquest and the resulting disruption of social relationships led to the Caste War. An important result of this conflict and later land reforms was that the relationship between the indigenous peoples and their environment remained relatively intact, as can still be seen 'in the field' in the Maya Zone of Quintana Roo. The present-day situation there contrasts sharply with the extensive social and environmental dislocation that has resulted from Spanish colonial rule in many other parts of Central America. Nevertheless, as I argue in Section 9, long-term processes of social and environmental change have had important consequences for the keeping of stingless bees in the Maya Zone.

2.1 Beekeeping in pre-Hispanic and colonial Yucatan

According to early Spanish colonial accounts, the breeding of stingless bees was noticeably more developed on the Yucatan peninsula then elsewhere in Latin America. In the 16th century, Bartolomé de las Casas wrote:

> "Let it hereby be known that in no part of all the Indies which are discovered has it been seen that they [the inhabitants] have domesticated hives, nor that they procure or cultivate them, except on that island of Cozumel and on the adjoining Yucatan, which is *terra firma*" (1951: Libro III, Capitulo XCVII: 162; my translation[1]).

Although I argue in Section 2.2 that meliponiculture was more widely practised in Mesoamerica than de las Casas thought, his statement is consistent with other evidence that Yucatan was an important beekeeping centre. Bishop Landa describes ceremonies performed for the protector deities of the bees ([1566] 1959: 95, 96). He also reports that it was customary to process honey extracted from hives into mead (*balche'*) and to consume this in large quantities during the subsequent rituals (ibid.: 37, 38). Honey was also used in local healing practices (Arzápalo Marín 1987). The importance of wax in pre-Hispanic Yucatan remains unclear, although it seems likely that the Maya

[1] "Y es aquí de saber que en ninguna parte de todas las Indias que están descubiertas se ha visto que tengan colmenas domésticas, ni las procuren o cultiven, sino en aquella isla de Cuzumel y en la de Yucatán, que es tierra firme, a la cual está pegada ella."

custom of burning it as ritual incense (*copal*) pre-dates the Spanish introduction of wax candles to Mesoamerica. To this day, during rituals, the Maya burn caramel-coloured mixtures of the resins and wax produced by stingless bees (propolis and cerumen). In the Maya language, 'wax', 'candle' and 'incense' are denoted by a single word, *kib*, and the corresponding hieroglyph (T525: Kurbjuhn 1989). It is well known that beeswax was indispensable to the ancient goldworkers and silversmiths beyond Yucatan, in other parts of what is now Mexico. These metals were cast by the lost-wax (*cire perdue*) process, which was widespread in Mesoamerica, and another, similar technique in which a mixture of wax and charcoal was used to form clay moulds (Bird 1979; Sahagún, cited by Schwarz 1948: 134-135). None of the colonial sources include any references to pollen being used by the Maya.

Several sources describe domesticated stingless bees in Yucatan and, even though the references are not very specific, it can be deduced that the species concerned was *Melipona beecheii*. Bishop Landa makes it clear that one species of stingless bee was domesticated in hives while the others lived in wild colonies, honey being collected from their nests in the forest:

"There are two castes [i.e. sorts] of bees and both are much smaller than ours. The larger of these two breed in hives which are very small; they do not fashion a comb as ours do, but certain small sacs like waxen nuts, each one adjacent to the next, filled with honey [...]. The others live in the forests, in hollows of trees and of rocks, where they [the Maya] seek them for the wax and honey in which this land abounds [...]. These bees do not sting, not even when they [the Maya] harvest severely" (1992: 169, my translation[2]).

Although it is obvious that these are all stingless bees, the description does not specify which species was domesticated. Oviedo's account of meliponaries in Chetumal (Quintana Roo) is equally inconclusive, yet the details correspond best to those of *M. beecheii*:

"[...] the honey, and it is not inferior in colour and flavour to that of Castilla [...]. The bees are like those of Castilla in form and size, except that they are white in colour and highly domesticated" (1959: Tomo III, Libro XXXII, Capitulo VI; my translation[3]).

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[2]"Hay dos castas de abejas y ambas son muy más pequeñas que las nuestras. Las mayores de ellas crían en colmenas, las cuales son muy chicas; no hacen panal como las nuestras sino ciertas vejuigas como nueces de cera, todas juntas una a otras, llenas de la miel [...]. Las demás crían en los montes, en concavidades de árboles y de piedras, y allí les buscan la cera de la cual la miel abunda esta tierra mucho [...]. No pican estas abejas ni hace (nada) cuando las castran mal."

[3]"[...] la miel, e no es menos buena que la de Castilla en calor e sabor [...]. Las abejas son en la forma e tamaño como las de Castilla, excepto que en la color estotras [estas otras?] son blancas e muy domésticas."

The fact that Oviedo compares the bees with those of Castilla (i.e. *Apis mellifera*), which were most familiar to him, is evidence that the domesticated stingless bee in question was indeed *M. beecheii*, for in general morphological aspects the two species quite strongly resemble each other,[4] and their honey is more alike than that of any other two species. In 1831, Bennett classified the most commonly domesticated species of Yucatan as *M. beecheii* E.T. Bennett, so it can be concluded with near certainty that the Maya of the peninsula were breeding this species before the Spanish conquest.

The early colonial sources give no precise numbers of domesticated colonies, but a few tell of immense meliponaries. The following is Oviedo's description of large bee-houses in Chetumal:

"There they discovered plentiful and very good honey, and large bee-houses of one thousand to two thousand hives, in logs of trees, well made, with waxen food-pots and entrances; and this is grand husbandry" (1959: Tomo III, Libro XXXII, Capitulo VI; my translation[5]).

Although this indicates that meliponiculture was well established, we do not know, even approximately, how many colonies were normally bred at that time. Such vast meliponaries were probably run by professional beekeepers, yet it seems likely that the common people also kept a few colonies for domestic consumption.[6] Oviedo gives a short account of the harvesting method:

"And into a certain hole in the hive they put, having first removed a plug, a smooth stick made for this very purpose, and therefrom issues [...] honey [...], without destroying the hive, nor doing it damage, nor causing any agitation of the bees" (1959: Tomo IV, Libro XXXIV, Capitulo II; my translation[7]).

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[4]We should not be misled by the word *blancas*: no truly white bees have ever been reported in Yucatan, although the species locally known as *Xiik'* (*Frieseomellita nigra*) does have white wing-tips. However, in morphological aspects, *Xiik'* is closer to a fly than to a typical bee. Oviedo's word-choice may be explained by the fact that *M. beecheii* is slightly paler in hue than *A. mellifera*.

[5]"Allí hallaron mucha e muy buena miel, e colmenares grandes de a mill e dos mill colmenas, en troncos de árboles, bien fechos, con sus cebaderos y entradas; y es grande esta granjería."

[6]In the vault of the Museum of Anthropology and History in Mérida, Yucatan, there is a collection of round flat stones known as *panuches*. Some researchers believe that these stone disks were stoppers from ancient Maya beehives, the logs in which the bees were kept having long since decayed, leaving the disks as the only remains. Freidel and Sabloff (1984: 33) briefly discuss *panuches*, citing Wallace, who argued that the round settlement structures in which they were found were apiaries (i.e. meliponaries) and that the disks indeed served as stoppers for hives. However, Rathje informed the two researchers that Hablin, who had studied the fauna of Cozumel, believed the round structures to be animal pens rather than bee-houses. Without indicating how such pens might have been used, Freidel and Sabloff state that further work is necessary to test the conflicting hypotheses.

[7]"E meten por cierto agujero de la colmena, quitando un tapón, un palo liso que para aquello tienen fecho, e por allí destila e sale [...] miel [...], sin desbaratar la colmena ni hacerle detrimento ni causar alteración a las abejas."

As the colonial sources shed no light on methods of keeping stingless bees, apart from the harvesting of honey, it is not clear whether the bees were fully domesticated or merely cultivated, though it is tempting to conclude from the size of bee-houses described in Yucatan at that time that the beekeepers knew how to multiply colonies. This seems to be confirmed by hieroglyphs, which have been translated as "*u pak' u kab*", found on the 'bee-pages' (103b & 104b) of the pre-colonial Madrid Codex (Hieroglyphs course, Leiden University; see also Knorosov 1982). According to the Cordemex Maya dictionary, this phrase means "to populate the hive". Apparently, these two 'pages' indicated auspicious and inauspicious days for multiplying colonies by splitting the brood.

2.1.1 Trade and tribute in honey and beeswax

Even before the arrival of the *conquistadores*, honey was a valuable commodity in Yucatan. The Relaciones Geográficas de Yucatán (Geographical Reports on Yucatan) relate that Maya noblemen demanded honey as tribute from their subjects (Wagner 1993: 131; Calkins 1974: 35[8]). It has been claimed that honey was one of the peninsula's few resources.[9] Cortes wrote in his first letter to the royal family:[10]

"This island [Cozumel] is small, and nowhere is any river or stream to be found, so that all the water which the Indians drink comes from wells. The land consists entirely of crags and rocks and forests; the only produce the Indians have is from beehives, and our deputies are conveying to Your Highnesses samples of the honey and beeswax from the hives, for Your inspection" (Pagden 1972: 18).

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[8]Based on the "Relaciones Histórico-Geográficas de la Gobernación de Yucatán 1579-1581 (Mérida, Valladolid y Tabasco). Edición preparada por Mercedes de la Garza *et al.* 1983.

[9]I have found no references in the sources to trading in wax by, or on behalf of, the Maya, either before the conquest or in the early colonial period. However, there is one reference to wax in Cuba. According to Bartolomé de las Casas, it was imported from Yucatan: "They found in a house a cake of wax [...] and he said that wherever wax was found, there should also be many other good things [...] that this wax had never been seen before on the island of Cuba, that the cake [...] was from the kingdom and provinces of Yucatan, where there was an immense quantity of wax, very good and yellow. It could have come [from Yucatan], for some Indians from [Cuba] went to Yucatan in their canoes" (Bartolomé de las Casas 1951: Libro I, Capitulo XL, VIII: 246; my translation). In contrast to what is implied here, there is a meliponine species in Cuba (*M. beecheii*, variety *fulvipes* Guérin: Schwarz 1948: 141) and it therefore seems unlikely that the wax was actually imported from Yucatan.

[10]Dispatched to Queen Doña Juana and to Emperor Carlos V, Her Son, by the Justiciary and Municipal Council of the Muy Rica Villa de la Vera Cruz on the Tenth Day of July, 1519.

As testified by the large number of harbours the colonists discovered in Yucatan, inter-regional trade was an important economic activity of the Maya. At the time of the conquest, a trade network based on vigorous commercial centres covered almost the entire peninsula: from Chauaca in the north, down through Cozumel and Tulum on the Caribbean coast, to Nito on the Bay of Honduras and across the base of the peninsula to the Gulf of Mexico. These centres channelled goods between the peninsula and the highlands of what is now Mexico and Central America (Farriss 1984: 14-15; Freidel & Sabloff 1975). Goods were transported either by causeway (*sac be*)[11] or by sea-going canoe. Because honey, presumably, was so abundant and would have been moved in bulk consignments, it seems likely that canoes were the main means of transport. Some sources identify Cozumel and Chetumal as important centres of honey-trading (Pagden 1972; Oviedo 1959: Tomo III). From the descriptions of large meliponaries and the presumed abundance of honey on the peninsula, as well as from Cortes' letter to the royal family and the large number of commercial centres, it can be deduced that honey was an important commodity in the period immediately prior to the Spanish conquest.

The seasonal availability of tradable commodities influenced the organizational infrastructure on the island of Cozumel. Besides honey, important products traded by the Yucatecan Maya were textiles and salt. Supplies of honey and salt were periodic, and storage was necessary to enable selling all the year round. In the period leading up to the Spanish conquest, there appears to have been no strong, centralized authority to control the long-distance trading network,[12] which was therefore susceptible to attack by pirates. As a result, these products had to be stored where they were relatively safe, i.e. in the interior of the island and within walled settlements such as Tulum (Sabloff & Freidel 1975). In this sense, then, ecological conditions did not only influence honey production but, in combination with the political situation, imposed constraints on the architecture that was necessary to guarantee secure trading.

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[11]*Sac be*, literally meaning 'white road', is also the Maya name for the Milky Way. The *sacbe'ob* were raised roads, or causeways, which formed a network linking principal Maya towns. The roads were used for secular purposes such as commerce and rapid troop-movements, but also served as routes for ceremonial processions and pilgrimages between related members of the nobility (Schele & Freidel 1990: 355, 498; Farriss 1984: 151).

[12]Freidel and Sabloff hypothesize that, between 900 and 1250 AD, Cozumel lacked tight local control: "With the collapse of the Toltec capital at Chichén Itzá and the concomitant decline of Toltec power [... AD 1250], control of the procurement and distribution of resources from the greater Yucatan area became fragmented or localized. Major centres at Mayapán, Tulum, and in the Tabasco-Campeche lowlands arose at this time and became controlling centers of the long-distance trading network" (Freidel & Sabloff 1975: 372-373).

On the Yucatan peninsula, large-scale beekeeping with *M. beecheii* continued well into the colonial era. Beehives were often included in the testaments of the wealthy, and theft of honey or hives (*kabob*) appears to have been lucrative, for Maya dictionaries include frequent references to it (see Wagner 1993: 118-119). Under colonial rule, Yucatan continued to export all but a few of the raw or processed materials it had done in pre-conquest days, including bee-products and cotton cloth (Farriss 1984: 153). However, whereas the pre-colonial Maya had traded honey, beeswax became a more important commodity under Spanish rule, mainly in the form of hand-made candles for Catholic churches.[13] A royal decree issued in the year 1549 stipulated the quantities of honey, wax and other commodities that each settlement had to contribute. The *vecinos* (settlers) demanded tribute from 175 *encomiendas*[14], 163 of which had to pay in wax and 158 of which had to pay in honey. Accordingly, the crown collected some 27,280 kilograms of wax and 3,210 kilograms of honey annually (Paso y Troncoso 1939).[15] From the time of the conquest to the late 18th century, the colonial economy in Yucatan depended on exports of cotton cloth and beeswax (Farris 1984: 38, 418; Paso y Troncoso 1939).

Although the quantities of wax collected as colonial tribute in Yucatan were considerable, the figures do not shed much light on the number of domesticated colonies kept at that time. As a typical meliponine colony produces little wax, and as extracting it easily depletes the colony, the most important questions are whether the quantities of bee-products paid as tribute were extracted entirely from cultivated colonies and whether all originated on the peninsula. In the light of Bishop Landa's description in Section 2.1, we can assume that some of the tribute in wax was taken from wild nests in the forest. Further evidence for this assumption is supplied by several colonial reports of wax-gathering expeditions that took the Maya far from home for extended periods (Farriss 1984: 18; Scholes & Roys 1968: 228, 234, 245). Tribute lists, then, do not suffice as a basis upon which to estimate the number of

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[13]In churches in Europe and Mexico, large quantities of beeswax were needed for candles. Wax symbolized the body of Christ as derived from the Virgin Mother; a burning candle represented the Holy Trinity (Dixon 1988: 89). Ransome comments that the 'Ancient Laws of Wales' include the following article on bees: "The origin of Bees is from Paradise, and on account of the sin of man they came hence, and God conferred his blessing upon them, and therefore the mass cannot be said without wax." Similar ideas existed in other parts of Europe and can probably be traced back to the thoughts of Virgil (Ransome 1986: 196-197).

[14]Roughly stated, Spanish rule divided colonial society into the *vecinos* (neighbours or residents), i.e. the Spanish settlers who received tribute, and the *Indios* who were obliged to pay it. The indigenous population was organized into units called *encomiendas* (trusts or missions), each being represented by an *encomendero* who actually collected the tribute for his colonial masters (Dumond 1997: 26).

[15]The colonial authorities annually demanded 2,372 *arrobas* of wax and 279 *arrobas* of honey. According to Roys (1939: 329, 337) an arroba was 25 Spanish pounds. One Spanish pound equalled 0.46 kg.

colonies cultivated in the early Hispanic period, though they certainly indicate that honey and wax were abundant.

2.1.2 The decline of meliponaries

Several descriptions of the peninsula, spanning a period of five centuries, refer to large meliponaries. While travelling in Campeche between 1809 and 1814, Humboldt observed bee-houses of 600 to 700 colonies (cited in Wagner 1993: 87 and Schwarz 1948: 145). From 1840 to 1847, it was also common practice to keep stingless bees on Spanish landed estates (*haciendas*) in Yucatan. An inventory of the possessions of 27 *haciendas* shows that 23 of them kept a total of 5,977 meliponine hives, the smallest meliponary consisting of 64 and the largest of 474 hives (Bracamonte y Sosa 1990: 102-103). In the first half of the 20th century, some Maya families in Pisté had meliponaries of 100 to 300 hives (Steggerda 1948). There are several other accounts of meliponaries with hundreds of hives (Carmen 199; Weaver & Weaver 1981; Schwarz 1948: 144, 147). The University of Yucatan's veterinary department permanently exhibits two photographs (property of *Licenciado* Gonzáles Acereto) which depict the meliponaries of a Yucatecan family, each containing hundreds of hives. Elderly people in Tepich recall their childhood days when some villagers kept meliponaries of 200 hives. The sad fact is that, in the modern era, there has been a considerable decline in the number of large meliponaries and in the average number of hives per meliponary. Nowadays, a meliponary of only 40 hives is considered to be large (see Section 5.2 & 5.4.6).

2.2 Meliponiculture in other parts of Mesoamerica

Even though the early colonial chroniclers were particularly impressed by the quantities of honey produced in Yucatan, and despite firm evidence that a significant portion of that honey was exported to other parts of Mesoamerica, it cannot be assumed that meliponiculture was confined to the peninsula; nor is such an assumption necessarily justified by the paucity of 16th-century references to the keeping of stingless bees elsewhere.

Some early sources speak only of abundant honey and wax, without specifying whether they were taken from wild or cultivated colonies. A few refer directly to meliponiculture. If it were true that these two bee-products were mostly or entirely collected from the forest, their abundance would not have been obvious to the Spanish newcomers, for many species of wild forest-bees nest in tree-hollows or cavities in the ground and are therefore not easy to detect. Yet early Spanish tribute lists clearly specify areas where honey and wax were produced and, while this does not necessarily imply that bees were bred in those areas, the tribute system is far more likely to have been established on a long-standing production and trade infrastructure rooted in cultivation than on dispersed and shifting patterns of gathering in dense forest. Early reports of the abundance of honey and wax, the surviving documentation of the tribute system, as well as later descriptions of meliponiculture, are circumstantial yet compelling evidence that beekeeping practices pre-dated the Spanish conquest.

Various sources suggest that, during the colonial period, meliponiculture was practised outside Yucatan in the following parts of what is now Mexico (modern names are used where necessary):[16]

1. Tabasco State
2. Jalisco State
3. Acalán province (a Chontal Maya region between Tabasco and Yucatan)
4. the Pacific lowlands of Sinaloa and Nayarit
5. the Rio Balsas basin of Michoacan, Guerrero and Puebla States, and the lowlands of Veracruz and eastern San Luis Potosí on the Mexican Gulf coast
6. Solizo province (a colonial province of Nueva España)
7. Santa Eulalia de Chihuahua
8. Ocozocoautla in Chiapas
9. Chiapas
10. Colima on the south-west Mexican coast

[16]The sources are as follows: 1. Tabasco State (Vasquez Davila & Solis Trejo 1992: 350; Roys 1972: 105; based on tribute lists of Paso and Troncoso and an observation by Dampier in 1676: Dampier, W. 1906, 'Dampier's voyages', 2 volumes, New York), 2. Jalisco State (Oviedo 1959: Tomo IV, Libro XXXIV, Capitulo II 'Xalisco: Description of Meliponiculture'), 3. Acalán province (Hernan Cortes' fifth letter in Pagden 1972: 367; Scholes & Roys 1968: 180), 4. Pacific lowlands of Sinaloa and Nayarit (description by Oviedo & Father Juan Bautista de Velasco of Nueva Galicia, and based on tribute lists: see Dixon 1988: 57-70), 5. Rio Balsas basin, Veracruz lowlands, and eastern San Luis Potosí (based on tribute lists and later ethnographic descriptions: see Dixon 1988: 57-70), 6 Solizo (breeding, cited by Oviedo 1959: Tomo IV, Libro XXXIII, Capitulo XLIX), 7. Santa Eulalia de Chihuahua (1778 - breeding: Campbell, W. Pennington, 1963, 'The Tarahumar of Mexico: Their Environment and Material Culture', University of Utah Press, Salt Lake City: 133, cited in Kent 1984), 8. Ocozocoautla in Chiapas (ethnic group - Zoque, in Carlos Navarrete: 'La Relación de Ocozocoautla', Chiapas Tlalocan 5, 1968: 371), 9. Chiapas (Roys: 110; 'Early missionaries report the production of maize, cotton, cochinal, honey, fruit and some cacao'), 10. Colima (cited in Kent 1984).

As far as meliponiculture in Mexico is concerned, this document only deals with Yucatan. Therefore, I now turn to historical accounts of meliponiculture in southern Mesoamerica. In the 16th century, stingless bees are reported to have been cultivated in parts of what are now Guatemala, Honduras, El Salvador, Nicaragua and Costa Rica.

Some early colonial sources, the oldest of them based on 16th-century reports by eye-witnesses, refer to meliponiculture in an area which would now be defined as extending northwards from the Nicoya peninsula of north-west Costa Rica to the Granada area of south-west Nicaragua. In his description of Nicoya, Oviedo reports that, in the year 1529, there was an abundance of honey and wax (1959: Tomo III, Libro XXIX, Capitulo XXII). A priest who administered a Nicoyan village was entitled to 55 kilograms of honey as tribute every six months (Kent 1984: n.22). Oviedo also reports abundant honey and wax in Nicaragua (1959: Tomo IV, Libro XLII, Primer Capitulo & Capitulo XII), and refers explicitly to meliponiculture in Tecoatega, where hives were hung from the eaves of houses (ibid.: Capitulo XIII). Interestingly, pre-Hispanic images of bees have been found in Costa Rica, perhaps indicating that the bees were ascribed some religious significance. (These artifacts are now kept in the archives of the National Bank in San José. See Photo 1, courtesy of Dr. M.J. Sommeijer).

In the 1950s, Wagner gave a clear description of contemporary meliponiculture in the Nicoya peninsula:

> "One of the most characteristic features of the rural household in Nicoya is the bee-log which hangs under the eaves of the dwelling. The native stingless bees that are kept around houses belong to several genera of the Meliponinae. Eight kinds are distinguished in Nicoya. The most common is the bee called *jicote*, which feeds on papaturro (*Coccoloba floribunda*), orange blossoms, and other fragrant nectars, and produces a light honey resembling that of European bees" (Wagner 1958: 232).

The *Jicote*, or *Jicote Gato* (Cat Bee), is still bred in the region and has been identified as *M. beecheii*. Wagner also refers to the other seven species: the highly valued *Chicopipe*; the *Cera-y-Todo*, which he describes as "a tiny bee that produces an acid-sweet honey especially from the nectar of *Curatella americana*"; the *Soncuán*, a reddish bee which secretes an irritant capable of producing a skin rash and whose honey is also highly acid and sometimes irritant; the *Mariola* (*Tetragonisca angustula*); the *Tamaga* (*Cephalotrigona* sp.), which "produces the most useful wax, hard and clean"; the *Mariseca* (*Tetragonisca angustula*); and, finally, the black bee *Zopilotillo*. Wagner also refers to the gathering of honey in the forest in April and May, the capture of swarms in the forest and the fact that "almost every house in the country hamlets and many of the dwellings in the towns have such bee-logs" (ibid.). Small-scale meliponiculture is still practised by a few people on the Nicoya peninsula and in south-west Nicaragua, as I observed in the season 1989/90.

In other parts of Costa Rica and Nicaragua, one occasionally encounters people who breed a few colonies of stingless bees. In the Talamanca area of southern Costa Rica, which is inhabited by the Bribri people, the keeping of stingless bees is rare; *M. beecheii* does not occur in the area, though a few people keep *Tetragonisca angustula*. In the area around Puntarenas, several people breed meliponine bees, including *M. beecheii*. The keeping of stingless bees is occasionally found among the Miskitos on the east coast of Nicaragua (H. Arce Arce (M.Sc.), personal communication).

The earliest reference that I have found to bees in El Salvador and Guatemala is in a communiqué to the King of Spain, written by Don Diego García de Palacio in 1576:

"White bees are found in this province, but in small numbers. Their honey and wax have an extraordinary whiteness, and their sting is not as severe as that of the ordinary varieties" (Squier [1860] 1985: 17).

Squier travelled in El Salvador in the mid-1850s. He translated García de Palacio's letter and added:

"The species similar to those which produce honey in Europe have the general Mexican name *jicotes*. They are encountered wild in the cavities of trees and, not [being] poisonous, they can be transported in the trunks or branches in which they nest to a place near one's habitation, in order to extract easily the honey they make. The wax is dark gray, not white" (ibid.: n.15).

Pedro de Alvarado, who conquered the province now known as El Salvador in the name of the Spanish crown, does not refer to the breeding of bees, though he does report capturing two spies who claimed they were searching for honey (Mackie 1969). Oviedo (1959: Tomo IV, Libro XXXIII, Capitulo XLII) repeats this account, stressing the abundance in El Salvador of high-quality wax and honey in 'several forms', a probable reference to the many species prevalent at that time.[17] He also tells of large quantities of honey and wax in the province of Guatemala (1959: Tomo IV, Libro XLI,

[17]This can be deduced by comparing the stated reference to another Spanish edition of the same work, which clearly indicates that various sorts of bees produced honey and wax of different qualities (Oviedo 1944: Libro Decimo Quinto, Capitulo III).

Capitulo I).

Among the Pipil people in Cuscatlan province (now El Salvador), in the year 1532, twelve settlements paid tribute to the Spanish rulers in honey and twenty-three in beeswax,[18] while in south-eastern Guatemala, in the mid-16th century, four Pipil towns paid tribute in honey (Fowler 1989: 183-185). Fowler argues that:

> "...apiculture [i.e. meliponiculture] was certainly practiced by the Pipil-Nicarao, but early colonial tribute data indicate that it was probably a relatively minor economic pursuit. Honey was, nevertheless, important in indigenous subsistence, and regions that did not produce it traded other goods to obtain it" (ibid.: 183).

Another brief description of the keeping of stingless bees among the Pipil of El Salvador dates from the late 19th century. It reports that a large and a small bee were kept: a *Melipona* and a *Trigona* species respectively (Hartmann 1901 in Sapper 1935: 189). A more informative 19th-century reference to meliponiculture describes how the Kekchi people of Alta Verapaz in Guatemala kept two species in hives suspended under the eaves of their houses: *Kerk-cam*, small black bees which nest in tree-hollows, and *Sac-cau*, which resemble the European honeybee but are smaller. These bees have been identified as *Trigona mexicana* Guérin var. *alisfumatis* and *Melipona fulvipes* Guérin respectively. According to the description, the colonies of both species were harvested only once a year, reportedly yielding about eight litres of honey per hive (Sapper 1935, discussing a letter from Helmrich). Sapper travelled in the Central American forests and lived among the Indians. He stated that the wild nests plundered by his escorts yielded between one and three litres of honey. Eight litres, the quantity noted by Helmrich, is a huge yield for a single harvest of a typical *Melipona* colony. In fact, a bee-log of average size can contain no more than four litres of honey. The reference to eight litres per harvest should therefore be regarded as spurious. Helmrich also reported that the *Melipona* species was less common than the *Trigona* species in the area concerned. Sapper noted that bees' nests were generally not very abundant in the Central American tropical forests. Significantly, as early as in 1935, he concluded that

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[18]Fowler gives the names of several honey-producing centres in the province of Cuscatlan: "Tecoluzelo (near Tecoluca) [...] Cuzcatan (Cuscatlan) [...] Mazagua (San Pedro/San Antonio Masahuat), Tecoyluca (Tecoluca), Terlingtepeque (Talnique), Naozalco (Nahuizalco), Cuxutepeque (Cojutepeque), Metapa (Metapán) and Zacatecoyluca (Zacatecoluca). [...] It would appear from these data that a number of significant honey-producing settlements were fairly evenly distributed in the province of San Salvador, and that very little honey was produced in the province of Izalco. Before the Conquest, a number of settlements of the province of Cuscatlan probably produced honey for exchange with other towns in the region, in the province of Izalco, and perhaps beyond. Among the most important pre-conquest producers of Cuscatlan were probably Tecoluca and Tecoluzelo" (Fowler 1989: 183).

the keeping of stingless bees was declining in the region (Sapper 1935).

Oviedo reports that "very much and excellent honey and wax" was obtained from hives at "Celimonga" and "Tepeaca" in Honduras (1959: Tomo III, Libro XXXI, Capitulo XI). Also in Honduras, in 1850, William Wells observed bees in logs at Olancho (Kent 1984). In the colonial era, Belize was administered by the Spanish government of Yucatan. The territory was handed over to the British in 1893. The earliest evidence that I have found of the keeping of stingless bees in Belize (British Honduras) dates from the beginning of the 20th century, but, obviously, this does not rule out that beekeeping was practised before then. Ghane (1902), reporting on the keeping of stingless bees in Belize, stated: "Beekeeping here was known as far back as the history of the colony, but of course in a very crude way." Ghane describes four species that were kept: "The big bees which are of two colors, yellow and gray, a big and a small black bee and a green one. All are stingless." The two-coloured bee matches the appearance of *M. beecheii*; however, the black and green bees defy identification.

The early colonial sources indicate that, as far as the southern part of Mesoamerica is concerned, meliponiculture was practised not only on the Nicoya peninsula but also in many parts of what are now Nicaragua, Honduras, El Salvador and Guatemala. Although the keeping of stingless bees on the Nicoya peninsula was described as 'widespread' even in the 1950s, all indications are that the meliponaries there were significantly smaller than in Yucatan. To my knowledge, there are no descriptions of meliponaries containing hundreds of colonies in southern Mesoamerica, and it is unlikely that the extent of meliponiculture there even approached the situation in Yucatan. Furthermore, before the Spanish conquest, Yucatan exported bee-products to several parts of Central America, a clear indication that demand exceeded production in those areas.

That Yucatan surpassed Central America in honey production during the colonial era cannot simply be ascribed to the cultivation on the peninsula of a more productive bee, for *M. beecheii* was among the species cultivated in many parts of the region, as the descriptions of bees in Belize, Guatemala, El Salvador and Nicoya testify. Although the term '*los Jicotes*' is sometimes used to denote stingless species in general, when used for a single species it refers to *M. beecheii*. Only in relation to the Guatemalan *Sac-cau* is there some uncertainty. Helmrich identified the species as *Melipona fulvipes*; however, Schwarz informs us that:

"There is no meliponid species that has been more often adopted by man than the bee that is frequently referred to as *fulvipes*. It was this bee that Huber [...] spoke of as '*Melipona domestique*' and that Darwin [...] designated *Melipona domestica*. [...] the earliest name (even earlier than *fulvipes*, which is an insular race first recorded in 1835) is *beecheii*, described in 1831 by E.T. Bennett" (Schwarz 1948: 143-144).

Hence, the names *M. beecheii* and *M. fulvipes* have both been used for the *Melipona* species now exclusively referred to as *beecheii*. In Guatemala, the common Spanish name for *M. beecheii* is *Colmena Real* (Royal Hive), though the indigenous people must have given this bee other names. Although we lack exact data on the native bee species that were cultivated and their number, the descriptions indicate that *el Jicote* (i.e. *M. beecheii*) was the most common species cultivated in Costa Rica and El Salvador. Such descriptions are lacking for the other former Spanish territories, yet those areas certainly fall within the current geographical range of the species. The use of the common name *Jicote* to refer to *M. beecheii* as the archetype of all stingless species is another probable indication that this bee was the most important to the indigenous peoples of the region.

2.3 Introduction of *Apis mellifera*

At the time of the Spanish conquest of Mesoamerica, beekeepers in many parts of Europe were breeding *A. mellifera*, a species native to the continent, which produces considerably more honey and wax than the Meliponinae. *A. mellifera* was introduced to Mexico and Central America by the colonizers, but did not spread rapidly throughout the region. Although swarms of *A. mellifera* disperse more widely in their natural habitat than meliponine swarms, the European bees did not colonize deeply into the tropical forest by their own efforts. According to historical research by Calkins, it was the British who brought *A. mellifera mellifera* L. from north-west Europe to the United States, specifically to the peninsula of Florida, from which they were probably introduced to Cuba in 1794. It seems that the European honeybees were brought to Mexico shortly thereafter. Calkins found proof that they were taken from Veracruz to other parts of Mexico and Central America, but were not introduced to the Yucatan peninsula until the beginning of the 20th century.[19] The first references

[19]Why did the Spanish not import *A. mellifera* sooner? Calkins suggests four possible explanations, the last of which he regards as the most plausible: 1. "Mayas would have had a strong resistance to accepting a bee that possessed the undesirable characteristic of stinging"; 2. The Spanish were preoccupied with other

to European honeybees in Central America are by Ephraim George Squier, who states that they were first reported in Honduras in 1780 and in El Salvador in 1855 (Calkins 1974: 59-74; Sapper 1935: 193).

Apiculture was first practised in Central America by European settlers. In Guatemala and Costa Rica, German coffee-planters used the bees to pollinate their plantations, each typically keeping from 100 to over 1,000 hives. No records indicate to what extent the indigenous peoples adopted apiculture; however, Sapper, who lived among the Kekchi for several years, states that, once the people had become acquainted with the new species, they enthusiastically practised apiculture alongside meliponiculture. In 1929, according to statistics of the Guatemalan Ministry of Agriculture, 311 colonies of *A. mellifera* were kept in Alta Verapaz (Sapper 1935). In Costa Rica, apiculture was practised by the non-indigenous population as early as in 1900 (ibid.), yet Wagner does not refer to the use of European honeybees in Nicoya in 1950, so it can be assumed that this had not yet become an important activity among the indigenous population of the peninsula. According to Kent (1984), meliponine bees provided honey for consumption in Costa Rica until the turn of the 20th century. There is no information about the spread of apiculture in El Salvador; the first statistics date from 1960, when there were already 4,000 apiaries comprising 40,000 colonies of European honeybees in the country (Woyke 1983). Nowadays in Central America, small beekeepers are responsible for the greater part of the total honey production; except in El Salvador, where 30 per cent of the hives (i.e. approximately 60,000 colonies) are owned by beekeepers possessing more then 1,000 hives each (Arce Arce & van Veen 1997: 105).

Whereas the first documentary evidence of the introduction of *A. mellifera* to Yucatan dates from the turn of the 20th century, the foundations for modern apiculture and its widespread adoption on the peninsula were laid in the first two decades of the century by Dr. George J. Gaumer, who introduced European honeybees from Italy and established crossbreeding and cultivation based on scientific understanding (Merrill-Sands 1984: 148-151; Calkins 1974: 82-84). Gaumer's methods were adopted by members of the wealthy Hispanic elite, who took up beekeeping as a sideline to their activities as urban entrepreneurs and professionals, or as managers of henequen

concerns (henequen and sugar plantations, etc.); 3. "Beeswax [...] was no longer a profitable export item following the suppression of tribute payments by Mexican authorities"; 4. "Yucatan occupied a geographical position that was somewhat 'off the beaten track' between Mexico City and the countries to the south, over which many things and ideas were carried" (Calkins 1974: 70-71).

plantations. In 1937, they founded the *Sociedad de Apicultores de Yucatán*, which grew to more than 100 members in only a few months. The society's magazine, *Apicultores de Yucatán*, mainly featured previously published articles translated into Spanish (Merrill-Sands 1984: 155-157; Calkins 1974: 84-85, 114). The society controlled the production and marketing of honey until the late 1960s. The apiculture of that period was characterized by large-scale enterprise: typical owners had 1,000 to 3,000 hives (Merrill-Sands 1984: 182), their activities were capital intensive (ibid.: Table 5.4: 193) and honey was sold abroad by 10 privately owned export-houses (ibid.: 5, 164-167). However, the entrepreneurs employed Maya Indians to do the labour-intensive beekeeping itself. In Yucatan State, apiculture expanded rapidly from a total of 15,000 hives in 1942 to 27,000 in 1981 (Merrill-Sands 1984: Figure 5.1: 165).[20]

An important process of change started in the mid-sixties; large-scale, capital-intensive apiculture increasingly giving way to small-scale, capital-extensive operations by Maya peasants. There were diverse underlying reasons for this gradual shift: certainly, only a combination of factors made it possible for the Maya to wrest apiculture out of the hands of the Hispanic elite. Already familiar with traditional meliponiculture, the Maya employed by the big commercial enterprises also learned apicultural techniques and were therefore able to start their own apiaries. Those too poor to buy a colony could at least capture a wild swarm and use multiplication techniques to establish new colonies. By the late fifties, several entrepreneurs from Mérida had located hives near Valladolid to profit from the forest resources and the low density of bee colonies in the area. This enabled the Maya to take over the activity:

"Small peasant producers were able to capture the production strategy by circumscribing the large producers' access to floral resources and by factor substitution of labor for capital. They asserted their legal right of control over the extensive *ejido* forest lands and forced large producers to remove their apiaries. Secondly, peasant farmers' rapid propagation of small apiaries and constant pilfering of hives from the large producers undermined the high yields on which the capitalist enterprises depended for profitability. Finally, in many parts of the state, peasants stopped working as wage laborers for the large producers and used their knowledge of apiculture

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[20]As Merrill-Sands indicates, these figures do not accurately represent the growth of apiculture on the entire peninsula: many apicultural enterprises were located in Campeche State, so the numbers should probably be doubled. Furthermore, until 1970, no distinction was made between hives of *A. mellifera* and those of stingless species (165: note 14). She argues that export figures are a more reliable indicator of the growth of apiculture. In the period from 1967 to 1981, honey exports rose from between 3,000 and 4,000 to 13,000 metric tonnes. However, the honey market being far from stable, exports fluctuated enormously and, in 1983, the figure slumped back to the 1967 level (Figure 5.2: 166). Hence, colony density is better indicated by the number of domesticated colonies, although this figure is only available for Yucatan State.

to produce independently. With the labor recruitment difficulties, limited access to floral resources, and the decline in yields, commercial apiculture lost its value as a remunerative capital investment. However, it simultaneously emerged as a high yielding form of production in the peasants' sector where the producer invests his own labor" (Merrill-Sands 1984: 143-144).

From 1964 to 1969, honey prices were low on the world market (ibid.: 209-210). This, in combination with the changes already stated, was the final blow to large-scale, capital-intensive beekeeping (ibid.: 204-208, 535-546). By the time the market price of honey recovered, i.e. in 1970 (ibid.: Table 6.2: 248), the production base was largely in the hands of the Maya (ibid.: Table 6.1: 235). In addition, between 1968 and 1970, the private export-houses had been replaced by two government-sponsored export co-operatives. Nowadays, apiculture is a common enterprise of Maya throughout the peninsula (see Section 9), their apiaries producing 30 to 40 per cent of the total Mexican honey exports, even though the peninsula is only eight per cent of the country's land area (Echazaretta 1997). In the eighties, Mexico was the second largest producer of honey on the world export market (Merrill-Sands 1984: 118). In the nineties, the country has held on to its position as one of the world-leaders in honey production (see Section 9.2).

Slowly but surely, then, the Maya took over apiculture and profited from it; after all, the European honeybees easily surpassed the indigenous stingless bees in their production of honey and wax. The attention of government programmes and social scientists was also directed at apiculture, to the exclusion of meliponiculture. Before apiculture became widespread among the Maya, stingless bees supplied the honey for the production of Xtabentun liquor in the *aguardiente* ('fire-water') factory in Valladolid. For economic reasons, the liquor factory eventually switched over to the honey of European bees. Those Maya who had mastered apiculture at an early stage in its adoption around the Yucatan peninsula reaped economic benefits that were not inconsiderable. Apiculture had proven to be an activity that, like meliponiculture, was perfectly compatible with Maya agriculture in general. However, what many Yucatecans may have regarded as an unmitigated success story was to be rudely interrupted by the entrance of a new player: the Africanized honeybee.

2.4 Invasion of the 'killer bees' (Africanized honeybees)

"I am the man who introduced the so-called killer bee to the Americas," declared

Warner Kerr in the Times Literary Supplement in 1992, concluding his article with: "If I could, I would send all my Africanized bees back to Africa and start a production of Brazilian honey from *Melipona* species." At the request of the Brazilian Minister of Agriculture, who had read about the prodigious yields of African bees, Kerr introduced African honeybee queens to Brazil. Africanized honeybees result from the deliberate or accidental crossing of African bees with European strains of *A. mellifera*. It is not known whether the first Africanized colonies that swarmed were released on purpose or just escaped. Be that as it may, 26 colonies swarmed in October 1957. It was not long before Africanized bees had colonized large areas and crossing with European strains had become extensive. By 1990, Africanized honeybees had arrived at Hidalgo, Texas. Now, all the colonies of European honeybees in the entire region stretching from Brazil to the United States are assumed to have become Africanized to some degree. The 'killer bee' tag can be traced back to Time magazine in 1965 (Kerr 1992) and dramatically reflects the impressive defensive behaviour of Africanized bees. Compared to purely European strains of *A. mellifera*, they attack with far less provocation, in larger numbers, at a greater distance from the hive, and are more insistent (D. De Jong 1996: 68). Certain noises or strong odours such as perfume can rouse a whole colony to attack. The widespread fear of killer bees was exacerbated by alarmist articles in newspapers and magazines, as well as by at least one movie: 'Deadly Invasion - The Killer Bee Nightmare' (O'Brannon 1995). Recently, however, the fear has receded somewhat in the light of more positive attention, particularly from the scientific community. Whereas, in 1994, scientific articles screamed titles such as "Fatal Mass Attacks by 'Killer Bees'" (Franca *et al.* 1994), by 1996, the bees were well on the way to rehabilitation, judging by the title of another scientific article: "Africanized Honeybees in Brazil, Forty Years of Adaptation and Success" (D. De Jong 1996). So far as the effects of Africanization in Mexico are concerned, the truth lies somewhere between the two extremes.

In Mexico, Africanized bees were first observed in the southern state of Chiapas in 1986 (Guzman-Novoa & Page 1994) and in the Yucatan peninsula in 1987 (Diario de Yucatán 10-4-1994). The Mexican African-Bee Program (SARH) responded by setting traps in urban areas to capture wild swarms and minimize stinging incidents. Nevertheless, the number of annual deaths in Mexico as a result of stinging attacks by Africanized bees rose from five in 1988 to around 60 in 1993. Innocent passers-by are in greater danger than beekeepers since the latter usually wear protective equipment. The bees have also attacked an unknown number of animals. Being unaware of how to handle Africanized bees, many beekeepers were quick to abandon apiculture.

Eventually, however, hybridization led to an increase in the number of apiculturalists maintaining small numbers of colonies because the frequent swarming of Africanized bees offered more opportunities for apiculturalists to capture the bees and start breeding them. In Mexico, the difficulty of managing Africanized bees forced honey yields per hive down from an average 32.5 kg in the season 1985/86 to 26.8 kg in 1991/92. However, as the number of apiculturalists and cultivated colonies had increased, Mexico's total production of honey was only slightly less than before the advent of Africanized bees (Guzman-Novoa & Page 1994). In the eight years following the arrival of Africanized bees in Yucatan, there was no significant reduction of honey production on the peninsula (see Table 2.1). According to Villanueva and Colli, the process of Africanization may have been slowed down by the high concentration of European honeybee colonies in the area, as well by the government's policy of setting traps for Africanized swarms and informing beekeepers how to manage Africanized colonies. In 1995, however, production decreased by a massive 33 per cent, which Villanueva and Coli tentatively ascribe to the combined effects of Africanization, the pest-mite *Varroa jacobsoni*, and the drought and hurricanes that affected the peninsula that year. There was a limited recovery in Yucatan and Campeche States in 1996 and, because neither drought nor hurricane affected the peninsula that year, they conclude that *Varroa jacobsoni* and the Africanization of *A. mellifera* must have been to blame for the fall in honey production (Villanueva & Coli 1996). Surprisingly, they do not even consider the low price of honey on the world market in 1995 as a reason for the fall, even though the apiculturalists themselves regard this as the main factor. In 1996, the apiculturalists started increasing their colonies again (see Section 9.2).

Table 2.1: Honey production (in metric tonnes) in the three States of the Yucatan Peninsula 1986-1996

States	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	mean per year
Yucatan	14500	11600	16000	10000	14000	13700	13500	12800	12000	8600	10043	12431
Campech	7871	4878	8850	6770	8450	8600	8605	5453	5550	3900	4000	6302
Q. Roo	3551	3730	3500	3071	3350	3150	3000	3744	3220	2700	2700	3246
total	259201	20208	28350	19841	25800	25450	25105	21997	20770	15200	16743	22307

Source: Villanueva Colli-Ucan 1996

Less information is available on the impact in El Salvador, where Africanized bees were first reported in 1986. Table 2.2 summarizes official statistics on apiculture in the years following Africanization.[21] After the season 1985/86, the number of apiculturalists, apiaries and hives decreased significantly, reaching a low in the number of hives and the production of honey in 1986/87 and a low in the number of apiculturalists and apiaries in 1987/88. These decreases may be attributable in some part to the drought of 1986/87. Thereafter, the number of apiculturalists, apiaries and hives started to increase again, as did honey production. In the period 1993-95, apicultural activity passed the levels of 1985/86, the last season before all the country's hives became Africanized. The average production per hive increased by almost one kilogram following full Africanization (Ing. M. Díaz Paniagua, *Ministerio de Agricultura*, *Unidad Apícola de la Dirección General de Sanidad Vegetal y Animal*).

Table 2.2: Apicultural development in El Salvador 1985-1995 as indicated by the number of apiculturalists, apiaries and hives over the years.

season	number of apiculturalists	number of apiaries	number of hives	honey production (metric tonnes)	mean production per hive (kg.)
85/86	8000	12800	19200	5600	26.5
86/87	5240	7860	118000	2900	22.3
87/88	4900	7300	132000	3800	26.2
88/89	6200	9300	140000	4600	30.0
89/90	6300	9500	152000	4900	29.3
90/91	7200	11400	174800	5500	28.6
91/92	7560	11970	183540	5775	28.6
92/93	7862	12448	190881	6006	28.6
93/94	8097	12821	199607	6066	28.0
94/95	8258	13108	200539	5156	23.4
mean	6.961	10.850	168.336	5030	27.2

Source: Ing. Mauricio Paniagua, Ministry of Agriculture and Cattle-Breeding, San Salvador

Both Mexico and El Salvador are exceptions in the region in the sense that their honey production did not suffer a sustained, major decrease after Africanization. In other Central American countries, the number of hives decreased by an average of 25 per

[21]When comparing the situation in El Salvador with that on the Yucatan peninsula, it is important to note, however, that the land area of the former (21,041 km^2) only represents 18 per cent of the latter (113,000 km^2). It is therefore more appropriate to compare El Salvador with Yucatan State, which is only six per cent larger than that country but produces 60 per cent more honey. In terms of production density (i.e. per unit land area), El Salvador and Campeche State are almost equal (the difference is only one per cent, in favour of the latter), while both surpass Quintana Roo State by a full 35 per cent. The high production in Yucatan State is conceivably the result of better apicultural techniques. However, much of the Salvadoran honey is produced by large-scale beekeepers (not the subject of my study) who also have well-developed techniques. Perhaps the climatic conditions and specific vegetation of the Yucatan peninsula better explain its supremacy over El Salvador.

cent and honey production by an average of 18 per cent. The decline of apiculture was particularly dramatic in Honduras: from approximately 1,000 apiculturalists keeping a total of more than 65,000 hives before Africanization, to a mere 26 with 24,800 hives thereafter.[22] In Mexico and El Salvador, government agencies and beekeepers' associations supported large-scale beekeeping and training programmes, successfully maintaining production levels (Arce Arce & Veen 1997: 107). However, in the geographically more isolated area around Montecristo in El Salvador, beekeepers were not informed how to handle Africanized bees and, therefore, many abandoned apiculture. The same thing happened in other areas of Central America where no information was provided by the responsible agencies.

Africanized bees do not crossbreed with Meliponinae. The impact of Africanization on meliponiculture has not been precisely assessed, though competition of honeybees with certain meliponine species, including *M. beecheii*, has most probably intensified. Africanized bees are much stronger colonizers than European strains of *A. mellifera*. Biologists generally accept that European honeybee strains only colonize forest borders and clearings. Wild colonies of Africanized bees, in contrast, penetrate deeply into the forest, where they probably compete with wild colonies of *M. beecheii* for the available floral resources. They are more aggressive foragers, have a greater flight-range and start foraging earlier in the day than European honeybees, which in turn surpass Meliponinae in all these respects. But does this imply that cultivated colonies of *M. beecheii* have also been facing increased competition for floral resources since Africanization? There is no simple answer to this question. Africanized bees are very aggressive foragers and can drive other species of bees away from a foraging location (Roubik 1989). As *M. beecheii* generally avoid competition and will not visit a location that is frequented by other species, including non-Africanized and Africanized honeybees (see Appendix I), the influence of Africanization on cultivated species should not be overestimated. In response to the Africanization of honeybees in Central America and Mexico, official regulations have generally been introduced to exclude colonies of *A. mellifera* from residential areas, a measure which should logically minimize competition for resources. Yet such regulations are often ignored by apiculturalists and often have the opposite of the desired effect. As already stated, one result of Africanization is that more people have been able to capture a colony of honeybees (Guzman-Novoa & Page).

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[22]These figures, taken from the reference work, are based on official statistics, which probably did not include many of the small-scale apiculturalists in Honduras.

2.5 Changes in the bees' habitats

Although the introduction of foreign bee species to the American tropics has significantly and irreparably affected pollination and foraging relations, other changes that have taken place in the human environment since the Spanish conquest have had far greater consequences for beekeeping. Shifting cultivation was widespread among the indigenous peoples of Mesoamerica long before the Spanish arrived and forced them to change their subsistence pattern. This colonial intervention dramatically and irreversibly altered the environment of indigenous beekeepers (see Section 2.6) and the habitats of native bees (this section). Changes in the bees' habitats can only be assessed properly in relation to certain characteristics of meliponine species. Firstly, meliponine bees have a limited flight-range (see Appendix). From the early colonial sources we know that cultivated colonies were suspended from, or kept near dwellings, a practice that continues to this day, as we shall see in subsequent sections of this dissertation. Floral resources in the vegetation surrounding dwellings are therefore the most important food supplies for hives of stingless bees. Secondly, stingless bees have a peculiar swarming behaviour: the mother-colony maintains relations with the daughter-colony for several weeks, during which nest materials are transferred from the old to the new accommodation. Restricted by their limited flight-range, stingless bees do not disperse very quickly or widely. In addition, many species depend on tree-hollows for nesting sites. As older forest trees, in particular, tend to have suitable hollows, their presence in the neighbourhood of colonies is important if the bees are to swarm. These characteristics of meliponine bees form the framework within which changes in their habitat should be assessed. In fact, the characteristics of stingless bees are such that detailed information on their habitats are required, such as the composition of vegetation complexes and the presence and concentration of certain food plants which are important to the bees. The historical sources do not provide this information. In Section 9.6, I shall examine the distribution of a few important food plants in specific vegetation complexes. In the present section, I am concerned with how the landscape has changed in its general aspects and which consequences this has had for meliponiculture.

In very general terms, the impression we have of the Mesoamerican landscape at the time of the Spanish conquest is one of dense tropical forests in which the human inhabitants made clearings for their relatively small settlements and the adjacent agricultural fields. The staple diet of the Mesoamericans appears to have been corn (i.e.

maize), beans and squashes, all three crops having been planted together in the same fields. The basic pattern of agriculture was shifting cultivation. Oviedo informs us:

"[...] and when they wish to sow, they cut down the woods or thickets (because the land where only grass grows is not considered fertile hereabouts, like that of thickets and woods), and after the cutting or clearing is accomplished, they burn, and the ash of the cut material remains, giving a richness to the soil, as if it had been fertilized" (1959: Tomo I, Libro VII, Capitulo I, translated by Wagner 1958: 213).

They would only cut some of the fully grown trees (Terán & Rasmussen 1992: 30). After two or three subsequent planting seasons, the fields were left to lie fallow for several years to allow the natural vegetation to reclaim them and, eventually, to develop into more or less mature forest. By then, the fields had regained their fertility. Shifting agriculture is, above all, a cyclical process. It is also referred to as 'slash and burn' or, in Mesoamerica, *milpa* agriculture. Other, more intensive forms of agriculture were also practised in the region, such as terraced cultivation and irrigation, which made urbanization possible (Drennan 1988; Palerm 1972). However, I shall limit my discourse to shifting cultivation, as this was the system of agriculture practised by the rural dwellers who also bred stingless bees. The system altered the immediate habitat of the bees cultivated in hives by establishing a process whereby vegetation was regenerated. To be able to demonstrate the importance of this aspect (see Section 9), I must first examine the dominant settlement pattern in rural areas and address the issue of access to agricultural land.

For shifting cultivation to be successful, sufficient areas of land suitable for agriculture must be available within easy reach of a settlement to enable all its *milperos* (corn-growers) to re-locate their *milpas* (cornfields) as frequently as is necessary to prevent soil depletion. The inhabitants of pre-Hispanic Mesoamerica only had rights to the produce of the land (i.e. the usufruct); land itself was never regarded as private property. Provided that basic necessities such as water and construction materials were available, families could construct dwellings on land that was not under cultivation and establish *milpas* wherever they wished. At times of the year when there was no harvest from farming, they needed to supplement their diets by hunting wild animals and gathering natural products in the surrounding forest. Because *milpa* agriculture is labour intensive and requires quite a lot of land, it is only compatible with a dispersed settlement pattern. It takes many man-hours to hack a plot of adequate size out of mature forest with a machete and, after the vegetation has been cleared and cultivation starts, the *milpero* needs to visit his plot regularly (see Section 6.3). The *milpero* saves considerable time and energy if the *milpa* is located near to his house. Shifting cultivation in Mesoamerica therefore reinforced two settlement patterns in rural areas: either single houses were built at scattered locations, with much space in between them, or several dwellings were built together in small clusters (Drennan 1988; Farriss 1984; Palerm 1972).[23]

Palerm studied the settlement pattern of a 19th-century village in Veracruz, Mexico. To him, this settlement illustrated perfectly the benefits of the traditional system of shifting cultivation, despite the changes that had taken place after the Spanish conquest (1972: 13). The people created their *milpas* in what is locally known as *monte alto* (high or mature forest):

"According to oral tradition, the territory was occupied by a small number of indigenous families. Their habitations were dispersed, constituting aggregations no larger than those of an extended family [...]. Everyone made his dwelling and his *milpa* wherever he pleased. The occupation [of the territory] could be recognized as a sort of precarious or transitory tenure, for the slash [and burn cultivation] obliged the families to change the location of their *milpas* and, for the comfort of the farmers, the position of the houses" (Palerm 1972: 13, my translation[24]).

Palerm calculated that each family required a minimum of 12 hectares of land suitable for agriculture, of which only one eighth part was cultivated at any one time. In the area studied, once cultivation ceased, it took about 24 years for the secondary vegetation to regenerate into forest. At that point, the cycle was completed; the land had regained its fertility and could again be used for agricultural activities (ibid.: 16). Because of local ecological conditions, the system showed some variation from one area to another. For example, in the temperate mountainous area of Puebla, where people practised agriculture in mainly coniferous forest, shifting cultivation led to regeneration of the vegetation within a considerably shorter fallow period than elsewhere (ibid.). Because cultivation was moved to a new plot every two or three years, the vegetation regenerating in successive former *milpas* was in various stages of development. Hence, in the neighbourhood of settlements, human interaction with the environment in the form of shifting cultivation gave rise to patches of secondary vegetation in different stages of development interspersed among mature forest.

As has already been stated, Wagner (1958: 201- 203) went to the Nicoya peninsula

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[23]Compared to other parts of Mesoamerica, settlement patterns in the Maya lowlands were relatively dispersed (Drennan 1988).

[24]"Según la tradición oral, el territorio estaba ocupado por un pequeño número de familias indígenas. Sus habitaciones estaban dispersas, sin constituir mayores agregados que los de una gran familia [...]. Cada uno hacía su casa y su milpa donde quería. La ocupación se reconocía como una especie precaria de propiedad transitoria, pues la roza obligaba a las familias a cambiar de localización de sus milpas y, para comodidad de los agricultores, la ubicación de las casas."

of Costa Rica in the 1950s and judged meliponiculture to be widespread there. He also described the landscape, reporting that, as one ventured further inland, the deciduous broadleaf vegetation gradually changed from a three- to a two-layered forest and the density of Leguminosae and deciduous species increased. This was, however, not an even progression, the forest physiognomy having been affected by human interference. Stock breeding and other agricultural practices had been introduced to the region, yet the mass influx from the Meseta Central had only just begun. *Milpa* agriculture was common in the Chorotega villages. Wagner describes the variety of the landscape around settlements:

"Within settled areas, the intervention of cattle, fire, and man has so affected the vegetation that it is a confusing mosaic of cultivated patches, introduced pasture grasses, weeds, and secondary successional aggregations at every stage of development from bare earth through scattered cosmopolitan weeds, tangled brush, and single-species 'societies' to forests which may approach equilibrium condition" (Wagner 1958: 204).[25]

Shifting cultivation in the Mesoamerican landscape thus led to a pattern of dispersed settlements surrounded by a highly varied mosaic of vegetation. Since the settlements were small, fallow fields were within flight-range of the bees. It is likely that local differences in ecological conditions engendered quite varied vegetation complexes, implying that the bees of Yucatan did not necessarily find the same food plants in their habitat as their counterparts in Costa Rica did. Furthermore, Spanish colonial rule had a more drastic impact in El Salvador than it did in Yucatan.

Little is known of the pre-conquest vegetation complex in what is now El Salvador, for the Spaniards axed vast areas of forest at a very early stage in the colonization process. Fowler attempted to reconstruct the original complex,[26] estimating that tropical deciduous forest once accounted for as much as 90 per cent of the climax vegetation, while areas higher than 800 to 1,000 metres above sea-level were covered with mixed upland vegetation formations. These included oak-pine forest similar to that of the

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[25]Wagner also records the species commonly cultivated in homesteads, including some nectariferous plants, such as *Anonacea* sp. and the introduced *Citrus* spp. Although he states that some weeds were allowed to grow in homesteads, he makes no reference to patches of shrubby vegetation. *Coccoloba floribunda*, which he identifies as an important food plant for *M. beecheii*, is absent from his homestead record. According to Pittier (1978), this is a tree from the Pacific coast which grows in *matorales* and is commonly known as *Papaturro*.

[26]Fowler based his reconstruction on earlier work by Daugherty, H.E. 1961, 'Man-Induced Ecologic Change in El Salvador', Ph.D. dissertation, University of California, Los Angeles (Ann Arbor: University microfilms).

Montecristo area (Fowler 1989: 71-86; see also Section 1.7.1). When the *conquistadores* arrived from Europe, they found that the lower-lying areas were quite densely settled. Fowler assumes that, in the period immediately prior to the conquest, all of El Salvador was inhabited to varying degrees of density, even though some areas were probably devoid of agriculture. He estimates that at least 60 per cent of western and central El Salvador was inhabited by the Pipil, whose average population was about 460,000 (1989: 149-150). As in other parts of Mesoamerica, the basic subsistence pattern of the original inhabitants was the cultivation of corn (i.e. maize), beans and squashes by means of slash-and-burn techniques with a subsequent fallow period. Around the settlements, therefore, the typical pattern would have been the varied mosaic of vegetation in different stages of development that results from the interaction between traditional agricultural practices and forest complexes, as already described. Because of population pressure, former *milpas* may have lain fallow for shorter periods than in other parts of Mesoamerica, but not to such a degree that the soils became depleted and no longer productive. (That would imply that the regeneration of secondary vegetation, the decisive factor in *milpa* production, had become impossible, which would be tantamount to the collapse of shifting cultivation.) In addition, more intensive forms of agriculture were practised in the area to satisfy local demand for cotton and cacao. The urban centre Cihautan was characterized by extensive man-made terraces, probably used as residential space and for dooryard cultivation of corn and cotton (Fowler 1989: 113). Whereas the vegetation complex at lower levels was thus highly influenced by human settlement and agricultural practices, the upper slopes remained heavily forested and relatively unaffected by man. This is confirmed by colonial descriptions of extensive forests on the slopes of the San Salvador basin, the Tacuba range of coastal mountains, the mountains of 'Cuscutlan', the San Vicente volcano and on the upper slopes of the Santa Ana mountain complex (Fowler 1989; Daugherty 1972).

The pre-Hispanic Maya of Yucatan constructed impressive urban complexes such as those in the Puuc region and at Chichén Itzá. These imposing monuments of the political or religious elite now attract hordes of tourists from all parts of the globe; far less renowned are the countless artifacts of ordinary pre-colonial peasant life on the peninsula. In contrast to the urban areas,[27] the predominant settlement pattern was characterized by small, compact villages comprising multiple residences for as many as

[27]Yucatecan urban centres were more sparsely settled than other Mesoamerican sites (Drennan 1988).

twenty or thirty adults and children (Drennan 1988: 281; Farriss 1984: 134). These family groups lived primarily on crops produced in their *milpas.* As was customary in many parts of Mesoamerica, they slashed a plot out of the forest and burned the vegetation to enrich the soil. After two or three successive years of use, the plot was left fallow. This settlement pattern of *milpero* family-groups endured throughout and even beyond the colonial era.

When the Spaniards arrived, semi-deciduous forest covered most of the peninsula. According to Bishop Landa, the environment was rich in food plants for bees:

> "Great and most notable is the diversity of herbage and flowers that adorn Yucatan in their seasons, in the trees as well as among the plants, and many of them [are] marvellously fine and beautiful and of various colours and fragrances; beyond the adornment with which they attire the forests and fields, these afford over-abundant sustenance to the bees for [making] their honey and wax" (Landa [1556] 1992: 170, my translation[28]).

He describes several trees used by the people for various purposes. One of these is *Nicte* (*Plumeria* sp.), which bears yellow-and-white flowers in season and was accorded a special place in Maya mythology on account of its copious nectar. According to Cortes (Pagden 1972: 18), the Spaniards viewed the area as being rich only in trees and honey. Although the peninsula had much more to offer, at first, the Spanish *conquistadores* had their hearts set on gold and silver. In fact, precious metals proved to be notably absent from El Salvador and Yucatan, yet both areas were relatively well endowed when it came to human resources (Fowler 1989: 131; Farriss 1984). Despite these two similarities, colonial development and its impact on the environment was quite different in the two areas.

2.6 Changes in the beekeepers' environment

Shifting cultivation thus formed the basic subsistence pattern of the indigenous population before and during the early colonial period. As colonial society expanded, it took possession of more and more land and tightened its grip on the indigenous communities. In the process, the relationship between the people and the land

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[28] "Mucha es, y muy de notar, la diversidad de yerbas y flores que a Yucatán ornan en sus tiempos, asi en los árboles como en las yerbas y muchas de ellas a maravilla lindas y hermosas y de diversos colores y olores, las cuales, allende el ornato con que a los montes y campos atavían, dan abundantísimo mantenimiento a las abejitas para su miel y cera."

changed. Shifting cultivation came under increasing pressure, as did the traditional beekeeping practices as a result. This section addresses changes in the human environment, which took very different courses in El Salvador and Yucatan.

2.6.1 Impact on the beekeepers' environment in western El Salvador

Browning (1987) gives a detailed description of agricultural changes and their impact on the landscape from the 16th century onwards. El Salvador being abundant neither in gold nor other minerals, the colonists instead exploited indigenous vegetal resources, in particular, balsam (*Myroxylon pereirae*), cacao (*Theobroma cacao*) and cotton[29], while also introducing indigo (*Indigofera suffruticosa*)[30], cattle breeding and coffee cultivation. Of all these activities, balsam and cacao production were the least severe in their environmental impact. Traditionally, the Pipil cultivated cacao on irrigated fields. The Spanish took over this activity for the purpose of export to Europe, concentrating their operations in the western Salvadoran areas of Santa Ana, Ahauchapan and Izalco. Production of cacao being labour-intensive, the Spaniards forcibly relocated large numbers of indigenous people to the plantations. At the end of the 16th century, the Izalco area was producing more cacao than any other part of the Americas; however, a shortage of manpower forced the Spanish to develop other activities. Balsam was extracted exclusively from wild trees in the coastal zone below Sonsonate and, by the time collection ceased in the 18th century, it had had little impact on the environment. It was cattle breeding and the production of indigo and coffee, combined with population growth (because of the many immigrants), that devastated the environment, mainly by causing massive deforestation, and drastically altered the relationships between people and land.

Cattle breeding became very popular among the Spanish immigrants and quickly assumed considerable proportions. The breeders felled vast areas of forest to create space for pastures and introduced various strains of pasture vegetation. Livestock was allowed to roam freely, trampling the cultivated plots of the indigenous people. The

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[29]Prior to the Spanish conquest, cotton was produced on a small scale in the region (Browning 1987: 370). Spanish commercial production of cotton continued until 1922 (ibid.: 383), by which time vast areas of forest had been destroyed. Cotton was grown on available ranch land and in areas of former *milpa* cultivation. Whereas *milpa* (i.e. shifting) cultivation allowed vegetation to regenerate, cotton production techniques ravished the land and left it unsuitable for traditional slash-and-burn agriculture (ibid.: 395-7).

[30]Prior to the conquest, the indigenous peoples of El Salvador made use of other species of this genus (*I. tinctoria*). *I. suffruticosa*, locally known as *añil*, was not native to the area (Browning 1987: 124).

widespread destruction eventually sparked off a peasants' revolt in San Miguel in 1537-9 and forced up the price of grain in 1541. Cattle breeding and forest clearance continued to expand without any attempt at control. By 1612, the Salvadoran lowlands consisted mainly of pasture-land. At last, in 1637, it was decreed that breeders must keep their cattle off fields and that indigenous farmers could kill intruding livestock with impunity. However, this did not curb production, as is testified by the slaughter of 50,000 head of cattle per year in the 18th century. The effect of cattle breeding on the landscape was permanent: pasture-land could not be turned back into virgin forest (Browning 1987; Daugherty 1972).

Indigo gradually replaced cacao as the main export item. Cultivation of the shrub was concentrated in the areas of San Salvador, San Vicente, San Miguel and, to a lesser degree, Santa Ana. First, forest was slashed and burned and then cattle was introduced into the clearings to break up the soil. The land was used for only three successive years, after which the forest did not regenerate. Moreover, cultivators held areas of land in reserve to insure themselves against disasters, which were frequent with this type of monoculture. Indigo cultivation, like cattle breeding, resulted in the clearance of enormous areas of forest. Widespread production continued for four centuries until about 1880, when it became concentrated in the north, indigo being abandoned in the rest of the country in favour of coffee.

As coffee grows well at altitudes of 400 metres and higher, its production was an incentive to bringing as yet untouched mountain slopes under cultivation. At the turn of the 19th century, coffee was only being grown on a small scale, but production grew rapidly around the mid-century, as coffee plantations expanded in the western areas of Santa Ana, Chalchuapa, Ahauchapan, Santa Tecla and Sonsonate, as well as in San Vicente further to the east. In the last decades of the 19th century, a government consisting mainly of coffee-producers was in a position to make policy in the interests of their own clique, revoking communal land rights in 1881 and abolishing the *ejidos* a year later. In 1897, the government prohibited the use of fire to clear forest, as this endangered the coffee plantations (Browning 1987). The introduction of a real-estate and mortgage register prevented small farmers from establishing formal ownership of land. These reforms stimulated the privatization and amalgamation of plantations, allowing individual coffee-barons to increase their land areas and production volumes. At the same time, they made a great number of indigenous peasants virtually landless and left them scraping a living as *minifundistas* on marginal lands or renting land as sharecroppers (Pelupessy 1995). To counteract the effects of the massive deforestation that had continued in El Salvador ever since colonization, the government decreed that everyone should plant a tree each year on the 3rd of May (Browning 1987: 341-359). Whatever the effect of this measure may have been, most of the original Salvadoran vegetation complex had been destroyed before 1900 (according to Daugherty, cited in Fowler 1989: 81).

As if commercial agriculture were not enough of a strain on the environment, population growth resulted in ever-increasing demand for agricultural and residential land, as well as for timber as a fuel and a construction material. Between 1800 and 1900, El Salvador's total population increased from 175,000 to 775,000 inhabitants, resulting in an average density of 40 persons per square kilometre. By 1972, the population had rocketed to nearly 3,700,000 inhabitants, making El Salvador the most densely populated mainland nation in the western hemisphere, with 185 persons per square kilometer (Daugherty 1972: 274-5). By 1985, population had increased even further, to an estimated 5,235,700 inhabitants (249 per square km.; Encyclopaedia Brittanica) and the number of people living in El Salvador in 1997 was estimated at 5,661,827 (while over one million Salvadorans were living abroad). At the time of writing, forest and woodland have been reduced to only five per cent of the country's land area (Internet: www.odci.gov/cia/ publications/factbook/es.html).

To summarize, then, the abolition of communal land rights allowed commercial enterprises to accumulate vast areas. *Ejido* and village land was distributed to the legal tenants. The changes were eventually to undermine the practice of shifting cultivation in the country. If slash-and-burn cultivation is to be productive, sufficient land suitable for agriculture must be accessible to the villagers. Privatization severely limited the amount of land available to the common farmer and enabled others to accumulate great riches. Of course, slash-and-burn cultivation also requires the presence of forest (whether primary or secondary), yet this has become exceptionally scarce in the Salvadoran landscape. Nowadays, instead of enriching the land with nutrients from the ashes of vegetation, farmers use commercially produced fertilizers to boost productivity. The environment of the traditional beekeeper has changed drastically since the conquest of El Salvador. The remaining five percent of 'original' vegetation is concentrated in the Montecristo and El Impossible forest reserves.

2.6.2 Impact on the beekeepers' environment in Yucatan

Spanish records show colonial society developing along quite different lines on the

Yucatan peninsula. Initially, this was because the settlers there were largely supported by those indigenous communities they controlled, which had to pay material tribute to the Crown and provide labourers. The same system collapsed in other territories as the indigenous peoples declined in the aftermath of the conquest, partly because of pressure from the growing number of foreign immigrants. Although the Yucatecan Maya suffered the same fate, there was sufficient produce from their *milpas*, and other commodities, to sustain colonial society and its exports. Spanish settlers in other areas, driven by shortages, had to organize production themselves: this driving factor was lacking in Yucatan, where resources were plentiful (Farriss 1984). Commercial production therefore developed at a slower pace on the peninsula, and its impact on the landscape, on the environment of the Maya, was relatively restricted. Although the Spaniards there had various commercial incentives, their activities, at least initially, did not drastically alter the subsistence pattern of the greater part of the Maya.

From the arrival of the *conquistadores* to the industrial revolution in Europe, colonial Yucatan's main export commodity was cotton: the Maya grew it in their *milpas*; the Spanish on their plots and ranches. Maya women wove homespun cotton; the *vecinos* demanded a portion of the cloth in tribute. The indigenous communities were also required to provide labourers for crop growing on land held by settlers. By 1862, commercial cotton fields on the peninsula totalled 15,000 acres. However, with the emergence of the textile industry in England and China's entry into the European cotton market, cultivation of the crop in Yucatan declined to a mere 3.3 acres by 1878. Maya subsistence agriculture continued on traditional patterns in and around the villages (García Quintanilla 1990: 151).

The wax that the Spanish rulers took as tribute from the Maya was shipped from Campeche and Sisal, via Veracruz and other colonial ports, to Europe (Calkins 1974: 49, citing evidence in the 'Relaciones Histórico-Geográficas de Yucatán: Relación de Tecauto y Tepacan'). As there are no historical references to the processing of wax in Yucatan, it seems likely that it was exported as a raw material.

The Spanish settlers established cattle ranches (*estancias*) for commercial production in the north-western part of the Yucatan peninsula. As in other Spanish colonies, livestock was allowed to wander freely and ruined *milpa* cultivation in some areas. However, compared to cattle-breeding in territories such as El Salvador, the activity in Yucatan remained on a relatively small scale. Most *estancias* kept a few hundred head of cattle and about a dozen horses and other animals; there were very few *estancias* with one thousand or more cattle (Bracamonte y Sosa 1990: 97-129; Farris 1984: 34). Tenant farmers, or *luneros*, were an integral part of the colonial system, living on the *estancias*, cultivating their own *milpas* and providing the ranch with basic foodstuffs. After the harvest was brought in and before the planting season started, the *milpas* supplied forage for the livestock. Demand for labour in the *estancias* was quite low, and these small-scale operations had relatively little impact on the environment and the subsistence agriculture of the Maya.

Colonial exploitation of dyewood, i.e. *Palo de Tinte* (*Hematoxylum campechianum*), was concentrated in what is now Campeche State and involved logging the wild tree, which grows in seasonally flooded forest and other very humid areas. At first, the English ran the logging camps, which were along the coast, shipping off supplies to the European market. In the mid-18th century, the Spanish expelled the English from the area and took over the business (Farriss 1984: 36). Dyewood was not cultivated, so felling continually shifted to new areas, until the chemical dyes of the 20th century undercut the market and demand dwindled. Limited quantities of other crops, including sugar-cane and henequen, were grown on the peninsula during the colonial era. Sugar-cane production was concentrated around Valladolid, Tekax, Peto, Hopelchen and Sotuta (García Quintanilla 1990: 151-152). Henequen was produced on the *estancias*, but only become an important economic activity after independence.

Cotton, salt, wax and honey, all of which were produced by the Maya, continued to be the leading exports of Yucatan's colonial society. There can be no doubt that commercial crop growing and stock breeding altered the local environment in the areas where they were developed; however, these activities would never affect patterns of indigenous subsistence agriculture to the extent that they did in El Salvador. During the 16th century, the Maya homesteads and villages retained their communal land rights. By law, the Maya could only sell land with the permission of two tiers of administration, the *Republica de los Indios* and the *Republica de Españoles*[31], though in practice the Spanish settlers often flaunted the rules and appropriated large areas. The laws nevertheless had some effect; after all, the colonial government and the Church benefited from and depended on the tribute supplied by the Indians, and to deliver this tribute the Maya needed sufficient land (Patch 1990: 49). The indigenous people in the pacified area under Spanish sovereignty were forced to supply labour and tribute to keep the system going. However, if the burden proved too heavy, they could always flee to the unpacified southern part of the peninsula, which was only nominally under

[31]Spanish Yucatan imposed its administration (*La Republica de Españoles*) on the Maya without completely reorganizing their society. In 1550, the colonial authorities established the *Republica de los Indios* to rule the indigenous population indirectly through a native lord who accepted Spanish sovereignty. The two republics existed in parallel (Dumond 1997: 30; Farriss 1984: 148, 376).

control of the *conquistadores*.[32] There they lived in family groups, beyond the clutches of the colonial tribute system and with access to ample land. They formed small settlements in the forest, on a similar pattern to those of the pre-conquest era (Patch 1990: 61). According to Farriss, at the beginning of the 19th century about two-thirds of the indigenous population were living as independent *milpa* farmers in their own communities, while the eastern part of the peninsula was "scarcely touched". Only in the last few decades before independence did the *haciendas* start to dominate agricultural production (Farriss 1984: 35). Roughly speaking, the area around Valladolid, Tekax, Peto, Hopelchen and Sotuta (in which the present-day *ejidos* of Tihosuco and Tepich are located) formed the frontier zone between the pacified and the unpacified area. By the time Spanish colonial rule ended in Yucatan, and even though the government had long been trying to get the Maya to congregate in 'stable' villages from which tribute could be exacted, most of the people were still living in the unpacified area (Patch 1990: 49). The basis of their subsistence agriculture, as of old, was the production of corn, beans and squashes.

2.6.2.1 Late colonial and post-colonial land reform

In the last quarter of the 18th century, the *haciendas* started to expand rapidly; in the 19th century they were to dominate the colonial economy of Yucatan (Farriss 1984: 35). Around Tihosuco and Tepich, in the zone bordering on the unpacified area, commercial agriculture was introduced at an early stage. Sugar-cane production was concentrated there, reaching its peak in the period from 1825 to 1840. Problems on the international market and the events that culminated in the Caste War eventually caused its decline. Church and civil tax systems forced the indigenous population to provide labour for commercial enterprises, which also preferred to collect supposed 'debts' from the Maya in the form of labour (Rugely 1997: 41). In parts of the frontier zone where the commercial enterprises had no influence, many people still lived in relative independence. In 1838, the *juez de paz* (Justice of the Peace) in Tepich informed

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[32] There was no clear boundary between the pacified and the unpacified area, or 'uninhabited zone', as the Spanish colonists preferred to call the latter. Of course, they were perfectly aware that large numbers of Maya had always lived in that area and that increasing numbers were taking refuge there. The Maya were even accused of 'cultivating poverty' in order to justify their escape. The Spanish did not leave the unpacified area unmolested: several military and ostensibly evangelical expeditions were launched in an attempt to gain control of it. However, these were to no avail and Spanish control remained little more than nominal (Farriss 1984: 16; 72-75).

his superiors that:

"One finds more than two-thirds of the Indians who make up this community living in the midst of the remote forest, [their] houses 4, 6, 10, 15 and 20 leagues one from the other as far as the sea, getting themselves embroiled in the most occult of their idolatries and evading the collection of both the civil and religious contributions" (Patch 1990: 57; my translation[33]).

While families south of the frontier zone supported themselves with produce from their *milpas*, a series of major reforms empowered the *haciendas* to the north to accumulate land, putting the practice of shifting cultivation under increasing pressure. At Cádiz in 1812, a legislative assembly approved a new constitution founded upon liberal Spanish traditions and certain ideals of the French Revolution. This was an important step towards the liberalization of the States. In September 1821, Yucatan was proclaimed independent of Spain (Dumond 1997: 52-55). The Mexican government implemented new land-laws, which posed a definite threat to the indigenous communities. The Constitution of Cádiz facilitated the sale of any land that was neither under cultivation nor property of an *ejido*. A law enacted in 1841 imposed a four-mile limit on the *ejidos*: land at a greater distance from the villages was now in the commercial domain and could be bought and sold. Another law, passed in 1844, required farmers to pay taxes on *milpas* beyond the *ejidos*. Until then, Indian customs had granted individuals only the usufruct of land. The new Mexican legislation privatized the land itself. In effect, the descendants of the *conquistadores* were given free rein to appropriate vast areas at the expense of the Maya communities (Patch 1990).

The 1841 law having facilitated the hoarding of land by *hacienda* owners, the economic basis of the landed estates was transformed. In the latter half of the 19th century, henequen gradually replaced cattle breeding (Bracamonte y Sosa 1990) and was to dominate the economy of Yucatan State until the 1980s (Aguilar & Pérez Cruz 1992). A wave of *hacienda* expansion began around Mérida and along the main road to Campeche, then continued through the hilly region as far as Tekax and Tihosuco, across the Yucatan heartland and northwards to the Tizimin area and the northern part of what is now Quintana Roo State (Antochiw 1997). The privatization of land took place at a time when the Maya population was growing quite rapidly. In Tihosuco, for example, the official population increased from 3,226 inhabitants in

[33]"Más de las dos terceras partes de los indígenas que componen este pueblo, se hallan viviendo en el centro del monte distante 4, 6, 10, 15 y 20 leguas, una casa de la otra hasta la marina, procurando hallarse lo mas oculto que sus idolatrias y evadirse de la solución de ambas contribuciones civil y religiosa."

1806, to 5,595 in 1821 and to 11,322 in 1845 (Rugely 1997: 42). The result, particularly in the north-eastern part of the peninsula, was a shortage of land. Although Patch maintains that this process was not well-documented, he is somehow able to calculate that a total of at least 600,000 hectares was absorbed by the *haciendas*. Many indigenous communities did not even have the four-mile radius of land to which they were legally entitled (Patch 1990: 62, 85). In the northern part of the peninsula, where henequen estates came to dominate the economy, *milperos* were deprived of land to such an extent that many were left with only one option: to work for wages on the henequen estates. Most of the Maya labourers lived on the *haciendas* and became completely dependent upon them. Increasingly, the privatization of land threatened the traditional subsistence pattern of the Maya in the northern part of the peninsula. To the south, though, people continued to live relatively unfettered by state affairs and taxes. Because the Maya settlements there were so widely scattered, the authorities were unable to collect the taxes pursuant to the land law of 1844 (Patch 1990: 58). However, the confiscation of indigenous communal lands in the northern part of the peninsula ultimately became an important factor in the unrest that, in 1847, led to the eruption of the Caste War in the frontier zone.

2.6.2.2 The Caste War

At the time of the Caste War, the Yucatan peninsula was not homogeneously controlled by the political and religious *vecinos*. The indigenous communities in the 'old colonial region', i.e. the pacified area, were the most intimately incorporated into the civil, political and religious regime, and offered the least resistance to external domination. In the central part of the peninsula, civil and church taxes led to an increase in the number of debt peons, while the population expanded rapidly. There, the absorption of land into the commercial estates was the most substantial and the potential for rebellion logically the greatest; yet, according to Dumond, the rebellion that culminated in the Caste War took hold among independent subsistence farmers:

> "[The] question of loyalty to *vecino* landowners was almost non-existent among independent *campesinos* -Indians and poor *vecinos*- who also found themselves responsible for their own taxes, unlike debt peons or *hacienda* servants for whom the landowner usually paid. Taxation, both church and civil, struck hard at the meager yield of their subsistence endeavors. It was the freedom from complex obligations to the Yucatecan system that also made them the most free to join the armed forces when the call went out from leaders [...]" (Dumond 1997: 137).

First there was the Maya revolt of 1847, to which the mestizo army responded by executing a Maya *cacique* (headman). The avenging Maya leaders Cecilio Chi and Jacinto Pat then attacked the village of Tepich with their own forces, which provoked the *mestizo* army to liquidate Maya in the village (Antochiw 1997). In the Caste War, both the rebels and the *mestizo* army had a series of successes and setbacks. Rebel coherence and unity was at its peak in the period from 1853 to 1870, which saw the emergence of the religious cult of the 'Talking Cross'. A Maya general, Venancio Puc, declared himself God's messenger through the medium of the Talking Cross and attracted a large following of rebels, known as the *Cruzob* (literally: 'The Crosses'). From his base at Noh Cah Santa Cruz (now Felipe Carrillo Puerto), he successfully led the Maya rebels through the ensuing years of war until 1863, when he was killed in a leadership struggle by one of his own generals. Two other centres of secular and religious power, one in Tulum and the other in San Antonio Muyil, also played an increasingly important role in the rebellion, though never to the same extent as Noh Cah Santa Cruz (Dumond 1997: 406-426). Beset by a series of natural disasters such as droughts, hurricanes, diseases and even plagues, the *Cruzob* gradually declined in strength. At the turn of the century, General Bravo marched an army equipped with modern weapons against the Maya. In May 1901, he and his troops entered Noh Cah Santa Cruz, the bastion of the Talking Cross. Thereafter, General Bravo administered the Territory of Quintana Roo (established in 1902) until 1912, when he was replaced (Antochiw 1997).

2.6.2.3 *Ejido* organization in the Maya Zone of Quintana Roo

The Territory of Quintana Roo was established in 1902 and granted a form of nominal autonomy (Dumond 1997: 426). The *Cruzob* inhabitants of the central part of Quintana Roo, also known as the Maya Zone, continued to live by traditional methods of subsistence agriculture. The new Territory remained relatively isolated, and the area inhabited by the *Cruzob* was often excluded from official statistics. Uncertainty as to the Territory's political status and destiny ended in 1974, when it became the Federal State of Quintana Roo (Dachary & Arnaiz Burne 1984: 48). The State is divided into seven administrative districts, the *Cruzob* area lying in the districts of Felipe Carrillo Puerto and Jose Maria Morelos. A vast majority of the people there still speak Maya and perform traditional Maya ceremonies. In contrast to the situation in other districts of the State, the basic pattern of subsistence is shifting cultivation in maize fields, or *milpas* (see Section 6.3). The inhabitants of the Maya Zone, organized in *ejidos*, enjoy communal rights to land.

The contemporary land-tenure system of the communal *ejidos* is enshrined in Article 27 of the Mexican Constitution (1917), which provides for the redistribution of land to the communities. In the first few years after its coming into force, however, land reform was not given priority by the government. In the State of Yucatan, the henequen *haciendas* still held most of the land. In the Territory of Quintana Roo, contracts and concessions distributed the usufruct of land and forest to eleven commercial enterprises, most of them foreign (Dachary & Arnaiz Burne 1983: 63). A crisis struck the henequen industry in 1916, causing a decline in the number and size of the estates. The first extensive land reforms in Yucatan took place under the government of Felipe Carrillo Puerto (1922-1924), 665,000 hectares of public land being returned to communities (Baños Ramírez 1989: 92). In the ensuing years until 1933, an additional 264,829 hectares was redistributed. Since these reforms only applied to public land, the hegemony of the landed estates was unaffected. President Lazaro Cardenas (1934-40) made agrarian reforms a priority. The *Banco Nacional de Crédito Agrícola* was founded to support the measures and to extend credits to the *ejidatarios*. These reforms also affected the henequen estates and, in 1937, some 100,000 hectares were transferred to about 185 *ejidos*. By 1940, 247 *ejidos* in the State of Yucatan were supplying 61 per cent of the total henequen production, while around 80 per cent of the land held by the *ejidos* in the henequen zone was being used for *milpa* production (Baños Ramírez 1989: 99-111).

Land reforms in Quintana Roo coincided with the international crisis (Great Depression) of the thirties, which affected the commercial enterprises. The estates of larger landowners were expropriated (Dachary & Arnaiz Burne 1983: 59). The first *ejidos* were established in 1928, the process was accelerated in 1936, and new *ejidos* continued to be established and existing ones enlarged until the eighties. In 1981, there were 234 *ejidos* in Quintana Roo (ibid.: 96). In 1982, the district of Felipe Carrillo Puerto had fifty *ejidos* and 4,253 *ejidatarios* with a total area of 849,680 hectares (ibid.: 117). The *ejidos* in the Maya Zone are principally based on *milpa* production.

The *ejidos* consist of communal land. The governing body of the *ejido* is the *asamblea general*, in which every *ejidatario* has a seat. The executive consists of a *delegado* who is elected every three years, a commissioner and a board of supervision. Article 27 of the Mexican Constitution was amended in 1992 and 1993, enabling the government to start its programme of certification of *ejido* rights and titling of urban plots (PROCEDE). Previously, *ejido* land was government property and the *ejidatarios* only had usufruct. Now, *ejido* land is the property of those *ejidatarios* who are signatories to the programme (INEGI 1994). Accordingly, they can legally sell, rent, sharecrop or mortgage their land parcels. In addition, they can transfer *ejido* land to private companies or establish a joint venture for a period of up to 30 years (Jones 1996; Austin 1994).[34] The *ejidos* of Tepich and Xmaben have joined PROCEDE, even though their members cannot foresee the consequences of the legal reforms. The *ejidos* have been delimitated under supervision of INEGI (National Institute of Statistics, Geography and Information Science) and both *ejidos* have ruled that their urban or village plots are property of individual *ejidatarios*. Otherwise, the *ejidos* operate as before. When an *ejidatario* wishes to start a new *milpa*, he lays claim to a parcel within the *ejido* boundaries, his choice being subject to approval by democratic consensus of the other *ejidatarios* at a subsequent meeting of the *asamblea general*, which also settles other issues in the *ejido*. To date, the new agrarian legislation has not led to major changes in either Tepich or Xmaben.

2.7 Conclusions

Early colonial reports indicate that stingless bees cultivated on the Yucatan peninsula produced far more honey than those kept in other parts of southern Mesoamerica. In addition, the Yucatecan meliponaries were much larger than those elsewhere: the peninsula's inhabitants built special bee-houses accommodating hundreds of hives, whereas people in other areas generally hung relatively small numbers of hives from the eaves of their dwellings. Prior to the Spanish conquest, honey and wax produced by stingless bees were apparently exported from Yucatan to other parts of Mesoamerica; during the colonial era, these products were shipped off to Europe. However, the more impressive production on the peninsula does not appear to have been attained by cultivating an inherently more productive species of stingless bee, for we can infer from historical sources that *M. beecheii* was cultivated in many parts of

[34]Jones, however, points out that the reforms are confusing: on the one hand, "the *ejido* is property of the *ejidatarios*, and to them fall the decisions about its management"; on the other hand, "the *Ley Agraria* establishes the *Asamblea* 'not as principal authority in the initiative but as organs of representation and execution' [...]. Having established the *ejido* as property of the *ejidatarios* with autonomy to control internal affairs democratically, the new agrarian law sets about removing this autonomy and the *Nueva Ley de Asentamientos Humanos* [...] re-establishes that all land in Mexico is subservient to the nation and subject to State control. This allows the State to circumscribe the autonomy of the *ejido* by a host of rules and regulations which permit intervention" (Jones 1996: 194).

Mesoamerica, as were several other species. Unfortunately, the sources provide little information on methods of meliponiculture, so we only know how and where the bees were housed and how the honey was extracted. The 'bee-pages' (103b and 104b) of the pre-colonial Madrid Codex suggest that Maya beekeepers knew how to create daughter-colonies by dividing the brood. Today, the world's highest concentration of commercial honeybee colonies is in Yucatan, supplying 30 to 40 per cent of Mexico's total honey production, a significant contribution to the country's position as the fourth largest honey-producer in the world. The high carrying-capacity and productivity of those modern hives is probably due to the peninsula's favourable climate and abundant floral resources. This implies that the recent decline of meliponiculture cannot be attributed solely to environmental factors.

After the conquest, the indigenous people continued to breed stingless bees in some regions, but the colonial settlers demanded honey and wax from them as tribute. Then, as the colonial authorities shifted the emphasis to wax, which is only produced in limited quantities by stingless bees, increasing pressure was put on wild colonies in the forest, presumably resulting in the destruction of countless wild nests. As the history of El Salvador testifies in particular, colonial society was directed at rapid exploitation of the environment rather than its sustainable use. This policy led to drastic changes in the habitat of the bees and to the agricultural practices of many indigenous farmers, whose predominant mode of subsistence was shifting cultivation in *milpas*. This form of agriculture engenders a pattern of dispersed settlements, with wide spacing between individual dwellings or small communities of family groups. Shifting cultivation on plots hacked out of the forest in the vicinity of the settlements produced a mosaic of various patches of secondary vegetation interspersed among mature forest. Stingless bees having a flight-range of less then one kilometre (see also Section 9 and Appendix I), this pattern of vegetation determined the foraging and swarming behaviour of the domesticated colonies accommodated in bee-logs suspended from the eaves of houses or closely packed in bee-houses. There are no historical indications that keepers of stingless bees outside Yucatan knew how to multiply colonies by dividing the brood. Several meliponine species, including *M. beecheii*, nest in tree-hollows, which mostly develop as trees reach full maturity. As the forest was close at hand and the *milperos* spared at least some of the older trees from felling, we can assume that there were sufficient hollows within reach of the cultivated colonies for the bees to be able to swarm naturally. To summarize, then, the practice of shifting cultivation would appear to have afforded a perfectly suitable habitat for stingless bees.

Under colonial rule, many *milperos* were forced to change their farming methods.

Whereas Spanish society in El Salvador was, from the outset, almost entirely based on wholesale exploitation of the environment, the colonists in Yucatan depended to a large extent upon tribute paid by the local Maya, but also undertook limited commercial activities. In both regions, large areas were deforested for commercial agriculture and some land was absorbed into the colonial estates. However, the colonial society in Yucatan had significantly less impact on the indigenous population than its counterpart in El Salvador. In Yucatan, most of the people were able to flee from land pressure, the tribute system and 'debt' peonage in the north to the forest in the southern part of the peninsula, where they lived and cultivated their *milpas* in relative freedom from the colonial *vecinos*. Indeed, it was among those less fettered people that the seeds of rebellion were sown. In El Salvador, in sharp contrast, there was no escape from colonial control, so the basic mode of subsistence, shifting cultivation, came under greater pressure from commercial agriculture. At a time when the Spaniards of Yucatan were becoming embroiled in the Caste War, their fellows in El Salvador abolished communal land rights and enforced privatization, leaving many indigenous farmers landless. Those fortunate enough to own a plot continued to grow corn, beans and squashes, though under circumstances very different to those they were accustomed to and preferred: they now had to cultivate the same piece of land continuously. Shifting cultivation having become impossible, their agricultural practices no longer resulted in the traditional mosaic comprising patches of secondary vegetation in various stages of development. The consequences for stingless bees of so drastic a change to the landscape are discussed further in Section 9. In the Maya Zone of Quintana Roo, on the other hand, the legacy of the Mexican revolution is that people live in *ejidos* where they enjoy communal ownership of land. To this day, they practise shifting slash-and-burn agriculture just as their ancestors did.

The introduction of foreign bee species to tropical America has had far-reaching consequences for both native bees and native vegetation. Restricting the discussion here to bees and, in particular, to their breeding, how did the introduction of European honeybees (*A. mellifera*) and their subsequent Africanization affect traditional meliponiculture? Honeybees being more productive and apiculture being technologically more developed, many people abandoned the stingless species for commercial reasons. Not surprisingly, the few available sources reveal that, initially, apiculture was mainly practised by the non-indigenous population and spread very slowly among the indigenous peoples. The Kekchi of Guatemala had gone into apiculture by the turn of this century, whereas meliponiculture on the Nicoya and Yucatan peninsulas was not even partially supplanted until the 1950s. In the past few decades, however, apiculture has become increasingly prevalent in both areas. In theory, if colonies of *A. mellifera* are located within the flight-range of *M. beecheii*, the two species must compete for the same floral resources. The food plants from which *A. mellifera* is known to collect include species visited by *M. beecheii* (see Appendix I). Africanized bees do not cross-breed with meliponine species, and by the time the former came on the scene, cultivated colonies of *M. beecheii* were already facing competition from European honeybees. Nonetheless, Africanization has not had entirely negative consequences for meliponiculture. In areas where people have had little or no access to information on how to handle Africanized bees, many beekeepers have abandoned apiculture, indirectly reducing competition between the two species. In addition, the fact that meliponine bees do not have a functional sting has become an even stronger point in their favour. In areas where the people have been well informed, on the other hand, the total number of apiculturalists has not declined. In fact, because the Africanized bees swarm more frequently than all others, increasing numbers of people have been able to capture a swarm and start breeding colonies. So human behaviour must be taken into account if we are to understand properly how the Africanization of *A. mellifera* has affected meliponiculture. The human factor is discussed further in Section 9.

3 Meliponiculture in El Salvador

When the Spanish conquered what is now known as El Salvador, they found that people in many parts of the new territory cultivated stingless (meliponine) bees, which were native to the extensive forests. One such area was Sonsonate, on the low coastal plain. Now, in sharp contrast, the landscape there is dominated by large, open pastures with scanty floral resources: hardly a favourable environment for the keeping of stingless bees (meliponiculture). Indeed, during my fieldwork in that area, almost every time I inquired about the most important native bee species traditionally kept in hollow logs around the house - *Melipona beecheii*, commonly known as *Jicotes* - people would wistfully reply: "*Ah si, los Jicotes ... ya no hay!*" ("Oh yes, the *Jicotes* ... there are none left!"). I came to expect this standard answer, but eventually discovered that some people still kept a few logs of the bees. The reason why people are generally so negative is that they compare the present lamentable situation to bygone days, still in living memory, when the native bees were kept in greater numbers. Further to the north, meliponiculture is still widely practised around the Montecristo Nature Reserve, a forested mountainous area which falls under the departments of Santa Ana and Chalatenango (see Map 2, Section 1.7.1). I visited that area for some months, staying in the villages of El Brujo and El Limo. I also spent a few weeks in the village of La Criba, situated in a much lower-lying and therefore ecologically very different area (see Section 1.7.1). There, meliponiculture is not as extensive as in the Montecristo region, though in almost all the villages one or two beekeepers still keep stingless bees.

While deforestation is certainly a key factor in the recent decline of Salvadoran meliponiculture, it cannot be ruled out that the beekeepers themselves may be exacerbating the situation through their traditional practices. Therefore, the main aim of this section is to examine methods of keeping stingless bees - especially *el Jicote* - and to assess their profitability and other, non-financial benefits. What exactly motivates the beekeepers to continue trying to cultivate these 'delicate' bees, when they know full well that the European honeybee *Apis mellifera* is far more productive? Are the prevalent meliponicultural practices sustainable in the present, seriously degraded environment? How do the people themselves explain the decline of meliponiculture? While attempting to answer these questions in this section, I raise a number of issues whose full significance only becomes apparent at a later stage in this dissertation, when I compare contemporary meliponicultural practices in El Salvador with those on the Yucatan peninsula of Mexico. In this section, I focus on the stingless species that are cultivated or from which honey and wax is collected in the wild, the details of the beekeeping and collection practices, and the current yield of *M. beecheii* colonies.

I am less concerned here with a cognitive system that governs and is partly derived from beekeeping practices. This is not by choice, rather by force of circumstances: indeed, it proved impossible to find a coherent cognitive system among the communities of La Criba, El Limo and El Brujo, which are extremely heterogenous in the cultural sense. The people of La Criba are most probably of Nahua origin. Most of the villagers have recently been converted to Protestantism and tend to reject ideas that do not fit into that doctrine, including the traditional beliefs and practices handed down from generation to generation. El Brujo and El Limo are relatively new settlements. El Brujo was founded by four Guatemalan families of unknown provenance. The vast majority of the villagers are their descendants. Other scions of the founding families went to live in El Limo. That village expanded as it absorbed migrants driven from western El Salvador by a shortage of agricultural land. Most of the inhabitants of El Brujo and El Limo are Catholics: only a small proportion have become Protestantists. The Salvadoran beekeepers who are the subject of this study are thus anything but homogeneous in their cultural background. Furthermore, it soon became obvious during my fieldwork that the cognitive system in which traditional beekeeping would normally be incorporated had become seriously fragmented during the past few decades; in such a culturally heterogeneous context, it proved impossible to correlate and piece together the disparate aspects of whatever remained. However, a few concepts turned out to be highly consistent, and those that are closely related to beekeeping practices and the use of bee-products are briefly described in this section.

3.1 Stingless bee species: their classification and uses

If you ask people in western El Salvador about *los Jicotes*, many will understand that you are searching for stingless bees in general. Strictly speaking, however, the name refers to a single species, the renowned and greatly valued *M. beecheii*. In El Salvador, as in neighbouring countries, dozens of distinct species of stingless bees occur in the wild. The people put certain species, particularly those that are useful to them in some way, into specific categories. The classification may conveniently provide relevant information about certain aspects of the bees. For example, species that belong to the category of *Chumelos* are inoffensive little bees that produce small quantities of honey, which is likely to have medicinal properties. Nowadays, in fact, two classification systems are used in parallel: one based on the quality and accessibility of the honey; the other on the bees' habitat and observable biological characteristics.

Firstly, stingless species are ranked according to the quality and accessibility of their honey. Most esteemed are the species whose honey or other products are used for medicinal purposes: *Jicote* or *Colmena Grande* (*M. beecheii*); *Tensuque* (*Melipona yucatanica*); *Miel de Talnete* (*Geotrigona* sp.); *Chumelo* (*Tetragonisca angustula*) and *Tamaga* (*Cephalotrigona capitata*). Of second rank are the species whose honey is considered suitable for human consumption but is not ascribed medicinal properties: *Magua Alazan* (*Scaptotrigona pectoralis*); *Magua Negra* (*Scaptotrigona bipunctata*); *Omo* (*Trigona nigerrima*); *Alazana* (*Trigona fulviventris*); *Mandinga* (also *Trigona fulviventris*); *Chumelon* (*Tetragona dorsalis* Ziegleri) and *Zarquita* (*Plebeia* sp.). The least favoured species are those whose honey is considered to be distasteful or even harmful, and those who may produce edible honey but are disliked for their aggressive defence of the nest: *Cushushu* (actually two species - *Partamona* aff. *cupira* and *Trigona fuscipennis*); *Culo de Buey* (*Trigona fuscipennis*); *Culo de Chucho* (*Partamona nigrior*); *Chichivo* (*Plebeia* sp.); *Maltatía* (*Oxytrigona* sp.) and *Limoncillo* (*Lestrimelitta* sp.).

Classification according to habitat or biological characteristics gives very different groupings. The stingless bees are associated with certain types of soil and climate. As the differentiation of climatic zones in El Salvador is mainly a function of height above sea-level, some of the species are restricted to areas which lie within a certain altitude band, while others are more widespread. To distinguish the habitat preferences of the species, the beekeepers use the terms 'savannah', 'fertile ground' (*tierra fértile*), 'lime ground', and 'wild ground' ('*tierra rústica*'). The meaning of 'savannah' here does not correspond to the scientific understanding of it (i.e. "tropical grasslands, often with scattered trees" - Chapman & Reiss 1992: 218); rather, the beekeepers in the three villages studied use the term to refer to lower-lying land with a warmer climate than they are accustomed to in their area. This means that a beekeeper of El Brujo valley will categorize a stingless species that occurs in La Criba as 'a bee of the savannah'. When a beekeeper in La Criba uses the term, he is referring to El Salvador's warm coastal plains, such as the Sonsonate region where meliponiculture has dwindled to insignificance. When speaking of the habitat of stingless species, the beekeepers of La Criba tend to make more use of the terms *tierra fértile* and *tierra rústica*. The former is agricultural land bordered by small patches of forest; the latter is uncultivated forest land near the village. The forest itself is known as *machoral*, which signifies a forest of small pine trees, with many fallen trunks and much vegetation between the trees. 'Lime ground' (*cerro de cal* - literally 'mountain of lime'), which has many cavities, mainly occurs in some areas around Montecristo. The biological characteristics that the beekeepers use to compare and classify stingless bees are morphological aspects, the structure of the nest, and defensive behaviour.

To sum up: whereas the first classification is an indication of the quality and accessibility of the honey (and, as described below, the risk associated with collecting or consuming it), the second system gives a rough idea of where the species in question can be found and what it looks like. What follows is a description of the individual species from the beekeepers' perspective and according to their systems of classification. The information is summarized in Table 3.1.

3.1.1 Bees that produce 'white' honey: *Jicote* and *Tensuque*

M. beecheii and *M. yucatanica* are said to produce 'white' honey. Actually, the honey is of a transparent yellowish tint. *M. beecheii* is by far the most commonly cultivated stingless species in El Salvador. The people of El Brujo and El Limo and the surrounding area call this species *Colmena Grande* (Great Hive), whereas in a region stretching from the Nicoya peninsula of Costa Rica more or less to the area of La Criba, it is known as *Jicote*. This name is probably a corrupted form of the original Nahua word for bee, *xicôtl(i)*[1], the Pipil rendering of which is *xikuh* (Campbell 1985). In this section of the dissertation, *M. beecheii* are generally referred to as *Jicotes*. In the *machoral* around La Criba and in the cloud forest of the Montecristo area, this species typically dwells in tree-hollows, although it may occasionally be found in underground nests in the latter area. It must be stressed that such nesting behaviour is very unusual for this species and has never been reported in other areas. Because the Montecristo area is so high (mean altitude approx. 1600 metres above sea-level), its climate is relatively chilly, windy and rainy. According to the local beekeepers, underground nests are warmer than those in tree-hollows, which seems logical and would explain

[1]Prof. R.A.M. van Zantwijk translated the Nahua names of bees that appear in this section. Note that the 'x' is pronounced as the modern Spanish 'j'.

Table 3.1: Stingless bee species of El Salvador

Scientific name (*)	Collection number	Common name	Translation
Melipona beecheii (Dew Makhan)	17***	*Colmena Grande*	Great Hive
	17***	*Jicote*	(*Xicot(l)*) Bee
Melipona yucatanica (Roubik '94)	1112	*Tensuque*	Lip-biter **
Tetragonisca angustula (Dew Makhan)	1002	*Chumelo*	Lazybone
	1002	*Doncella*	Little Maiden
Geotrigona acapulconis (Roubik '94)	1003	*Miel de Talnete*	Honey of the Warm Ground
Cephalotrigona capitata	not collected	*Tamaga*	Giver - Punisher **
Scaptotrigona bipunctata (Dew Makhan)	1008	*Magua Negra*	Possessor of the hand, Grease, Oil **
Scaptotrigona pectoralis (Dew Makhan)	1009	*Magua Alezan*	Possessor of the hand, Grease, Oil **
Trigona fulviventris (A. Ortiz '95)	1001	*Alezana*	Gold Fox
Trigona fulviventris (A. Ortiz '95)	1004	*Mandinga*	
Trigona fuscipennis (A. Ortiz '95)	14***	*Cushushu del Talchinol*	Beverage of the *Talchinol*
Trigona fuscipennis (A. Ortiz '95)	11***	*Culo de Buey*	Ox's Arse
Trigona nigerrima (A. Ortiz '95)	1006/1007	*Omo*	Bony **
Plebeia sp. (Dew Makhan)	18/19***	*Zarquita*	
	not collected	*Congo*	
Pleibeia sp. (Dew Makhan)	1107	*Chichivo*	Sucker **
(probably *Plebeia*)	not collected	*Boca de Sapo*	Mouth of the Toad
Partamona aff .*cupira* (A. Ortiz '95)	1108	*Cushushu (del Arbol)*	Beverage (of the tree)
Tetragona dorsalis Ziegleri (A. Ortiz '95)	1109	*Chumelon*	Big Lazybones
Oxytrigona sp. (Dew Makhan)	1110	*Maltatia*	
	not collected	*Amona*	
Partamona nigrior (A. Ortiz '95)	16***	*Culo de Chucho*	Dog's Arse
Lestrimelitta sp.	not collected	*Limoncillo*	Little Lemon

* The person who identified the species
** Translation Prof. R.A.M. van Zantwijk
*** These species were not given a collection number at the Bee Research Department, Utrecht University

this abnormal habitat preference.[2] *M. yucatanica*, locally known as *Tensuque* (Lip-biter), is smaller than *M. beecheii*, though the two species are very similar in morphological characteristics. Rather than defending its nest, *M. yucatanica* tends to take refuge in it at the slightest hint of danger. This behaviour may explain the common name, for lip-biting is a sign of fear or nervousness in humans. These bees have certainly never been observed to bite the lips of human assailants! A 'savannah' species, *Tensuque* occurs in the La Criba area, though in very limited numbers nowadays. It has not been reported in the Montecristo forest reserve.

To keepers of stingless bees, the *Jicote* is very special. The honey it produces has countless uses as a traditional medicine and its wax is used for personal protection against evil spirits and black magic (see Section 3.8.2). According to some Catholic beekeepers, these bees are blessed:

"They pray every night, blessing the Great Hive. At dusk, the bees pray like good Catholics, you can hear them even when you are inside the house. The bees pray just like people. Saturday is their rest day. It's the day the Lord set aside for relaxation. The bees rest and wait for God's blessing before going back to work. The hive is blessed" (Don Julio, El Brujo).

In La Criba, where most people are Protestantists, the beekeepers do not agree with such statements, though the idea is fairly widespread among Catholics in El Brujo and El Limo. In general, the *Jicote* is considered to be 'a very well-mannered bee' (*una abeja bien educada*). As becomes apparent below, the species is thought to have a very delicate disposition and must be treated according to certain principles by Protestantists and Catholics alike.

3.1.2 *Tamaga*

The black bee *Tamaga* (*Cephalotrigona capitata*) lives in hollows in trees. The species

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[2]Schwarz has established that: "To work actively within the [stingless bees'] nest a temperature of 30 degrees Celcius is desirable; at 25 degrees Celcius the activities of the bees are already susceptible to a notable decline. Drory found that at 18 degrees Celcius the stingless bees would fly forth only in very small number, at 15 degrees [Celcius] not at all, while 10 degrees [Celcius] was fatal to them. On the other hand, the higher the temperatures [...], the more lively they became, the more they worked the happier they seemed to be" (1948: 166). Dixon concluded from this that their altitude limit must lie between 1100 and 1700 metres above sea-level (1988: 48). According to local beekeepers, however, stingless bees occur above 1700 metres in the Montecristo reserve. Schwarz' observations do indicate, though, that the activities of stingless bees are seriously limited by temperature at such high altitudes (for climate details: see Section 1.7.1).

occurs at a wide range of altitudes and is found both in La Criba and in the Montecristo area. The beekeepers say that it prefers the same habitat as the *Jicote* and that the two species sometimes nest in the same trees, albeit in separate hollows. The honey of *Tamaga* is not as highly prized as *Jicote* honey, for although it is edible it has no medicinal applications. *Tamaga*, however, does have a very useful speciality: it stores in the hive a lightweight, solid mass of what are probably digested pollen grains (see Appendix I). This material is much used by women for its curative properties. The species' common name is of Nahua origin and means 'giver-punisher'. This may be explained by the fact that, although the bees provide humans with important medicines, they tend to defend their nests rather aggressively.

3.1.3 *Miel de Talnete*

Another black bee, the *Talnete* (*Geotrigona* sp., probably *acapulconis*), is greatly valued for its honey. This species is most commonly referred to as *Miel de Talnete*, a Pipil-Spanish compound which can be interpreted as 'Honey of the Warm Ground' (*miel* is Spanish for 'honey'; the Pipil word *talnex* means 'warm ground' - Campbell 1985). This species, which builds underground nests to a maximum depth of two metres, is said to prefer 'lime ground', such as in the Montecristo area, and what is locally known as 'warm ground' (open spots where the sun shines on the ground) in La Criba. *Talnete* also occurs in the 'wild ground' of the *machoral*, where it is very difficult to detect. The nest is distinguished by its entrance tube, which protrudes about two centimetres above the ground and is camouflaged by dry leaves in the *machoral*. The species is not particularly aggressive; if the colony is in danger, no bee will leave or enter the nest. Although the honey is greatly valued, this can hardly be due to its flavour, for people say that when it is exposed to the air, a chemical reaction turns it acidic.[3] The honey does, however, have curative properties.

3.1.4 *Chumelos*

Chumelos is a generic term for several stingless species, none of them longer than a few

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[3]So far as I have been able to ascertain, there are no scientific references to such a peculiar property of this type of honey.

millimetres. The group is named after the most important species among them: *Chumelo*, which may be translated as 'Lazybones' (*Tetragonisca angustula*). This name reflects the bees' very low honey production of about 0.25 litres per hive per annum. Some people call this particular species *Doncella* ('Little Maiden'), though others maintain that *Doncella* is another species, smaller than, but very similar to, *Chumelo*. Be that as it may, bees given these names have elongated, ruddy-brown bodies. They live in small colonies accommodated in little nests which may be found in almost any kind of cavity, including tree-hollows, calabashes, empty tins, spaces between fence-boards and between the chipboard panels of doors, and even holes in the ground. As they are not at all selective about nest sites, it is literally childs' play to keep them. Indeed, they are often used to introduce children to the noble and ancient art of beekeeping. The nest-entrance consists of a small, almost transparent wax tube, which the bees close at dusk and open when the air temperature rises in the morning or the sun shines on the nest and warms it. Typically, a small cloud of soldier bees hover around the entrance in the daytime to guard the colony. Whereas many small stingless species take cover in their nests as soon as they sense danger, *Chumelos* frantically defend their nests by biting into the hair, eyelids or any other accessible protrusions of the attacker.

Although the two species known as *Zarquita* and *Congo* (*Plebeia* spp.), as well as a third called *Boca de Sapo* ('Mouth of the Toad', which was not collected and must therefore remain unidentified), are classified as *Chumelos* on account of their body size, beekeepers recognize that, in other respects, they are very different to the definitive *Chumelo*. They are black bees that do not aggressively defend their colonies: if they sense anything unusual, they tend to lurk in the nest for hours. Their honey is not used for medicinal purposes. Although adults may occasionally harvest honey from a wild colony of one of these three species, they generally use them - like the definitive *Chumelo* - only to instruct children in beekeeping. The beekeepers say that these species 'escape' from captivity less frequently than, for example, *Jicote* and *Tamaga*. They produce little honey, though *Zarquita* and *Congo* are quite abundant. Like *Chumelo*, they are not very selective about nest sites.

3.1.5 *Maguas*

Magua - meaning 'Grease', 'Oil' or 'Possessor of the Hand' - refers to two species that secrete a strongly smelling pheromone (a chemical signal-compound secreted by an animal for detection and behavioural response by another individual of the same species). This substance sticks to one's hands and gives a distinct flavour to the honey, which some people like and others find extremely distasteful. The two species are: *Magua Negra* (*Scaptotrigona bipunctata*), a black bee, as the name suggests; and *Magua Alazan* (*Scaptotrigona pectoralis*), also known simply as *Alazana*, 'Gold Fox', probably because its body is yellowish brown (Campbell 1985). These species dwell in tree-hollows in the Montecristo forest area. The beekeepers in the lower-lying village of La Criba are not familiar with these bees. In defence, they tend to buzz around the attacker's head and try to bite him or her. This behaviour is quite harmless to humans, though it can be rather annoying.

3.1.6 *Alazana*, *Mandinga* and *Chumelon*

Although these bees are not collectively set apart from the other stingless species, as is the case with the *Maguas*, beekeepers do say that they are alike. The only apparent difference between *Alazana* (not to be confused with *Scaptotrigona pectoralis*, described above) and *Mandinga* (both *Trigona fulviventris*[4]) is the location of their nests: *Alazana* lives in tree-hollows and *Mandinga* in underground cavities, preferably beneath stones or tree roots. In La Criba, *Mandinga* even dwells in 'fertile ground'. The entrance tube of *Trigona fulviventris* is about four centimetres in diameter and partly visible, protruding some eight centimetres from the tree or soil. *Chumelon* (*Tetragona dorsalis* Ziegleri), with its elongated, ruddy-brown body, looks rather like a larger version of *Chumelo* ('Lazybones' - *Tetragonisca angustula* - described above) and this morphological similarity explains its name, which may be translated as 'Big Lazybones'. In other respects, however, the species is more akin to *Alazana* and *Mandinga* (*Trigona fulviventris*): all three bees (i.e. both species) produce about one litre of honey per hive per annum, live in relatively large colonies and are similar in body size. *Chumelon* dwells in hollows in the lower part of tree trunks and in underground cavities. The visible part of its entrance tube is approximately one and a half centimetres in diameter and four centimetres long. Specimens of *Alazana*,

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[4]This was confirmed by subsequent examination of the specimens that I collected in the *machoral* with Don Felipe, a local beekeeper. The bees were positively identified as members of the same species by *Licenciado* Ortiz (*Centro de Investigaciones Apícolas Tropicales*, Universidad Nacional, Heredia, Costa Rica) when he visited Utrecht University. Beekeepers occasionally confuse species: in this case, Don Felipe seems to have erroneously given two different common names to the same species.

Mandinga and *Chumelon* were collected in La Criba. In defence, these bees tend to buzz around the attacker's head more furiously than the *Maguas* described above and they bite, though usually into the hair. The honeys of these species are consumed, but are not particularly favoured. This is because people see the bees alighting on faeces and argue that their honey may be somewhat contaminated as a result. The beekeepers of El Limo and El Brujo were not familiar with these species and assumed that they must be 'bees of the savannah'.

3.1.7 *Cushushus* and *Omo*

The people distinguish two species of *Cushushu*: *Cushushu del Talchinol* (*Trigona fuscipennis*) and *Cushushu del Arbol* (*Partamona* aff. *cupira*). *Talchinol* is the local name for an exposed nest, the characteristic form of accommodation constructed by *Cushushu del Talchinol* and *Omo* (*Trigona nigerrima*). According to the beekeepers, the outer shell of such nests is made of a mixture of earth, tree resins and bark, and the faeces of cattle and dogs. Whereas *Omo* uses wax to make quite large and pliable food-storage pots, *Cushushu del Talchinol* appears to store its honey and pollen in pots that are relatively small (about one centimetre in diameter) and brittle. In addition, its honey and pollen pots are intermingled in the nest, unlike those of *Omo*, which are kept separately. When the honey is harvested it therefore tends to become polluted with pollen and nest material. The honey of *Cushushu del Talchinol* is disliked for another reason too: the species collects resin from a tree known as Chilimate (species unidentified) and mixes it with its honey. As a result, the honey is highly viscous and rather irritant: it produces a burning sensation when consumed. *Omo* makes a sweeter, less viscous honey that is much relished. *Omo* and *Cushushu del Talchinol* occur at a wide range of altitudes in many parts of El Salvador. *Cushushu del Arbol* (*árbol* is Spanish for 'tree') has only been observed in El Brujo, where a colony dwells in a tree on land owned by one of the beekeepers. Morphologically, this bee is very akin to its *talchinol*-dwelling counterpart. It lives in the lower part of the tree trunk and the location of its nest is betrayed by a large squad of black bees guarding the entrance, an oval aperture measuring about seven by three centimetres. The keeper of this wild colony has not opened the nest to try the honey, as this would require severely cutting into or even felling the tree. *Cushushus* and *Omo* defend their nests fiercely by buzzing around and biting the attacker; they also try to enter orifices such as ears and nostrils, which is infuriating. Whereas *Omo* tends to abandon the defence suddenly, the

Cushushus keep on fighting to the bitter end. As they are more aggressive than *Omo*, people regard them with a certain disdain. Rather surprisingly, given that the honey of *Cushushu del Talchinol* is not appreciated, this bee's name means 'Beverage of the (exposed) Nest'. *Omo* translates as 'Bony', a meaning which is difficult to relate to the species.

3.1.8 *Culos*

Culo de Chucho ('Dog's Arse', *Partamona nigrior*) and *Culo de Buey* ('Ox's Arse', *Trigona fuscipennis*) are so unkindly named because they are said to collect from the faeces of dogs and cattle. Of course, this behaviour does nothing to endear the honey of these two species to humans. The observant reader will already have noticed something that was only revealed by expert examination of collected specimens, i.e. that *Culo de Buey* is the same species as *Cushushu del Talchinol* (*Trigona fuscipennis*, living in exposed nests as described above). The difference is that the bees referred to as *Culo de Buey* live exclusively in tree-hollows. *Culo de Chucho* builds underground nests. Both species (*T. fuscipennis* and *P. nigrior*) make sweet and perfectly edible honey,[5] even though people turn up their noses at it. Both species defend their nests aggressively by buzzing around the head of the attacker, biting, and trying to enter the nostrils and ears. For these reasons, most people ignore these species if other stingless bees are available in the area. *Culo de Chucho* and *Culo de Buey* occur throughout El Salvador.

3.1.9 Bees that produce harmful substances

The species *Limoncillo* (*Lestrimelitta* sp.), *Maltatía* (*Oxytrigona* sp.) and *Chichivo* (*Plebeia* sp.) are said to produce substances that are harmful to humans. *Limoncillo* ('Little Lemon'), is a pillage bee found throughout El Salvador. Its name refers to the

[5]This would appear to contradict the statement (in Section 3.1.7) that *Cushushu del Talchinol* honey is irritant because it contains *Chilimate* tree resin. A possible explanation is that the *T. fuscipennis* that build exposed nests (i.e. *Cushushu del Talchinol*) need greater quantities of resins - to bind the other collected materials with which they construct the outer shell of the nest - than the bees of the same species that dwell in tree-hollows (i.e. *Culo de Buey*). As a result, the honey of the exposed-nest dwellers would have a higher resin content. Of course, such honey can only be irritant if there are *Chilimate* trees within flight-range of the Cushushu del Talchinol nest.

lemon-scented liquid it secretes and from which other bees flee. People fear this secretion too, believing that it is urine and if a bee manages to 'urinate' into their eyes, they will go blind. Others argue that the bees 'urinate' into their honey, making it poisonous. As far as I can ascertain, though, nobody has even been harmed by *Limoncillo*. In contrast, the species *Maltatía* and *Chichivo* have caused actual bodily harm to people. The name *Maltatía* may be derived from the Spanish verb *maltratar*, 'to maltreat'. Beekeepers classify the species as 'a bee of the savannah': it lives in the limbs of trees in the *machoral* and in the forest borders of agricultural fields. Typically, large numbers of these yellowish bees linger at the nest-entrance, an oval aperture some 20 centimetres from top to bottom. In defence, these bees squirt a highly caustic liquid that produces severe skin 'burns'. For this reason, some people in La Criba call this species *Amona* (cf. *amoniaco*). *Chichivo* ('Sucker') is particularly treacherous. This small black species nests exclusively in tree-hollows in the Montecristo forest reserve. When they sense danger, the bees hide in the nest, which has no noteworthy characteristics except that it contains a rather fluid honey with a good sweet taste. This can, however, prove to be highly deceptive: on three separate occasions men have fallen ill after eating the honey, suffering from serious diarrhoea and vomiting blood. As a few people have consumed *Chichivo* honey without ill effects, it may be that it is only toxic when the bees have foraged from a particular plant, which has yet to be identified. Of these three species, only *Maltatía* produces honey that is considered to be edible.

3.2 Cultivation versus collection

The beekeepers thus distinguish the local species of stingless bees by their morphology, defensive behaviour, habitat, nest structure and the quality of honey and wax they produce. On the basis of their observations they decide whether a particular species can be cultivated - and, if so, how it should be kept - or whether it is better to collect its honey from wild nests. Which of the stingless species do they take to their homes and how do they keep them? And why exactly do they leave others in the forest?

The 'well-mannered' *Jicote* and its close relative *Tensuque* are clearly preferred for cultivation. As these species nest in hollow branches of forest trees, the beekeepers keep them exclusively in hollow logs; ideally, lengths cut from trees that the bees themselves normally select as nest sites: i.e. *Roble* (*Quercus* sp.), *Cedro* (*Cedrela mexicana*), *Pochote* (*Cedro espino; Zanthoxylum microcarpum*), *Tahiste* (unidentified), *Laurel* (*Cordia alliodora*), *Aguacate* (*Persea* sp.), *Senrino* (unidentified) and *Jujushte* (*Brosimum alicastrum)* (identification of species according to Standley 1925). The bees are said to dislike pine trees (*Pinus* sp.), which are common in the El Brujo area, because of their pungent resins. Beekeepers insist that *Jicote* and *Tensuque* cannot be kept in a box or other artificial accommodation, arguing that these bees will only build their nests in rounded hollows similar to their natural homes: the bees simply would not 'feel at home' in anything second rate. The bee-logs are suspended under the eaves of houses, where they are sheltered from the rain and out of reach of several animal species which crave honey. Three other stingless bees that dwell in forest trees are also kept in logs at people's homes: *Tamaga* and the *Maguas*. However, despite the beekeepers' observation that *Tamaga* and *Jicote* often dwell in the same trees, they are usually kept well apart around the home to stop *Tamaga* pillaging the nest of *Jicote*. *Tamaga* is renowned for its tendency to 'escape', suddenly swarming from the bee-log and leaving the keeper with neither bees nor the prospect of honey. Some people therefore prefer to collect their honey from the forest, rather than going to the trouble of cultivating the bees only to watch them fly away. *Chumelo* and *Zarquita,* both species that nest in 'any old object', are often brought home and kept in boxes, calabashes or other artificial accommodation (see Photo 2). *Chumelo* is sometimes called 'the Queen of the Bees', though its behaviour is anything but noble and dignified:

"Nobody can believe it! The little bee beats the big one! Tiny *Chumelo* hangs onto the legs of the big bee [*A. mellifera*] and, you see, just doesn't let go! The little bee fights the big bee to the death" (Don Trinus, La Criba).

So *Chumelo* attacks other species, including *Jicote* (*M. beecheii*), often biting into their wings to immobilize them and sometimes taking over their nest after the battle. The beekeeper is loath to expose his more productive *Jicotes* to these little pillagers. However, *Chumelo* honey is highly esteemed for its curative properties and the species is therefore often kept at home, though well away from other bees. *Omo* lives in exposed nests, and these are taken home in one piece to be placed among low vegetation such as shrubs and cacti. People have been known to keep a colony of this species for more than ten years in the original nest. Because its chosen habitat is so different to that of *Jicotes* and other bees that dwell in the limbs of trees, *Omo* is always kept separately.

The honey of other species is only extracted from wild nests in the forest. As *Talnete* naturally nests in what is known as 'warm ground', Salvadoran beekeepers argue that it is impossible to cultivate this species in logs or boxes because they do not retain sufficient warmth. A similar argument applies to *Mandinga*: it dwells in underground nests and therefore cannot be persuaded to live in a box. On the other hand, people say that *Alazana* and *Chumelon*, which prefer the lower parts of tree trunks, probably can be cultivated; though they are more inclined to collect their honey from the forest, for they dislike their defensive behaviour. In any case, the honey of these two species is not much valued. *Cushushu del Talchinol* and both *Culos* are considered far too annoying to be cultivated, and many people will not even bother to steal their honey. The honey of *Maltatía*, the only stingless species whose defensive behaviour actually causes injury to humans, is regarded as edible and some people go to great lengths to collect it, even if they have to kill all the bees first with fire or poison.

These practices illustrate that the way people obtain honey from a particular stingless species - if they decide that this is a worthwhile venture - is closely related to its natural habitat. Firstly, the natural nesting preferences of the bees are reflected in their cultivation: bees that inhabit tree-hollows are kept in hollow logs; those with no clear preference may be kept in man-made objects; bees found in exposed nests are taken home in their original housing, which is carefully preserved; and bees that dwell underground are not cultivated at all. Secondly, hostile relationships between species are reflected in the positioning of colonies around the house: bees that are known to pillage are separated from their potential victims. Finally, species that fiercely defend their nests are mostly ignored, especially if other, more placid bees can be found.

3.3 Methods of finding wild colonies

Whether one wishes to collect honey and wax in the forest or prefers to take colonies home for cultivation, the first challenge is to find wild nests of stingless bees. How is this done in practice? More specifically: how is knowledge of behavioural differences between the various species translated into specialized techniques for tracking them down in the wild?

As the beekeepers' descriptions of the various bees testify, there are placid species that do not defend their nests aggressively and more belligerent species, nearly all of which, however, can do nothing more than annoy humans. It is better to look for a colony of one of the placid species (i.e. *Jicote*, *Tensuque*, *Maguas* or *Talnete*) on a day with neither wind nor rain.[6] As most of these species tend to dwell high in trees, they are difficult to detect by their nest-entrances alone. The best way to track down a colony is to follow individual bees returning to the nest after foraging. Before ten o'clock in the morning and after four o'clock in the afternoon, when the sun is low in the sky, a bee in flight is often lit up by the brilliant shafts that penetrate the forest canopy - caught in the searchlights, as it were:

"The sunbeams are ideal in the morning. They make the bees look like little balls. The best time to go tracking bees is in August and another month, I don't remember which, when the bees carry big loads of pollen. I climb a tree to see which way the bees are going. When I see one - you need a lot of patience for this, of course - I don't take my eyes off it. When I lose sight of the bee, I go to the place where I last saw it and wait for the next bee to pass by; [this goes on] until a bee leads me to its nest" (Don Julio, El Brujo).

Several beekeepers use this technique, which seems to depend upon the stingless bees' habit of keeping to one attractive patch of flowers when foraging.[7] There is one crucial 'trick of the trade': you need to know that fast-moving bees are unladen and therefore outward bound, while slow-moving bees are returning to the nest with a heavy load of honey and/or pollen. The technique is also used for the ground-nesting species *Talnete*, which seems particularly sluggish when returning to the nest. Bees are easier to track in the rather open Montecristo forest than in the dense *machoral*, which has much low vegetation and fallen leaves. The best time to look for a *Talnete* nest in the *machoral* is in November, when there are fewer leaves on the forest floor to hide the nest-entrance.

The more aggressive species, such as both the *Cushushus*, both the *Culos* and *Maltatía*, are much easier to find, for a large squad of soldier bees always guards the nest- entrance. Several other species including *Alazana*, *Chumelo*, *Chumelon*, *Mandinga* and *Omo* build elaborate entrance tubes that betray the location of their nests. Although the entrance tube of *Chumelo* is relatively small, a conspicuous cloud of bees

[6]In winter months, especially January, the *nortes* (strong winds from the Arctic) often blow throughout El Salvador, hindering the bees in their foraging.

[7]In an artificial setting and while foraging 'solo', *Melipona fasciata* shows a high fidelity (floral constancy) to a specific odour or part of the patch. Under natural circumstances, however, foraging bees do not visit floral resources alone but are strongly influenced by the behaviour of accompanying nest-mates (and other species, of course). It has been demonstrated that the choice between two identically scented and equally appealing sub-patches is mainly determined by the number of visitors: the bees seem to prefer sites where the greatest number of nest-mates are already foraging, a phenomenon suggestively described as 'neighbour fixation' (Biesmeijer 1997: 185). In addition, novice foragers are mainly guided to sources by information obtained from nest-mates that have just returned from a flower patch, whereas experienced bees use information gathered on their own previous flights. *M. beecheii* (*Jicote*) is likely to employ the same foraging strategies as *M. fasciata* (see ibid.: 187), making the beekeepers' tracking method highly effective.

hovers around it in the daytime. Exposed nests are very easy to spot and trackers need no special tricks to find them.

Some people only go searching for honey and wax in the forest and never take colonies home. Usually, though, they are careful not to destroy nests so that they may visit them again and take away more honey and wax. This is easier with a tree-nesting species than with a ground-nesting one: firstly, part of the brood must be left intact; and secondly, the robber must be careful to open neither pollen-storage pots, as pollen strongly attracts deadly Phorid flies (see Appendix I), nor honey-storage pots, as the tiniest drop of honey draws hordes of marauding ants. If a nest in a tree is not too badly damaged, the bees will try to close it up again with batumen. A nest in the ground must be covered with earth again. Particular care should be taken not to block the entrance tube, which leads from the open air to the core of the nest and may be more than one metre long, so that bees will still be able to leave and enter. Inevitably, ground-nests sustain more extensive damage than nests in trees. However, if the gatherer cleanly removes the storage pots of the ground-dwelling *Talnete* and carefully covers the nest again, the colony may survive. This is particularly important if the honey is of great value, which is certainly the case with *Talnete.*

If a beekeeper wishes to take a tree-dwelling colony home, he cuts out the length of branch in which the bees have their nest and carefully lowers the log using ropes, being most careful not to let it turn upside down or drop to the ground. If the hive is impossible to reach, the beekeeper will have to cut down the entire tree, though most people tend to leave such colonies unmolested. If the colony has its nest in the vertical trunk of the tree, the beekeeper may try to open it and remove the brood and some food pots to a box or hollow log. This mobile hive must then be closed as quickly and as well as possible. In the forest, the beekeeper does not have all the materials and tools he has at home and will therefore use anything at hand to seal the hive: stones, leaves and, if available, wet mud. Once this task has been accomplished, the hive is left in the forest so that the bees that are out foraging can return and be collected. At dusk, when all the bees are back in the nest, the beekeeper returns and takes the hive home. Some people leave the colony in the forest for a number of days, to wait and see whether the bees will stay in their new accommodation. Others only take the bees home on a Saturday:

"You see, I follow the custom of filling the new hive with bees and then leaving it. I return to fetch the hive and bring it home on a Saturday, because on that day all the little bees assemble in the hive. I don't like to leave any stray bees in the forest, so I only take them home on a

Saturday. On that day, they rest from their work. It is the day of rest, the work of God. For they [the bees] are spirits ... spirits that God has left on earth" (Don Julio, El Brujo).

Bringing home the bees on a Saturday may be a very old custom, for several people use the same strategy as Don Julio. While the hive is being carried home, the nest-entrance is kept closed with a few leaves. The beekeeper ensures that he does not shake up the hive too much in transit or turn it upside down. Once home, he puts a rope around the bee-log and hangs it under the eaves of his house. The next morning, the leaves are removed from the nest-entrance so that the bees can inspect their new environment.

Table 3.2: The number of colonies of cultivated stingless bees in the villages La Criba, El Limo and El Brujo, El Salvador

	La Criba	El Limo	El Brujo
No. of families with stingless bees	3	11	22
Species			
Jicote (Melipona beecheii)		58	111
Tensuque (Melipona yucatanica)	1		
Chumelo (Tetragonisca angustula)	2	10	4
Alazana (Trigona fulviventris)	1		
Zarquita (Plebeia sp.*)*	1	2	2
Tamaga (Cephalotrigona capitata)		1	2
Omo (Trigona nigerrima)		4	5
Magua (Scaptotrigona sp.)		1	5
Chichivo (Plebeia sp.*)*			1
Total:	5	76	130

3.4 The number of meliponine hives in the villages

To ensure themselves of a regular supply of honey, the beekeepers take the nests of the above-mentioned species home. However, they are not all equally successful at keeping stingless bees. As Table 3.2 shows, there is a big difference in the number of hives kept in the three villages studied. Only three beekeepers still keep stingless species in La Criba and together they only have a total of five colonies, none of them *Jicotes* - the most cherished species. There used to be a far greater number of meliponiculturalists in La Criba, keeping *Jicotes* and a few other stingless species. One way or another, though, most of them have lost their hives. One of the village's five remaining colonies - a hive of *Alazana* (*Trigona fulviventris*) - died during the course of the year of my fieldwork (1993). In both El Limo and El Brujo, the numbers of meliponiculturalists are greater. In El Limo, ten households together have 58 colonies of *Jicotes*, though 41 of these are kept by one family, a fact which is not shown in the table. In El Brujo, 22 households keep 111 colonies of *Jicotes*: the largest meliponary consists of 38 colonies of *Jicotes*; there are a few beekeepers with more than 15; and, in comparison to El Limo, the *Jicote* colonies are more evenly distributed among the households. So far as cultivated species other than *Jicote* are concerned, the only difference between El Limo and El Brujo is that one beekeeper in the latter village keeps a single colony of *Chichivo* out of curiosity (the honey of this species can cause diarrhoea and vomiting of blood, as described in Section 3.1.9). Some migrant families brought hives with them when they moved into El Brujo and El Limo. As increasing numbers of people have been settling in this area in recent years, the number of cultivated colonies may now be higher than it was before the villages expanded. According to some people, however, every household used to keep *Jicotes*. Nowadays only about 55 per cent of the households in El Brujo have one or more colonies of these bees. It is therefore impossible to determine recent trends in meliponiculture with any accuracy. One thing is certain, however: in contrast with La Criba, meliponiculture is still an important practice in the Montecristo area, where there are several meliponaries of between 20 and 40 hives. *Jicote* is the favourite species for cultivation, occuring in 80 per cent of the hives. A variety of stingless species are kept in the other hives.

3.5 Declining apiculture in the Montecristo area

In addition to these stingless bees, some people keep a few colonies of the European stinging honeybee *A. mellifera*, locally known as *La Extranjera* ('the Foreigner') or *La Castilla* (indicating its Spanish origin). The number of hives per owner varies between one and twenty (only one apiary consists of twenty hives), many of which are kept in the village itself (by 24 per cent of the 49 informants in 1993). Apiculture has decreased significantly in recent years. More than 43 per cent of the informants said they had abandoned the practice completely, while another 22 per cent said they had cut down to only a few hives. Why did they give up apiculture? The answer is that the Africanization of the honeybees has deterred many people; particularly in El Limo and El Brujo, which are relatively isolated and where there have been no official campaigns to inform people how to deal with Africanized bees. In addition, alarming reports of 'killer bees' attacking unsuspecting passers-by and stinging them to death have got through to the people. Furthermore, most apiculturalists have been unable to obtain the expensive protective equipment which has become indispensable in the aftermath of Africanization. Hives of *A. mellifera* are mostly kept around the house, posing a threat not only to the beekeeper but to his family and neighbours as well. Africanization has resulted in a number of accidents in the area, all of them fairly minor but reason enough for many people to stop cultivating these highly productive bees. This is not the only problem to have affected apiculture. More recently, honey production has been hit by plagues of the Varroa mite as well as other pests and diseases. Furthermore, bees are generally very sensitive to the use of agrochemicals. Several informants claimed to have lost entire colonies after an area in the neighbourhood was sprayed. To conclude, then, apiculture has lost a great deal of importance in an area where meliponiculture is also practised. Many beekeepers prefer the non-aggressive, 'well-mannered' *Jicote*, despite its significantly lower production of honey and wax.

3.6 The harvest

People generally prefer to take wild colonies of stingless bees to their homes so that they can harvest honey and wax on a fairly regular basis and avoid the time-consuming search for nests in the forest. When is the best time to harvest? Does it vary from species to species? How much honey and wax can be extracted without irreparably impoverishing or killing the colonies? And how exactly should the bee-products be taken from logs, boxes and exposed nests without causing too much damage to the nest structure?

One thing that struck me was that all the Salvadoran beekeepers I met during my fieldwork were men - with the exception of one woman who owned a few logs of *Jicotes*. Interestingly, her brother always did the harvesting. In theory, there does not seem to be any reason why women should not keep stingless bees, yet in practice they almost never do.

As Table 3.3 shows, in the year of this study (1993) the majority of beekeepers harvested honey from their *Jicotes* and most other species only once, which is considered normal. Harvesting is done in March, in the dry season, during which some important food plants come into flower. *Xikuhnay* (*Vernonia* sp., probably *canescens*[8]) is said to be the most important source of food for *Jicote*, as suggested by the common name of this shrub, for *xikuh* is the Pipil rendering of *Jicote* ('bee'). The 'white' honeys of *Jicote* and *Tensuque* are said to be made from the nectar of *Xikuhnay*. Although several plant species flower during the rainy season, the bees amass greater quantities of

Table 3.3: Mean honey production of stingless bees per hive (in liters) in El Brujo, El Limo and La Criba, 1993

El Brujo	**harvest once a year**					
	Jicotes	*Chumelo*	*Omo*	*Tamaga*	*Zarquita*	*Magua*
	38 (1)	3 (0.25)	5 (1)	2 (1)	2 (irregular harvest)	5 (0,5)
	48 (1.5)	1 (irregular harvest)				
	6 (2)					
	5 (2.5)					
	11 (3.5)					
	harvest twice a year					
	Jicotes					
	3 (2)					
El Limo	**harvest once a year**					
	Jicotes	*Chumelo*	*Omo*	*Tamaga*	*Zarquita*	*Magua*
	2 (0)	4 (irregular harvest)	4 (1)	1 (1)	2 (irregular harvest)	1 (0.75)
	2 (1)	6 (0.25)				
	46 (1.5)					
	1 (3)					
	1(5)					
	harvest twice a year					
	Jicotes					
	6 (1)					
La Criba		*Chumelo*	*Tensuque*	*Alazana*	*Zarquita*	
		2 (irregular harvest)	1 (1)	1 (0)	1 (irregular harvest)	

honey in their hives during the dry season. According to the beekeepers, this is because rain flushes nectar from flowers and makes it difficult for the bees to forage: the only safe time to mount expeditions from the nest is between downpours. The seasonal variation in foraging is particularly marked in El Brujo and El Limo, where the

[8]Unfortunately, my flowering specimen of this species rotted before it could be identified. Dr. J.C. Biesmeijer, who studied *Vernonia* in Costa Rica, saw a colour transparency that I had taken in El Brujo and indicated that it was most probably the species *canescens*.

frequency of rainfall increases enormously during the rainy season. Only two of the interviewed beekeepers harvested honey twice in 1993 - in February and April (from a total of nine logs of *Jicote*) - though several informants said that they used to be able to harvest twice every year. Don Alcario, for example, who has a meliponary with 38 hives of *Jicote* and other species, had always harvested twice a year until 1990, when the honey production of his bees suddenly and unexpectedly fell, never to recover. Fighting started between his impoverished colonies, so he spaced them out over different plots of his land, ensuring that there were no other meliponaries or apiaries nearby.

In the preferred month(s) for harvesting, the beekeepers look to the sky to select the 'perfect' day to open their hives: there must be plenty of sunshine during the day and a 'mature moon' (*luna sazona*) at night. The choice of a sunny day is easy to explain: many bees will be out foraging, so the harvest will cause minimal disturbance to the colony and the bees will cause minimal annoyance to the beekeeper. Any bees unfortunate enough to get covered with honey during the harvest are carefully washed in water and put in a sunny spot to dry. Why, though, are beekeepers so particular about harvesting at full moon? What exactly does *luna sazona* mean to them?

The people of El Brujo generally distinguish two lunar phases: *luna tierna* (tender, young moon), from new moon up to and including eight days thereafter; and *luna sazona*, the remaining 20 or so days to the next new moon. The greater part of the waxing gibbous phase and the entire waning phase are thus included in the *luna sazona*. After waning, or dying, the moon is believed to be bathed in the sea, from which it emerges reborn and charged with water, enabling it to grow to full maturity again. People clearly relate the lunar cycle to the moistness or dryness of the land and thus rely on the moon to govern their agricultural practices. Under a *luna sazona*, the soil is said to have sufficient moisture for sowing to be successful. Most cultivable plots are sown or planted on particular days of *luna sazona*, as the people believe that only in these cases will the plants yield good and plentiful fruit. If sowing or planting takes place under a *luna tierna*, the plants may appear to grow fast and strong, but their fruit will be small and meagre. Root and tuber crops are the exception to the rule: they are said to develop well during this young phase. Generally speaking, all that lives upon earth, including the human race, is considered to be less fertile under a *luna tierna*. This is illustrated by the belief that women menstruate at new moon and are ripe for conception (planting) at full moon - obviously an idealization. The conceptual linking of lunar and fertility cycles also applies to the bees: people claim that if the previous honey harvest took place during *luna sazona*, the bees will store ample honey in the hive for the next harvest. In contrast, if a beekeeper unwisely harvests during *luna tierna*, next time round he will be gravely disappointed:

"The bees get fever if you remove their honey at *luna tierna*. They do no more work. If you open the hive the next year, [you'll see that] they abandoned their work where you stopped harvesting the year before. Maybe they grow lazy, but I think they lose their senses" (Don Amadeo, El Brujo).

So extracting honey at *luna tierna* makes the bees ill, lazy or senseless. Whatever the case may be, there will be no honey in the hive the next year. Similarly, trees are said to dry out if their branches are cut at or around the new moon. This is a time of drought and sterility. The moon, reborn of the sea, has not yet carried its watery load to earth. Once this is accomplished, however, and the moon is 'mature', trees do not dry out, plants bear fruit, cows and other animals can be successfully inseminated, people are fertile too, and beehives should be full of honey. Thus, according to my informants in El Brujo and El Limo, *Jicote* is as subject to lunar influence as any other living thing upon the earth.

Although most of the other stingless species are harvested at about the same time of the year as *Jicote*, the beekeepers are less concerned about the phase of the moon in their case. *Chumelo* produces so little honey (about 0.25 litres per hive per annum) that it is hardly worth harvesting for consumption; beekeepers only extract the honey incidentally for medicinal purposes (see Section 3.8.1). As stated above, the species jointly known as *Chumelos* (i.e. *Chumelo*, *Zarquita*, *Congo* and *Boca de Sapo*) are used to introduce children to beekeeping. No particular day of the year or lunar phase is considered when harvesting their honey. Although some stingless species are known to pillage the nests of other species if they can get into them, logs of *Jicote* and other species that inhabit trees in the wild are usually opened for harvesting at the same time. By maintaining an adequate distance between open hives, however, the beekeepers seem to be able to prevent pillaging during harvesting. The honeys of all such species are thus harvested on the 'perfect' day indicated by the sun and moon, though their hives may incidentally be opened at other times if a particular product is needed.

To remove honey from a *Jicote* hive, the beekeeper slackens the rope by which the log is suspended from the roof, lowering one end of the log into easy reach. The dried mud (with which both ends are hermetically sealed) is then removed at the lower end to expose the outermost storage pots. As the bees tend to store honey in pots towards the ends of the log and keep pollen in pots closer to the middle, the first pots exposed normally contain honey. Using a thin stick, the beekeeper either pierces pots so that honey runs out of the log and into a container, which an assistant is holding under the open lower end, or he dislodges entire pots. Some beekeepers rub in a little salt inside or on top of the log, as they believe that this pacifies the *Jicotes*. When the beekeeper reaches the outermost pollen pots, he stops extracting honey from that end, leaving some honey pots for the bees to feed on. He then re-seals the log with mud made from red earth and water. Some beekeepers mix wood-ash or cow-dung into the mud, as this helps it to dry without cracks, through which enemy insects could enter the nest. Once the end of the log is properly sealed, it is raised until the hive is again horizontal. Many beekeepers then repeat the whole process to harvest honey from the other end of the log; some beekeepers take all the honey from one end, leaving the honey pots at the other end to the bees.

It is much easier to harvest honey from stingless species kept in boxes. In fact, only *Zarquita* and *Chumelo* are ever put in boxes, though they may also be kept in other types of containers. Having removed the lid of the box, the beekeeper can see in one glance how productive the bees have been since the previous harvest and whether the colony is in good condition. He has so much room to manoeuvre that he can even use a hypodermic syringe to extract honey from pots without damaging or dislodging them. This virtually eliminates honey spillage and loss of wax. The bees need to spend very little time repairing the intra-nidal architecture and can therefore keep on foraging. This is especially important in the case of *Zarquita* and *Chumelo*, for they are not very productive.

As *Omo* lives in exposed nests, harvesting its honey causes even more damage than is the case with species kept in logs, for part of the nest wall is inevitably removed by the beekeeper to get at food pots: the bigger the hole, the greater the potential harvest. Some beekeepers try to help the bees by closing the gaping aperture with mud afterwards, though this reduces the volume of the nest. Others leave the nest in a state of partial demolition, reasoning that the bees can do a better repair job themselves. *Omo* seems to be quite resilient anyway, for several nests of the species have been kept for ten years or more, despite the destructiveness of the harvesting method.

As Table 3.3 shows, the production of honey differs significantly from one species to another, while there is also much variation among colonies of the same species. The amount of honey harvested from *Jicote* hives in one year ranges from zero to 5.0 litres, with a mean production of between 1.0 and 1.5 litres. Why are there such big differences in production? Logically, the main factors affecting production are: firstly, the availability of important food plants, such as *Xikuhnay*, within foraging distance of the hive; and, secondly, the number of colonies per unit area, which is an indication of the intensity of competition with other colonies of the same species and with colonies of other species, for example *A. mellifera*. However, this reasoning is not supported by the data from El Brujo and El Limo summarized in Table 3.3. Don Alcario of El Brujo, the beekeeper who, in 1990, stopped harvesting honey twice a year and spread out his bee-logs over a larger area, only extracted about one litre per hive in 1993. His brother, Don Esteban of El Limo, had 41 *Jicote* hives kept around two houses which were only some twenty metres apart. Yet in 1993, he extracted 1.7 litres of honey per hive, much more than Don Alcario (see Photo 3). In this particular case, the harvesting methods used may explain the different yields: Don Alcario tried to spare his bees by only removing honey from one end of his logs; Don Esteban harvested from both ends. Other cases, however, are less easy to explain. Don Meme kept three *Jicote* hives under one roof. One of those hives yielded three litres of honey, while the other two were found to contain only pollen pots. In previous years, other beekeepers reported similar, mixed results. Perhaps the wide variations can be attributed to differences in the development of colonies. While augmenting the brood, the bees may need to store larger quantities of pollen - the main larval food - than in other situations. Several beekeepers told me that they used to be able to harvest much more honey from their stingless colonies, typically five litres per hive per annum. As Table 3.3 confirms, such high yields are now rare. Furthermore, several beekeepers spoke of fights between *Jicote* colonies, which they thought were caused by a general shortage of food. In response, some beekeepers have spread out their hives like Don Alcario, while others occasionally try to supplement the diets of their bees (see Section 3.7).

At 0.5 to 1.0 litres of honey per hive per annum, the *Maguas*, *Omo*, *Tamaga* and *Tensuque* are significantly less productive than *Jicote*. Hives of the tiny *Zarquita* and *Chumelo* yield even less in a year, about enough to fill one liquor glass, which hardly seems worth the effort of cultivating them. *Zarquita* is therefore used to initiate children into the art of beekeeping. *Chumelo* honey, however, is ascribed curative properties and therefore fetches a high price, so some beekeepers find this species a viable option to cultivate.

To summarize: harvesting methods that involve the removal of whole clusters of food pots severely damage the intra-nidal architecture and therefore significantly reduce honey production, for the bees must spend a lot of time and energy re-building their storage facilities. According to Merrill-Sands, one kilogram of wax is equivalent to seven kilograms of honey, in terms of work done (1984: 229). If the food pots are not removed but just pierced with a sharp stick, the intra-nidal architecture is still partly destroyed, but the bees can re-use the wax, which remains in the log with this method. Extracting honey with a hypodermic syringe is by far the least damaging method, though it is only practicable if the bees are kept in boxes. Beekeepers argue that the only species that can be kept in boxes are those which, in the wild, do not show a preference for a particular type of nest site. The species which is most commonly cultivated, *Jicote* (*M. beecheii*), is always kept in logs. Its honey therefore cannot be extracted with a syringe and nests sustain serious damage during harvesting. The damage to exposed nests of *Omo* is even greater, for a large part of the nest wall is removed. Whenever nests or hives are opened for a while, pollen pots may be exposed to the air, attracting the deadly Phorid flies. Moreover, the practice of lowering logs at one end endangers the bee-larvae, which are highly susceptible to jarring and may drown in the larval food if the log is tilted too steeply..

It can only be concluded that colonies of stingless species kept in hollow logs and original exposed nests are seriously hampered in their development as a result of the traditional harvesting methods. If such bees were to be kept in modern boxes ('rational hives') and their honey harvested with syringes, as is now the case with some smaller species, their would be much less damage to the internal structure of nests and honey yields might recover.

3.7 Beekeeping practices other than harvesting

Apart from opening hives and exposed nests to extract honey, people generally pay very little attention to their cultivated colonies of stingless bees. Occasionally, however, they try to help the bees if they find them impoverished or notice some other problem affecting the colony. What problems are generally encountered and how do beekeepers tackle them?

One of the main problems is the difficulty of maintaining stocks, i.e. the number of hives in the meliponary. From time to time, colonies die out or flee. What can the beekeeper do to augment the meliponary? Salvadoran beekeepers depend primarily upon wild colonies in the forest to keep up stocks. As was explained in Sections 3.2 and 3.3, people take wild colonies of certain species from the forest to cultivate them at home. However, some of these species have become so scarce in the wild that people try other methods. Some keep a hollow log near existing colonies in the hope that a swarm of stingless bees, preferably *Jicotes*, will take up residence in it. A few beekeepers have succeeded in catching swarms in this way. Generally, though, beekeepers seem to know very little about when the bees are likely to swarm and how they actually do it. They say that when a wild *Jicote* colony swarms, the bees leave the nest 'in single file'. In fact, such behaviour implies that the bees have already decided where to build their new nest and are therefore certain to ignore any hollow log the beekeeper may place near to the nest that is being abandoned. Capturing a wild swarm is therefore quite rightly considered to be a question of pure chance, though many people know someone who has obtained a new colony in this way. Some people even fix a hollow log on top of an existing *Jicote* hive. This is a very passive method; it requires great patience and has no guarantee of success. Why do the beekeepers not try to create a daughter-colony by splitting the brood of an existing hive? Many people are convinced that *Jicotes*, unlike honeybees, cannot be multiplied in this way, arguing either that the stingless bees only have one queen or that they are likely to become infested with 'worms', actually the larvae of small black flies (humpback or Phorid flies).[9] So far as I could ascertain, only one meliponiculturalist has tried to increase his stock by splitting the brood, and this resulted in the loss of the entire colony. Instead, the people depend upon the forest for supplies of new colonies and upon the chance capture of a swarm, usually one fleeing from somebody else's meliponary! Occasionally, a *Jicote* hive can be bought from another beekeeper for about 100 colones (approx. 12 US dollars). Most people, however, prefer to keep their bees to themselves for, ultimately, it is far more profitable to sell *Jicote* honey, which is expensive and in great demand.

Although stingless bees are less susceptible to plagues and pests than honeybees, sometimes the beekeeper needs to rescue his *Jicotes* from invading ants or Phorid flies. To protect his bees against an attack of ants, particularly *Zompopos* (macrocephalic ants), *Pacacas*[10] and *Coruncas* (army ants), the beekeeper ensures that the hives are hermetically sealed at both ends: no crack must be left through which the ants might enter and evade the bees' defences. If the hive is properly sealed, the ants must take the nest-entrance, which is zealously guarded by a soldier bee. If ants attack one of his *Jicote* colonies, the beekeeper usually lights a smoky fire beneath the hive to drive off

[9]In fact, new queens are regularly produced in colonies of *M. beecheii*, so if all goes well after splitting the brood, there is bound to be a new queen in the daughter-colony before very long. It is true, however, that Phorid flies pose a serious threat to this stingless bee species, especially during and after the splitting of a colony, when stored pollen may be exposed and attract the flies.

[10]In Pipil, these ants are called *Tzumpupu* and *Pahpaca*, the latter meaning 'washes himself thoroughly' (Prof. R.A.M. van Zantwijk, personal communication).

the invaders or pours boiling water over them. Normally, beekeepers manage to save their hives from attacking ants. It is far more difficult to protect a colony against Phorid flies, which are strongly attracted to an open hive. Once they have gained entrance, these flies lay eggs in the brood and any open pollen pots. Once the eggs hatch, the colony is doomed. As soon as they notice these flies, therefore, beekeepers quickly seal the hive or try to expell the invaders with smoke, the latter being the more effective technique. I discovered that two beekeepers use common salt as a precautionary measure against Phorid flies: one simply puts the salt in a small cup inside the hive; the other impregnates the bee-log with salt water. There are other, less serious problems that may effect a colony: for example, cockroaches living in the bee-log or salamanders taking up position at the nest-entrance to devour outgoing bees. Both interlopers will be killed on sight by the beekeeper.

After extensive use and exposure to rain, the wood of the bee-log tends to rot. In that event, the bees must be transferred to a new log before the wood becomes perforated and provides access to enemy insects. Beekeepers either search for a suitable hollow log in the forest or make one themselves. In the latter case, they hollow out the log with the aid of a glowing piece of charcoal. Inevitably, the wood becomes impregnated with the pungent smoke, which is thought to be repellent to bees. Some beekeepers therefore treat the inner surface of a newly made bee-log with a leaf called *Te de Limon*, 'Lemon Tea', or with resins of the *Copalchi* (*Copal de Santo*) tree, while others rinse the inside of the hive with salt water. Bees, including *Jicotes*, are seen to drink from beads of perspiration on humans and animals, and are therefore said to like living in a salty hive.

Bees sometimes become impoverished, which means that their stocks of honey and pollen in the nest run so low that they may not survive periods of scarcity. If none of the flowering-plant species from which they normally forage are blooming in the vicinity, the food shortage becomes a serious threat to the colony's survival. Some beekeepers say that they notice when their *Jicotes* are starving because they start fighting with neighbouring colonies. Others have adopted as standard practice the opening of hives in the rainy-season months of June and July, when frequent downpours flush nectar and pollen out of blooms and make it very difficult for the bees to forage. They supplement the bees' diet by placing a small calabash of sugar-water or *A. mellifera* honey inside the log, and sometimes also a calabash with a little salt. The beekeepers claim that when they open the bee-log the next year, the bees will have 'consumed' the salt and filled the vessel with honey out of gratitude. Some say they sanctify the hive with salt, which is considered to be holy and a means of warding off evil spirits.

These practices are generally restricted to colonies of *Jicotes*. Although other stingless species are cultivated, they are neither provided with honey, sugar or salt, nor sanctified, and generally have to survive without human assistance. People pay the most attention to their *Jicotes*. As I argue in the next sub-section, this may be because they value the honey of this species highly for its curative properties. However, they also treasure the honey of *Chumelos*, though these bees are left to their own devices. This appears to be because *Chumelos* are regarded as more robust than *Jicotes*, which are rather delicate creatures requiring special treatment and much pampering.

3.8 The use of bee-products: honey, wax, pollen and batumen

As we have already seen, the honeys of certain bees are prized beyond others. This is especially true of those stingless-bee honeys which are most commonly used in traditional healing.[11] In this context, it is important to note that the antibiotic activity of *Melipona* honey is significantly higher than is the case with the honey of *A. mellifera*. The honeys of three *Melipona* species (including *M. beecheii)* have been demonstrated to have consistently higher bacterial counts than *A. mellifera* honey. In the analyses, the highest bacterial count corresponded to the highest antibiotic activity (Bruijn & Sommeijer 1997).[12] People in El Salvador use honey and other bee-products

[11]There are two main reasons why home remedies are important in villages such as those covered in this study: firstly, the people trust that they are effective, in some cases more so than modern western medicines; and secondly, towns where medical treatment is readily available are quite far away. To visit the nearest doctor, an inhabitant of El Brujo has to travel eleven kilometres over the mountains on foot or horseback (or, in serious cases, carried on a stretcher) before reaching the national highway, on which buses run to Metapán. The nearest hospital is in Santa Ana, an hour and a half by bus from the point where the road is first reached. El Limo and La Criba are reasonably accessible by car most of the year round, though travellers have to walk the last stretch from the nearest main road to the villages. There is no public transport in this area. Herbs, roots and honey can usually be found in the vicinity and cost nothing. Although all medical care is free at Santa Ana State Hospital, patients are charged for medicines, which can be prohibitively expensive. Furthermore, the women of such villages normally give birth at home, assisted by a relative or midwife. Traditional cures and techniques are used first and foremost: only if there are complications will an attempt be made to get the woman in labour to hospital. It is important to note, however, that the use of home remedies based on traditional lore is not restricted to villages. Although town-dwellers with serious health problems are more likely than their rural counterparts to consult a private general practitioner (who requires payment) or go to the state hospital (where healthcare is free), they also use home remedies, many of them based on honey. How they obtain honey is explained at a later stage in this section.

[12]The authors explain these higher bacterial counts as follows: "Stingless bees choose special micro-organisms and grow them intra-nidally. These bacteria are added to the honey during the ripening process. [...] We hypothesize that the typical waste dump in the stingless-bee nest and the food-storage pots containing very watery liquids may be important for the survival of symbiotic bacteria in the nest" (de Bruijn

for a variety of specific purposes, as briefly summarized in the following sub-section.

3.8.1 The medicinal use of honey

Honey of *Chumelo* (*Tetragonisca angustula*) is mainly used to treat people with eye complaints. It is said to cure cataracts, providing it is applied at an early stage in the development of the disorder. The honey is also used to cleanse the eyes in the event of infections commonly caused by airborne dust. It is said to cure conjunctivitis, to help repair physical damage caused by objects lodged in, or accidentally thrust into, the eyes, and to arrest the general worsening of eyesight. Obviously, it is of utmost importance to use refined honey for such purposes: pollen or any intra-nidal waste must be removed. People therefore strain the honey or extract a clean quantity using a hypodermic syringe. For all the above-mentioned disorders, a few drops of honey in the eye daily is the recommended dosis. If this is too painful, people sometimes dilute the honey with a little water, though this is said to diminish its curative properties. Cattle-breeders often use the honey to treat the eyes of their livestock for minor injuries. Interestingly, the honey is also used to get children talking if they are slow developers. If a child remains mute at an age when it should already have started talking, he or she is given *Chumelo* honey 'to set the tongue wagging'. It can also be used preventively:

> "You just harvest the honey and give it to the child. Before long, it starts talking. And they won't half talk, those children, they'll chatter like parrots! Their tongues won't stay glued to their mouths. It's a very good cure indeed. You can give it to them at any age, too. I don't have any silent ones, thank God ... maybe because I had the good sense to give my children this medicine, they are all good talkers" (Don Julio, El Brujo).

So children are fed the honey to become regular chatterboxes, and singers use it to improve the voice. *Chumelo* honey (like that of *Jicote*) is also used to feed new-born children before the mother starts lactating; it is applied to problem skin, for example when an adolescent has acne, and it is put into little ears which are painful, mainly because of infection. No other products from the nests of these bees are used in traditional cures.

& Sommeijer 1997: 166).

Jicote honey is used by women mainly after childbirth. Formerly, when *Jicotes* were more abundant, men were expected to provide their wives with sufficient honey for them to recover from childbirth. Don Esteban, for example, presented his wife with fifteen bottles after her first child was born. Nowadays, *Jicote* honey is so scarce that many men are unable to fulfil their obligation of obtaining 'white honey' for mothers-to-be.

"Well, women have to use warm things because they sometimes have ice in their system. From time to time, part of their body becomes very cold. For men who work a lot under the sun, it is not fitting to take warm things. They should take cold things" (Doña Martinez, El Limo).

Honey is considered important because women need to keep their bodies warm after childbirth if they are to conceive again. They must therefore consume food classified as warm: for example, corn-drinks, chicken, roasted *tortillas* and *Jicote* honey. According to some, though, women should not eat too much of such food:

"The Great Hive [i.e. *Jicote* honey] is for women. Don Ignacio says it's very good after childbirth. However, [under normal circumstances] it's only good for oneself: giving a lot of honey to your woman is bad, it increases her itching for a man. A woman gets very hot because the honey is hot - a woman gets horny. For a man, though, the honey is very good because it helps *la pita* ('the wire') to work" (Don Pablo, El Brujo).

The honey of *A. mellifera*, which is far more abundant nowadays than *Melipona* honey, is classified as cold and therefore cannot be used to boost fertility or sexual potency. *Jicote* honey is also said to clean and heal the inside of the womb when consumed. The birth may have caused a wound 'behind the navel', i.e. in the womb. Women also take the honey to arrest post-natal haemorrhage. New-born babies are given a dummy smeared with *Jicote* honey to clear phlegm from their throat and to feed them before the mother starts producing milk. The honey is applied to the knees of older children so that their legs will grow strong and enable them to walk as soon as possible. Beyond mother- and childcare, *Jicote* honey has many more applications. People recovering from surgery are advised to eat the honey to cure internal wounds. It is also applied to open skin wounds to promote rapid healing without infection. This is particularly important for diabetics for whom the wound-healing process is often fraught with complications. The honey is also used to treat more general skin ailments and to cleanse the skin. *Jicote* honey is said to work miracles as an ointment for burns and scalds if applied directly after the accident. To cure gastritis and ulcers, it should be taken on an empty stomach. Bone fractures are set using a plaster cast coated on the inside with *Jicote* honey (for the skin) and cornflour. Finally, *Jicote* honey is thought to stimulate blood circulation.

The honey and larvae of *Talnete* (*Geotrigona* sp.) are used to treat internal injuries resulting from physical blows. When consumed, the honey is believed to reduce internal swelling. The larvae are cut up coarsely and applied to the skin. The honey and larvae are therefore in great demand for the treatment of accident victims, though no other products of this nest are ascribed curative properties.

3.8.2 The uses of wax, batumen and pollen

People keep bees not only for the honey they produce but for the wax as well. Wax of all the stingless species is used to make candles; however, the smaller species produce too little for them to be of much importance. Because it is so sticky, the 'black' wax is used to glue things together; in particular, to fix the stopper in the opening of the corn silo to keep insects out of the stored corn. When the wax is removed from the hive, it still has honey and/or pollen sticking to it and must be cleaned by boiling (see Section 5.4.5) Some people throw the wax away, though *Jicote* wax is too precious to waste. Apart from its practical uses, black *Jicote* wax is much used in witchcraft. Sorcerers can use it to affect people through sympathetic magic: in particular, wax of the hive can be used to harm the beekeeper or his family. Simultaneously, wax of the same hive can be used to protect the subject from the evil influence. To harm people, the sorcerer moulds a wax doll, pierces it with needles and buries it, preferably under a chili plant. Most witchcraft practices in El Salvador seem to be derived from the notorious *Libro Verde de San Cipriano*.[13] Unrefined black wax can be used for domestic protection: it is moulded into a cross and hung at windows and doors. Alternatively, a member of the household can carry a lump of the wax when he or she ventures out of doors. If no *Jicote* wax is available, garlic or mustard may be used instead. In *milpas*, some people protect the corn plants from strong wind by placing crosses of black wax at strategic points within the plot. Particularly because it is used to control evil spirits, you should

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[13]This lists all kinds of secret recipes and their effects. A newly initiated witch should not buy the book but receive it as a gift from an experienced practitioner. It is a public secret that the book can be bought at most *suchelerías* (mostly market stalls, but sometimes shops, selling herbs, honey and other natural products), although some will not sell it because they do not wish to be associated with witchcraft. Sometimes, the book can even be obtained from general bookstores.

never carelessly throw away *Jicote* wax, for someone may find it and use it against you. Some people believe that this wax is holy. The wax of other bee species does not function as an agent of white or black magic (see Note 14).

Pollen, called *xuchillo* - derived from the Nahua *xuchiyot(l)*, 'blossom' - is usually left in the hive. A few people say they occasionally eat it, though one should be careful because it sometimes causes vomiting. Depending on the species and the time of the year, it can taste sweet, bitter or sour. Pollen in not generally used as a medicine. However, whereas the honey of *Tamaga* (*Cephalotrigona capitata*) is used only as a foodstuff, the digested pollen mass of this species, which is also stored in the nest, is ascribed curative properties. Women drink a tea of this material to treat all kinds of disorders that affect the womb, such as the inner 'coldness' which is said to make them infertile, menstrual pain, haemorrhage and problems associated with the menopause. The tea is also drunk to cleanse the womb. Although various stingless species use batumen in their hives, this material is used neither medicinally nor for any other purpose.

Traditional healing practices are mainly based on humoral medicine, a belief system which aims to maintain or restore the body's internal equilibrium between extremes, or 'humours', of hot and cold, dryness and moistness (though variations in these continua are not necessarily detectable by the five human senses or by scientific measuring devices - see Section 7.3, paragraph including Note 9). All ailments and foodstuffs, as well as curative roots, herbs and other substances, are given a value in the hot-cold continuum. *Jicote* honey is classified as warm; the honeys of *Chumelo*, *Talnete* and *A. mellifera* as cold. As the tea of *Tamaga* pollen mass is used to treat coldness of the womb, it is presumably held to be warm. People are not certain whether *Tamaga* honey should be classified as warm or cold, which is hardly surprising, as no particular curative properties are ascribed to it. Interestingly, the honey and wax of the more productive *A. mellifera* (and the Africanized variant) are not used in traditional healing or magic. However, these non-native bees have one medicinal use which meliponine bees, by their very nature, cannot have: their stings are said to alleviate rheumatism. Common foodstuffs that are frequently classified as warm include coffee, mangoes, chilies, garlic and salt. Cold foodstuffs include pork, duck (extremely cold), citrus fruits, cucumbers and carrots. The humoral state also depends upon the way the food is prepared or, in the case of meat and other animal products, upon the age of the animal: ordinary tortillas are cold, though roasted tortillas are warm; chickens and piglets are cold, though full-grown fowl and swine are warm. Ailments classified as cold - including influenza, common colds, rheumatism and arthritis - should be treated with warm substances in order to restore the humoral balance. Conversely, warm ailments - including bruises and swellings, eye complaints, headaches, fever and kidney disorders - should be treated with cold substances. The system is widespread in Central America and Mexico, though in El Salvador the finer points seem to have been forgotten and people often contradict each other in classifying the humoral state of an ailment or recommending a specific product as a cure.[14] As similar practices also occur on the Yucatan peninsula, I return to this fascinating subject at a later stage in my dissertation (see Section 7.5.4 and 7.6).

3.9 The economic value of *Melipona* honey

The honey of meliponine bees is expensive because it is scarce and in great demand for its special properties. Although the price is usually settled in on-the-spot bargaining, there do seem to be unwritten guidelines. As *Melipona* honey is mainly used for medicinal purposes, beekeepers charge next to nothing when it is required by a relative or friend. (All prices stated in this paragraph are from 1993.) When they sell to a *suchelería* (a shop or market stall where herbs, honey and other natural products are traded), they usually get 100 to 125 colones (11.60-14.50 US dollars) for a 0.75-litre bottle of *Talnete* honey and 40 to 50 colones (4.64-5.80 US dollars) for *Jicote* honey. Even the non-medicinal honey of *Tamaga* sells to *suchelerías* at around 25 colones (2.90 US dollars) a bottle, 2.5 times the price of *A. mellifera* honey (about 10 colones - 1.16 US dollars - for a 0.75-litre bottle). Although *Chumelos* are more abundant than the other stingless species, their low productivity makes their honey expensive, at 100

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[14]None of the villages covered in this study have specialists in traditional medicine, though some inhabitants consult practitioners in nearby villages. It should be noted in this context that a nominal distinction is made between 'black' and 'white' lore, the first referring to potentially harmful witchcraft and the second to protection and curing with herbs and other medicines. In practice, however, people known as *brujos* (witches or sorcerers) tend to be versed in both fields of traditional lore and may prescribe certain remedies of their own preference. Generally, ordinary people also make use of their own medicinal lore, which has been handed down from generation to generation within the community or family. Herbs, roots, candles of various colours, books with instructions for witchcraft: all can be obtained at special market stalls or shops in town - the *suchelerías* - where *Melipona* honey is also sold, if available. Village people also sell their wares to the *suchelerías*, and if these do not have the desired product in stock, the proprietors can ask their village contacts to try to find it. In this way, townspeople can obtain natural products with which to treat their ailments, and villagers can sell their medicinal wares: both know where to go.

colones (11.60 US dollars) a bottle. However, as only a little is needed to treat eye complaints, it is usually sold in smaller quantities than the other kinds of honey.

Once family needs have been met, beekeepers are eager to sell their surplus honey. Although crops are also sold on local markets, the price of wage labour provides a more reliable standard for determining the real relative value of *Melipona* honey. In 1993, wage labour was quite cheap in the villages, at approximately 25 colones (2.90 US dollars) a day. Using the prices quoted above, one bottle of *Talnete* honey was the equivalent of four to five days of hard labour! Although a bottle of *Jicote* honey represented no more than two days' labour, some beekeepers had made quite a handsome profit with it that year, despite the fact that they only had a few colonies: Doña Sebastiana, with only four *Jicote* hives, had sold ten bottles for a total of 500 colones (58.00 US dollars); Don Pablo had sold 20 bottles for 600 colones (69.60 US dollars). Don Esteban, who obtained 72.5 litres of honey from his hives, offered it all to a local pharmacy at 50 colones (5.80 US dollars) a bottle. However, the pharmacy would pay no more than 40 colones (4.64 US dollars), so Don Esteban decided not to sell.

Although stingless bees are not kept on as grand a scale as *A. mellifera* in El Salvador, the profits meliponiculturalists can make may represent a significant financial gain to their subsistence households. Fairly recent statistics show that the mean annual income from agriculture in Salvadoran households with less than four hectares of land was 880 US dollars (Trifinio report, 1994). In contrast to crop growing, meliponiculture requires no land holding. This is of particular importance in El Salvador, which is densely populated and - unlike Mexico - has no legal provisions for communal land ownership, where all cultivable land is therefore private property and very expensive, and where a large sector of the population therefore owns no land at all and must depend almost entirely upon wage labour. The honey of stingless bees, when its price is expressed in real terms, turns out to be a highly valuable commodity.

3.10 Scarcity of forest colonies

Given that beekeepers generally prefer *Jicotes* and other stingless species to the European honeybee, why do they not breed more meliponine colonies? This question is particularly relevant to the situation in La Criba, where none of the beekeepers breed *Jicotes* and very few people keep any stingless bees at all.

As the beekeepers believe that stingless bees cannot be multiplied by splitting the brood, and as the probability of capturing a wild colony by putting out vacant logs is very low, they primarily depend upon removing wild colonies from the forest to augment or to maintain their stock of breeding colonies. Even though bee-hunters have special techniques for detecting wild meliponine nests and these have certain eye-catching characteristics, the fact that they are often located high in trees or under rocks can make colonies very difficult to collect. In recent decades, moreover, wild colonies of stingless bees have become increasingly scarce. The forest around La Criba, for example, has been slowly but surely reduced in area and the remaining pocket is too small to provide a sustainable habitat for the larger animals. Four villagers and I searched for colonies in the La Criba *machoral* on three consecutive mornings. This intensive hunt eventually yielded just one colony of *Alazana*, another of *Chumelo* and a mere 0.3 litres of *Chumelo* honey, which was all we could extract from the nest. We did observe seven other nests of various species, but these were either inaccessible or my companions saw no point in taking them home for cultivation.[15] We did not see any *Jicotes*. All in all, this was a pretty meagre result for about 15 hours' work! It should be noted here that the inhabitants of the area do not normally go into the forest just to look for bees; they pass through on a fairly regular basis to look for firewood and other materials, occasionally coming across a bees' nest. They know the typical sites where colonies are likely to settle, for example hollows in trees or abandoned birds' or ants' nests. In the Montecristo forest reserve, which is less affected by human interference than the other areas covered in this study, wild colonies of stingless bees are more abundant. Salvadoran law prohibits the cutting down of any tree beyond the perimeter of one's own land without special permission from the local authorities, and it is compulsory to plant a seedling to replace a felled tree. Although this law is frequently broken in many parts of the country, people in the Montecristo area are well aware of its provisions and the news that somebody has cut down a tree spreads through the village like wildfire, rapidly becoming a 'public secret'. During my sojourns in El Limo and El Brujo, so far as I could ascertain, only two colonies of *Jicote* were taken from the forest and a single wild colony of *Tamaga* was robbed of its honey.

Why are some species more abundant in the forest than others? Obviously, the

[15]In a single fallen tree of a species called *Quebracho* (*Lonchocarpus michelianus*), we spotted one nest of *Chumelo*. The wood of the *Quebracho* was too hard to be cut with a hand axe. Elsewhere in the forest, we spotted a nest of *Alazana*, another of *Culo de Buey*, two of *Maltatía* and another two of *Tamaga*. These *Alazanas*, the *Culos* and the *Maltatías* were ignored. The *Tamagas* were also left in the forest because we would have had to fell trees to get at their nests.

more useful and valuable the products of a particular stingless species are considered to be, the greater the number of its wild nests that are plundered or taken home from the forest. Less obviously and more importantly, those species which occupy a specific environmental niche (those that clearly prefer to nest in tree-hollows, for example) are more vulnerable to habitat destruction and fragmentation than less selective species (see Appendix I). Obviously, habitat fragmentation due to deforestation has far greater impact on tree-nesting species such as *Jicote* and *Tensuque* than it does on ground-nesting species such as *Talnete*. This effect is particularly apparent in the Sonsonate area, where *Jicote* has become extinct but *Talnete* and other, smaller species that can easily find nest sites have not. Sadly, in the La Criba area, wild colonies of *Jicote* appear to be on the brink of extinction: indeed, they may already have vanished by the time this dissertation reaches you, dear reader. In some areas where there are many cavities in the ground, the number of *Talnete* nests per unit area is much higher than in other areas with more compact ground. This may indicate that the number of available nest sites is also a limiting factor for this species.

The extinction of indigenous bee species affects not only the humans who keep them and/or use their honey and other products: it also results in less effective reproduction of trees and other flowering plants which depend on the bees for their cross-pollination, and may therefore even be a factor in their extinction too (Dr. Roubik; IBRA-congress 1996, San José, Costa Rica). In other words, the extinction of certain native bee species can lead to a serious degradation of the local environment. Beekeepers can help to identify the flowering plant species from which *Jicotes* collect, though they believe that the other stingless species are indiscriminate foragers. All beekeepers recognize that the *Xikuhnay* (*Vernonia* sp.), which blooms in and around April, is the food plant preferred by *Jicotes*. Throughout El Salvador, this plant grows in fields which have been left fallow after cultivation. Beekeepers also say that *Jicotes* visit *Roble* (*Quercus grandis*; *Quercus vicentensis*), *Zapotilla* (*Clethra lanata*), *Matasano* (*Casimiroa edulis*) and a shrub called *Chupamiel*, 'Suck-honey' (*Combretum erianthum*) (identifications based on Standley 1925). It should be noted that, although beekeepers may know which plants their insect charges visit, they neither sow these species nor plant seedlings of them in the vicinity of the hives, which is unfortunate, for this would greatly benefit the bees.

3.11 Why do *Jicotes* flee from, and die in, captivity?

The Salvadoran beekeepers in the areas covered by this study argue that *Jicotes* are much more delicate and sensitive than other stingless species and are therefore more liable to flee from, or die in, captivity. This argument seems to be supported by the fact that, over the past five years, they have lost: 33 hives of *Jicote*; five of *Chumelo*; three of *Tensuque*; two of *Maguas*; two of *Tamaga* and one of *Alazana*. A few beekeepers have lost all their hives in one disaster, they or their neighbours having used agrochemicals (in particular Tamaron™).[16] According to the beekeepers, the *Jicote* is more susceptible to agrochemicals than the other stingless species. It seems reasonable to assume that the plant species sprayed by people in these areas include the floral resources that are preferred by the *Jicote*, though there have been no scientific reports to confirm this as yet. It may also be true that the beekeepers are more aware of the decline of the *Jicote* simply because this is the most frequently cultivated species.

Other causes of colony loss have been indicated elsewhere in this section: invasion by various species of ants and by Phorid flies (Section 3.7; see also Section 5.6.1 & 5.6.2); and battles between rival colonies. Beekeepers attribute such in-fighting to a shortage of bee-food and, if they become aware of the problem in time, they will give extra food to the affected colonies and save them (see Section 3.7). According to the beekeepers, the recent massive deforestation has resulted in a general shortage of food plants for bees.[17]

In addition, many people have reported losing hives due to the death of the beekeeper or a close relative of his. Whereas some people claim that the bees die with the unfortunate human, others maintain that the bees bid farewell by swarming around or even inside the house before heading for the forest. This idea is widespread in El Salvador. In El Brujo and El Limo, only *Jicotes* are said to behave in this way, while people in La Criba claim that the phenomenon is restricted to *la Extranjera* (*A. mellifera*). In all three villages, people often assert that *Jicotes* will leave if a married

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[16]In general, bees are known to be highly susceptible to the use of agrochemicals. In many parts of the world, the European honeybee is used as the standard test-organism for pesticides. Typically, bees are accidentally poisoned when foraging workers come into contact with residual insecticides in sprayed fields, almost always in the blooms of weeds or crop plants. The spraying of insecticides in fields without blooms generally poses no hazard to bees. Bee-poisoning usually becomes evident when large numbers of dead bees are found around their hives (Dr. M.J. Sommeijer, personal communication).

[17]Deforestation has also lead to serious erosion problems, particularly in the Montecristo area. Despite an official ban on tree-felling, beekeepers in El Brujo claim that cattle-breeders (often outsiders) are continuing to deforest hillsides in the area.

couple has a serious argument. While all such claims are intriguing, there is insufficient information to place them in a cultural context. It is interesting that certain European folktales also refer to the soul of the beekeeper. According to a belief that used to be widespread in Europe, if bees were not informed of the death of their keeper, they would follow his soul into the afterlife (Ransome [1939] 1989: 161, 172).

3.12 Conclusions

There are several reasons why Salvadoran beekeepers prefer various meliponine species, including *el Jicote* (*M. beecheii*), to *la Extranjera* (*A. mellifera*). Firstly, curative properties are ascribed to stingless-bee honey; particularly that of *el Jicote*, which women take when recovering from pregnancy, and that of *Chumelo* (*Tetragonisca angustula*) which is recommended for eye disorders. In contrast, no medicinal qualities are claimed for the honey of *la Extranjera*. Biological and chemical analyses confirm that *M. beecheii* honey has greater antibiotic activity than *A. mellifera* honey (de Bruin & Sommelier 1997). Secondly, given the implicit danger of keeping Africanized bees in urban or village areas, the lack of information on the proper way to handle them, and the unavailability of protective equipment, beekeepers understandably prefer stingless species. A third factor is that, although cultivating *A. mellifera* is more profitable in cash terms because the species is more productive, the honeys of stingless species are locally 2.5 to 12.5 times more expensive than that of the stinging foreign species. Moreover, meliponiculture is far less time-consuming and labour-intensive than wage labour (and apiculture, as I demonstrate in the case of the Yucatecan Maya: see Section 6.3.2).

The data on the villages indicate that both meliponiculture and apiculture have declined, the latter because of the Africanization of honeybees. The figures also show that the beekeepers of El Limo and El Brujo are more successful in maintaining meliponaries than their counterparts in La Criba, where only three people still keep stingless species, none of which is the preferred *M. beecheii.* Generally, beekeepers are facing major problems with meliponiculture. They complain that the stingless bees used to produce far more honey, that the colonies are becoming seriously impoverished. Beekeepers could profit more from their stingless bees if they kept them in rational hives. However, they insist that the cultivable species can only be kept successfully in hives if these resemble the nest sites preferred in the wild. Tree-nesting species are kept in hollow logs; bees normally found in exposed nests are not removed from these; bees with no particular preference are kept in boxes; and ground-nesting species are not kept, they are left in the forest. This aspect of beekeeping practice has a sound biological background. Boxes must be hermetically sealed, leaving only a small flight-hole, otherwise Phorid flies will enter and exterminate the colony. Yet the customary accommodation of the various species cannot be responsible for the current impoverishment, and certainly not in the case of *M. beecheii*, which has always been successfully kept in logs.

One of the possible reasons for the decreasing productivity of this species is its competition for floral resources with *A. mellifera.* Although apiculture had declined dramatically in the villages due to Africanization, the more aggressive hybrid honeybees have colonized large areas, including some in the more remote forest areas where there has never been a significant population of purely European honeybee colonies. This invasion has taken place at a time of continuing deforestation in the region. Particularly when and where these two factors combine, the consequences for meliponiculture can be very serious. The beekeepers of La Criba are no longer able to keep *M. beecheii* in the village, apparently because there are insufficient food plants. In comparison to El Limo and El Brujo, there is very little suitable vegetation in La Criba because houses are built with little space between them (Section 1.7.1) and fields for crop growing are no longer worked using traditional slash-and-burn methods (Section 2.6.1). As a result, the village has hardly any wild floral resources within reasonable foraging distance of the hives. Although the people of El Brujo and El Limo have also abandoned slash-and-burn cultivation, their houses are more widely spaced and there is more wild vegetation - herbs and other flowering plants such as *Vernonia* sp., which the beekeepers consider to be the most important source of food for *M. beecheii* - to sustain the colonies (Section 1.7.1). Furthermore, deforestation has led to a drastic decrease in the number of available nest sites for native bees, especially tree-hollows. Because the beekeepers do not know how to multiply their stocks themselves by splitting the brood to create daughter-colonies, they depend entirely upon the forest, where the larger stingless bee species have become particularly scarce. This has had two important consequences. Firstly, wild colonies of *M. beecheii* have become so hard to find that beekeepers can no longer prevent the numbers of breeding hives in their meliponaries from decreasing. Secondly, if accessible *M. beecheii* colonies are found in the forest, the people take them home, which exacerbates the decline of wild colonies. Particularly around La Criba, where floral resources are dwindling and cultivated colonies dying, this is a continuous drain on the natural resources: it can only be a question of time before *M. beecheii* becomes extinct in that area.

In El Salvador, newly introduced religious beliefs have played a major role in altering the cultural system, of which beekeeping was traditionally an integral part. Nonetheless, the use of *Melipona* honey in the context of pregnancy is still widespread, as is the belief that the moon influences human fertility. If anything can be concluded from the information presented in this section, which is admittedly rather fragmentary, even meagre, it is that fertility depends upon water. Apparently, water restores life to the moon, which, in turn, is the agent of fecundity upon the earth, including the fertility of the native bees. Similarly, another fluid - the honey of *los Jicotes* - boosts the fertility of women and makes married couples more sexually potent. However, there is insufficient basis for firm conclusions. Many concepts concerning beekeeping have remained unexplained in this section. Why, for example, do women not keep stingless bees? Why do the bees flee when their keeper or one of his kin dies or when husband and wife fight? These questions cannot be answered satisfactorily within the system of beekeeping as I encountered it in El Salvador, for it is too fragmented; its decline is too severe. There is, however, another traditional beekeeping system with a solid cultural background, which, though also subject to a certain amount of acculturation and disintegration, is still reasonable intact: I refer, of course, to the meliponiculture of the Maya on the Yucatan peninsula. The following five sections therefore address meliponiculture in the Maya Zone of Quintana Roo State, Mexico, and related topics.

4 The Maya appropriation of the animal domain and the place of Meliponine bees

In many 'non-westernized' societies, people are less likely to place themselves above or outside nature than their counterparts in 'westernized' societies, they are less inclined to regard the human world as strictly separate from the domain of animals. Ingold has demonstrated that, in several animistic societies, the relations between protector deities and their animal charges are regarded as homologous to the relations between humans and animals. In such societies, people believe that the various components of nature and the vital energies flowing within them should be harmoniously integrated, that this is an essential condition for life. However, people and animals have to eat in order to survive and must therefore disturb the equilibrium of other, often animal, species (1986: 245-6).

This raises some important questions about the Maya, who view the world as animistic and hierarchical and the animal kingdom as being governed by protector deities. Firstly, how do the Maya appropriate that part of the animal domain which they depend upon for survival and how do they distinguish it from their own human domain? Secondly, why do the deities or spirits permit the animals that they protect to be killed by people? Thirdly, given that the Maya strive for harmony between the biotic and spiritual components of their world, do they intervene to restore the equilibrium of the system when it is upset and, if so, by what means? Finally and most importantly in the context of this dissertation, what place does the keeping of stingless bees occupy in their general conceptions of the hunting and husbandry of animals?

The answers to these questions relate directly to the Maya classification of animals, which I describe in general terms in Section 4.1, and more specifically to their classification of social insects, including bees, which I examine in Sections 4.3 and 4.4. How exactly do the Maya conceive of the protector deities that form an essential part of their religion? In Section 4.2, I attempt to answer that question and, in Section 4.5, I further explore the concept of spiritual protection of animals by discussing the ceremonies that are performed in honour of the protectors and by investigating why some animals do not require such ceremonies. In Section 4.6, I examine the Maya belief that, in September, certain species of animals undergo a dramatic metamorphosis.

What is the function of such a concept?

This is the first of five sections in this dissertation which address the views held by the Maya themselves (i.e. the 'emic' view). Some of the questions raised above cannot be answered satisfactorily within the scope of this section and I therefore turn to those remaining issues in the other four 'emic' sections.

4.1 The human domain; domesticated and wild animals

In the *ejidos* of the Maya Zone, the people live in homesteads (*solares*) within villages or on ranches. Each homestead is physically, socially and ritually demarcated from the surroundings (see Section 6.2). In this protected area, the Maya live alongside their domesticated animals, which they refer to as *alak'*. In the forest beyond dwell the wild animals, which are referred to as *ba'alche' k'aax* (wild animals of the forest) or just *ba'alche'* (wild animals). In everyday conversation, the Maya clearly make a distinction between domesticated and wild animals,[1] but what exactly are the distinguishing criteria? The best authorities on such matters are the *hmenob* or shamans, such as Don Rocío, who lives in Tepich. He is quite old now, but in bygone years he was renowned as a successful hunter. He carefully guarded the secrets of hunting deer and managed to shoot one or two on every hunting expedition. Because of his prowess, he was always allowed to eat the choicest meat, which is relished by the gods. One day, though, his luck changed. The deer turned against him, transmitting a severe fever that almost killed him. Following his recovery, he aimed his rifle at a deer once more and fired a shot. As soon as the bullet hit the deer, however, the animal changed into a *ch'amak* (*Urocyon cinereoargentus fraterculus* Elliot, a fox-like mammal also known as a *tlacuache*; Cordemex Maya dictionary). Don Rocío understood that he had broken the unwritten rules of hunting. He sold his three rifles and never touched a firearm again, for he was convinced that to do so would prove fatal to him. Don Rocío possesses a great wealth of animal stories, many of which are also told by other shamans. He is recognized as the specialist by other *hmenob* who are less familiar with the animal kingdom. The following system of classification is based mainly on his knowledge.

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[1]I once asked a Maya women how to say 'animal' in Maya. She told me in Spanish that she could only answer my question if she knew what kind of animal I meant (i.e. domesticated or wild). Jacinta Pool May, who kindly translated for me during my interviews with shamans in Tepich, sometimes used the word *ba'alche'* (without *k'aax*) if it was necessary to clarify that the animal in question belonged to the wild category.

Table 4.1: The classification of the animal domain

Ba'alche' k'aax **(wild animals)**		*Alak'* **(domesticated animals)**
Alak' **of the gods**		*Xunan kab (M. beecheii)**
keh (deer)	*chirike*	*kax (*chicken)
	yuuk	*tso'* (domesticated turkey)
	chiik	*miis* (cat)
kitam (peccary)		*pek'* (dog)
ha'leb (mexican agouti)		*k'ek'en* (pig)
		wakax (cow)
Yiik'le k'aax **(social insects)**		*tsismin* (horse)
siinik (ants)		*Americano kab (A. mellifera)*
kaaxi kab (forest bees)*		
xuux (wasps)		
xtu-yul (termites)		
Ba'alche'ob		
weh (armadillo)		
chak mool or *balam* (jaguar)		
kuts (wild turkey)		
animals walking on forest floor'		
Ch'ich'ob **(birds)**		
buhu (owl)		
pili' (parakeet)		
etc.		
Kanob **(snakes)**		
kame'		
otz kan		
etc.		
Pepemob **(butterflies)**		

* see also table 4.2

The categories shown in Table 4.1 do not include all the animals that are encountered in the region. This is because the knowledge of Don Rocío and the other shamans is restricted to those animals which are in some way important to the people. The *hmen* explained to me why a certain animal belongs to a particular category. The criteria, which are agreed upon by other *hmenob* and many laymen, are as follows:

1. forest *versus* protected area of human habitation (homestead)
2. wild (untamed) *versus* domesticated (tame)
3. type of habitat
4. morphological aspects

The first criterion, the differentiation between animals of the forest and those living in the homestead, would appear to correspond entirely to the second criterion, the differentiation between wild and domesticated animals. (However, as I explain in the final paragraph of this sub-section, certain gods keep their own 'domesticated' animals in the forest, though not all Maya know this.) Domesticated animals, *alak'*, may be bred in captivity and may live their whole life alongside people in the homestead. *Alak'* do not usually try to escape to the forest because they are well looked after in the homestead. In this context, it is interesting that young children may also be referred to as *alak'*, for they also require nurturing. According to the Cordemex Maya dictionary, *alak'* are the companions of people. This concept is in contrast to the animals of the forest, *ba'alche' k'aax*, which may physically cross the village boundary to live in temporary captivity among people, but are wild by nature and therefore never reproduce in captivity and always try to escape to the forest.

At the general level, the category *ba'alche' k'aax* is the group of all forest animals. At the more specific level, some of these animals are still referred to as *ba'alche'* (*k'aax*) while others fall into distinct sub-groups. The true *ba'alche' k'aax* are, in fact, those animals which are not included in any other category and which walk on the forest floor,[2] such as the armadillo (*weh*), the jaguar (*chak mool*, 'red paw', or *balam*) and the wild turkey (*kuts*). Although these animals are put in the same category, they live independently of each other and, in everyday life, no links are recognized between them other than relations within the food chain. Habitat is considered at a very general level. Animals which live in the canopy of trees and/or which are able to fly, such as the bird group, are distinguished from animals living on the forest floor. Snakes also form a group apart because they are considered not to have real bones.[3] Many of these animals are commonly referred to by generic names which correspond directly to those used in European languages (e.g. *kan*, 'snake'; *ch'ich'*, 'bird'; *pepem*, 'butterfly'). In this sense, animals are classified according to morphological aspects.

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[2]In Jacinta's opinion, the genuine *ba'alche' k'aax* have bones, though Don Rocío did not make this distinction.

[3]Although snakes do, of course, have a skull and dorsal vertebrae, the important criterion for the Maya is that these reptiles, unlike many other animals, have neither an extensive skeleton nor limbs.

In addition, the Maya recognize at least two other categories; the group of social insects, *yiik'le k'aax*, to which I turn in Section 4.3; and the *alak'* of the gods. Many lay people do not realize that there are *alak'* dwelling in the forest. Even though deer (*keh*), wild boar or peccary (*kitam*) and *ha'leb* (Mexican agouti)[4] live in the forest, they are classified as *alak'* because they are regarded as the domesticated animals of the gods.[5] These animals are kept in a forest *kabal* (corral or enclosure) in a flat area between four hills, the location of which is known only to the gods. These *alak'* of the gods may also live in captivity in the homestead, though this is rarely seen nowadays. In such cases, they are still *ba'alche' k'aax* to the people, for they only abide temporarily among them. A deer that has decided to escape to the forest starts collecting twigs and flees as soon as it has obtained thirteen. The wild boar or peccary, on the other hand, searches for firewood and finds seven sticks sufficient. Don Rocío does not know why these animals collect such items. The gathering of twigs or sticks is a sign to the people who are keeping the animal that it is preparing to escape and should therefore be eaten before it gets a chance to flee! Apparently, mortals do not have as much control over these animals as gods: therefore, as far as people are concerned, these *alak'* belong to the forest.

4.2 *Ah kanulob*: the protectors and true owners of animals

Although domesticated animals have a human owner, most of them are regarded as belonging to their rightful owner, the protector deity known as *ah kanul*. By hunting or husbanding animals, people therefore enter into a relationship not with the animal itself but with its spiritual protector. The *ah kanulob* permit people to make use of their animals on the condition that they abide by the rules. Some forest-animal species certainly have an *ah kanul*, though it is a matter of discussion whether all forest and domesticated animals have such a protector deity. According to Don Rocío, all animals have a spiritual protector but not all of them are known to people. Others argue that only some animals have a protector. I return to this issue in Section 4.5. The protectors

[4]In Mexican Spanish, the *kitam* is called *jabalí* or *pécari* (peccary) and the *ha'leb* is called *tespesquintle* (*Dasyprocta punctata yucatana*; Cordemex Maya dictionary). Redfield calls the latter the Mexican agouti (Redfield & Villa Rojas 1934: 208).

[5]Animals that seem wild and undomesticated to ordinary people may be controlled by magic and are therefore classified as *alak'* of the sorcerers. According to Redfield and Villa Rojas: "the *alak'* of the sorcerers are snakes and a certain kind of malignant insects" (1934: 178). These insects are probably ants (see quotes of Don Crescencio and Villa Rojas in Section 4.3.

were assigned to the animals when Noah lived; when the dominion of the Giants (*P'usob*) over the world came to an end. A *hmen* from the village of Epedz, who owns the largest meliponary in the area, told me the following story:

"Before the Flood, *P'usob* dwelt upon the earth. These *P'usob* had great power, almost as much as the Gods. They only had to express their wishes and these were fulfilled at daybreak. At that time, *Ah Muzenkab* was the protector of the bees. When the *P'usob* spoke thus, the next day they had a hundred *Ko'olel kab* [i.e. *Xunan kab*, *Melipona beecheii*]. But the Supreme God grew angry at the immense power of the *P'usob* and sent the Flood to destroy them. Of each kind of being in the world, He saved one pair in Noah's ark. They were the seeds with which He rebuilt the world. But *Muzenkab* had no partner. He perished in the Flood" (Desiderio, *hmen*, Epedz).

Don Rocío denied that *Muzenkab* had been the protector deity of the bees, according to him this is the name of a species of bee that dwells in the ground. He does agree that God ended the power of the *P'usob* by sending the Flood and that Noah took a pair of each animal species into his ark; these were the 'seeds' (*semillas*) of the animals that now inhabit earth and each of them was assigned a protector, an *ah kanul*.

Who or what exactly are the *ah kanulob*? In an essay on certain shamanistic American societies, their conceptions of the animal domain and its appropriation by gods and humans, Ingold (1986: 245-7) gives a very clear picture of such figures. Many of the notions he discusses are very similar to those of the Maya. An essential belief, common to such societies, is that body and soul can be voluntarily separated. Among the Maya, this is apparent in shamanistic practice: in dream voyages, for example, the soul of the shaman visits the realm of the gods while his body remains asleep on earth. Ingold extends his argument by stating that all people have a personal soul which gives them a unique identity, but that these persons meet non-human beings who, rather than being unique, represent an 'essential type' (an archetype) and "it is the type rather than its manifestations that is personified" (ibid.: 247). This 'essential type' is the animistic or animal spirit. Among the Maya, this is evident in, for example, the stories told by Don Rocío and many other hunters, who are punished by the *ah kanul* of the deer or of some other prey, as manifest in the form of the animal. This animal does not have a personal name but represents its entire species. It follows that, in contrast to humans, animals do not have a personal but a collective spirit, as manifest in the *ah kanul*. This is possible because body and soul can be separated. On a non-human level, so it seems, there is a distinction between the bodies of individual animals on the one hand and their collective identity and spirit on the other hand. Some *ah kanulob* have names (e.g. *Ah kanul kax*, 'Lord of chickens'), not all of them known to people. People with their individual identities together form the human world; the animal spirits as archetypes of their species form the animal-spirit world.

When using animals for food or materials, people must therefore take the feelings of the *ah kanulob* into consideration. If you hunt infrequently, you are not likely to be resented by the *ah kanulob*. Skilled and frequent hunters, however, need to perform a special ceremony to obtain his permission. Similar rules govern the use of domesticated animals. Such ceremonies are actually a form of payment to the gods. For the protectors of *alak'*, a ceremony known as *loh* (meaning 'to redeem', 'to rescue' or 'to exchange': see also Section 4.5) should be performed. A different kind of *loh*, a ceremony called *tsom*, is required by the protectors of *ba'alche' k'aax*. As people do not have the power or right to domesticate the animals that are kept in the forest by the gods (*alak'* of the gods), for ceremonial purposes such animals should always be treated as *ba'alche' k'aax*, which means that their protectors should be honoured by the hunting ceremony *tsom*. If the people do not abide by these rules, they run the risk of being punished by the *ah kanulob* with illness or death. In particular, a hunter may incur the wrath of the *ah kanulob* if he kills too many animals that are domesticated by the gods themselves. One of these gods is *San Eustacio*, who keeps deer. If a hunter has killed too many deer, *San Eustacio* may send *Sip*, a cat-sized buck that bears the nest of *Ek*, a species of wasp, in its antlers. If the hunter attempts to shoot the buck, the wasps sting him to death. Instead of a wasps' nest, *Sip* may also bear a cross in its antlers and send a wind (*Sipiik*) which inflicts a severe fever.[6] Hunters should therefore perform a minor ceremony to obtain the permission of the *ah kanul* before shooting his animals.

Hunters may make use of secrets (*secretos*) to achieve their greatest successes. For example, there are three *suertes* ('virtues' or charms) for deer: a ball (*bola*), a fang or canine tooth (*colmillo*) and a stone (*chob*). These objects, which embody the power of the animals, are kept hidden in the stomachs of certain deer. If one of the *suertes* is lost, all the deer start looking for it.[7] If the hunter is lucky enough to find such a *suerte* and decides to keep it, the deer will be drawn to him. They will even wait for him at an entrance to the village, making it very easy for him to shoot them. Hence a *suerte* is very powerful; it should be handled with care, and requires the following special treatment:

"If the deer notices you, he will throw up [regurgitate] his *suerte* so that you cannot easily find it. If you find it but do not want it, the best thing is to throw it away, because you have to feed this

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[6]It seems likely that the original Maya notion has fused with aspects of St. Francis of Assisi, the Catholic saint, who is often depicted in the company of a deer with a cross in its antlers.

[7]Don Rocío was unable to explain exactly why the deer need these *suertes*.

suerte. Every time you go hunting, you have to shoot a deer. You may lend neither your rifle nor your *sabocan* [shoulder bag] to another person. Every day, you have to feed the *bola* [ball] with the blood of the deer. It is very dangerous because an ill wind may be sent to you. I once had all three *suertes*: *bola*, *colmillo* and *chob*. If you have all three, you should return them to the deer, otherwise you will become too powerful and this will kill you" (Don Rocío, *hmen*, Tepich).

A *suerte*, then, can become a dangerous possession. There are many stories of hunters who lost their lives through keeping a *suerte*. Don Rocío, too, was punished by the *ah kanul* of the deer because he had shot too many animals and not returned his *suertes*. Only by performing a *k'ex* (a ritual 'to change one's fortunes') did he save his life, but he never took up his rifle again. The *ha'leb* (Mexican agouti) and the wild boar or peccary are also protected by *ah kanulob*. The *ha'leb* has a *suerte*, but only one, and this is less powerful than those of the deer. Other animals, such as the armadillo, the *pavo del monte* (wild turkey) and the *ba'* (a rodent), may also be protected by *ah kanulob*, though the Maya maintain no relations with these collective animal spirits. *San Jorge*, the protector of snakes, may be petitioned for the favour of not being bitten. Hunters need to know these rules if they are to achieve success and remain healthy. In case of doubt or illness, the best thing a hunter can do is to consult a *hmen*.

Primarily, then, domesticated animals are under the control of their *ah kanul*; humans are never more than owners-by-proxy. Whereas wild animals do not have human owners, they may, in exceptional cases, dwell in the homesteads of people for a short period. The distinction between the relationship of humans to domesticated animals and the relationship of humans to the wild animals of the forest is thus a question of control. As a rule, the *alak'* pertain to the homestead, where people nurture and tend them (similarly, people raise children, who may also be referred to as *alak'*). Although some wild animals may cross the boundary between the forest and the homestead, they remain wild by nature and will neither stay long nor reproduce in the human domain. People must enter the forest to hunt the animals that are domesticated by the gods. The only way hunters can gain control of these animals is by obtaining their 'virtues'. However, the *ah kanulob* require something in exchange for the service or favour of sharing their animals with people. Hunters who cling to *suertes* of animals must be particularly careful not to incur the wrath of the *ah kanulob*. The important point in such cases is that the power of the hunter increases disproportionately and may easily disturb the harmonious balance of give-and-take, an abuse for which many a hunter has paid with his life.

4.3 The social insects

The Maya regard the social insects (*yiik'le*) as a separate category because they clearly live and act in groups. This category comprises bees (*kab*), wasps (*xuux*), ants (*síinik*) and termites (*xtu-yul*), which have the common characteristic of social behaviour: they live and work together as a large family. In the nest, individuals co-operate to perform the necessary tasks, including caring for other individuals in the group that are not able to leave the nest. All the various species of wild bees, wasps, ants and termites belong to the forest and are therefore known as *yiik'le k'aax* (social creatures of the forest) or *u yaalaki' k'aax* (the children of the forest). The Maya are familiar with several wasp species. Some of these live in exposed nests made of a paper-like substance (*u pak'*); others build underground nests. The Maya do not cultivate wasps, but they eat the larvae of several species (e.g. *Ek*, *Xanal Chak* and *Chup ti'*).[8] Some wasp species are known to be hunters (e.g. *Xakatbe'*), but the people are more acquainted with those few species that collect nectar and pollen from flowers.[9] The species known as *Ek* is the one that is said to dwell in the antlers of the divine buck *Sip*. Because wasps sting so ferociously, there are many stories about people who have been attacked by them. Termites, regarded as a group apart within the *yiik'le k'aax*, are not used for any purpose.

The Maya often compare the ant group to the bee group. Ants live together as a big family in a nest, which may be constructed in a cavity in a rock or the earth. The people know that the rainy season is approaching when the ants move with their whole family and offspring to other nest sites that are less likely to be flooded. When the leaf-cutting ants (*Atta cephalotes opaca*, called *Say* or *Mulsay* in Maya) carry large quantities of leaves to their nests, the people know it is time to start clearing the fields (*milpas*) for corn production. According to the *hmen* Don Hipólito, the ants are also 'cutting the fields'. The Maya explain this behaviour as ants taking leaves to feed their fellows that are not able to leave the nest. Frequently, leaf-cutting ants cause big problems for the *milperos* by destroying young corn plants. There are also carnivorous species, such as *Chak Wayah Kab* and *Xulab* ('Devil': *Eciton burchelii barvispinus*, according to *Licenciado* Gonzáles Acereto, *Universidad Autónoma de Yucatán, Escuela*

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[8]Although the species of wasp commonly known as *Chelem* is not cultivated, the Maya do not remove the insects if they construct their nest under the eaves of a house, see Note 26, Section 8.

[9]Such wasps are in the minority: most species are carnivorous.

de Veterinaria). These carnivorous species are seen as the worst enemies of the bees; the *Chak Wayah Kab* even owes its name ('Beehive-Destroying Red Ant') to this behaviour. *Xaakal* is another carnivorous ant (an as yet unidentified *Eciton* species) but, unlike the other species, it is useful to the people for it devours all scorpions, cockroaches, *grillos* (crickets) and other small animals that cross its path. When a colony of *Xaakal* marches in the direction of a house, the family will temporarily leave, allowing the ants to clean up for them. The Maya therefore regard ants as hunters. They operate in groups to pursue their prey and, once it has been immobilized, call in the assistance of their fellows to drag it home to the nest. The Maya refer to their leaving the nest *en masse* with the phrase *p'uúhul síinik*. The verb *p'uúhul* means 'to make a din, to cause a racket' and, as Hanks notes, citing the Cordemex Maya dictionary, this also denotes "the collective hunts that the men conduct, in which they fan out in the forest making a racket to drive the game towards men posted along known paths" (Hanks 1990: 528-9). The Maya thus draw a parallel between this behaviour of ants and one of their own hunting methods: they are, of course, both strongly associated with the forest. According to the *hmen* Don Medardo, this is why ants are grouped with the *yiik'le k'aax* or *u yaalaki' k'aax* (children of the forest). Ants are known to consume people's food and, like snakes, are associated with witchcraft. The following statement explains the link between these seemingly unrelated creatures:

"*Say* [a leaf cutting ant] never leaves his nest on his own, but is guided by a snake. There used to be a nest of *Say* beside a house near to the *telesecondaria* [secondary school]. The ants came to my homestead to eat the leaves of the crops. From that far away, they came straight here. Then, one day, a man told me what he had seen ... well, a snake guiding the ants. The snake goes in front leading them all the way to the place where the food is" (*hmen* Don Crescencio, Tepich).

Villa Rojas explains why the Maya associate ants and snakes with witchcraft:

"Of all evil beings, *Cizin* (the Devil) occupies the foremost place [...]. The house of *Cizin* is in *metnal* (hell), which is located deep under the earth; however, it is believed that he almost always stays in these underground nests [of the ants] called *Mulsay*, which are like the entrances to *metnal*. Perhaps this notion has been influenced by the fact that, in such ants' nests, one occasionally finds venomous snakes, which are considered to be representatives of the true Devil" (Villa Rojas 1978: 299; my translation[10]).

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[10] "Cizin (diablo) ocupa el primer lugar entre esos seres maléficos [...]. La casa de cizin está en el metnal (infierno) situado en el fondo de la tierra; sin embargo, se cree que permanece, casi siempre, en esos hormigueros subterráneos llamados mulsay; los cuales son como entradas al metnal. Quizás influya en esa

The Maya of San Antonio, Belize, who are partly descended from refugees of the Yucatecan Caste War, also associate ants with witchcraft and snakes (Thompson 1927-32: 68-69, 109, 115). While it is true that the Maya see certain similarities in the lifestyles of ants and bees, in some senses they regard ants as the opposite of bees: whereas bees 'grow' or store their own food, i.e. the honey which can be used by humans to boost their fertility, ants consume the food of other beings and are associated with witchcraft and illness. Furthermore, ants live in the forest while certain species of bees live in the homestead.

The bee group is sub-divided according to a number of criteria. As shown in Table 4.1, one species pertains to the group of domesticated animals, *alak'*, while all the others are regarded as *yiik'le k'aax* or, more specifically, *kaaxi kab* (forest bees):

"After the Flood, all the animals resumed their lives on Earth. God told the bees that He would perform a *loh* [ceremony] for them, that He would consecrate them. The bees *Xiik', E'hol, Xnuuk, Muul* and the others did not believe Him. They thought that God would kill them. They did not believe the word of God, so they fled into the forest. All except *Ko'olel kab* [i.e. *Xunan kab, M. beecheii*]. She did not leave and was blessed by God, who performed a *loh* for her. That is why the people must take care of *Ko'olel kab* and perform a *loh* [...] for her every year. Ever since then, *Ko'olel kab* has been cared for by the people, while the other bees dwell in the forest" (Desiderio, *hmen*, Epedz).

As this shaman also told (Section 4.2), *Muzenkab*, the *ah kanul* of the bees, perished in the Flood, therefore *Xunan kab* was placed in the care of the people by the word of *Yumbil Dios* (Almighty God). All the other animals were assigned a non-human protector or animal spirit. People nevertheless have to perform a *loh* for the bees, although this ceremony is not dedicated to a mere animal spirit but to *Kun K'u*, the chief of the rain gods and to Almighty God himself.

4.3.1 The domesticated bees

There are several stories concerning the origin of the bees. Some of these relate how *Ko'olel kab* (i.e. *Xunan kab, M. beecheii*) was born of a virgin:

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idea el hecho de que en tales hormigueros se encuentran ocasionalmente culebras venenosas, las cuales son cosideradas como representaciones del propio diablo".

"They cut the head off a virgin. From her body emerged *Ko'olel kab*. God consecrated her as someone that should be cared for" (Desiderio, *hmen*, Epedz).

"In Chichén Itzá they sacrificed virgins, the most beautiful ones. They cut their hair. They filled the virgins with gold and then threw them into the *cenote* [sink-well]. Once there was a very beautiful virgin. She had no desire to be sacrificed. Her lover cut her hair, but only the ends. He wanted her hair as a keepsake. They threw the girl into the *cenote* against her will. From the ends of that virgin's hair emerged *Ko'olel kab*. Because she came out of a virgin she is a very fine bee" (Doña Maria, Tepich).

Ko'olel kab means 'Lady bee', 'mistress', 'proprietress' and 'wet-nurse' (Cordemex Maya dictionary).[11] The Maya often call this species *Xunan kab* (see Table 4.2), which also means 'Lady bee'. As the two names and the stories indicate, the species is

Table 4.2: The bee species of the Yucatan peninsula used by the Maya in Quintana Roo

Scientific name	Common name	Translation
Melipona beecheii	*Xunan kab*	Lady bee
	Ko'olel kab	Lady bee / Mistress (etc.)
	(d)el Pais	(of) the Country
	Colmena kab	Hive bee
	Santo kab	Holy bee
Melipona yucatanica	*Yaxich*	Green-eyes
Trigona fulviventris	*E'hol*	Black-hole
Scaptotrigona pectoralis	*Kansak*	Strong-cloud
Frieseomelitta nigra	*Xiik'*	White-wing
	el Minero	Miner
Nannotrigona	*Bool*	Belly button
Plebeia sp.	*P'uup'*	?
Trigonisca sp.	*Chechem*	Eyesmut
not collected	*Ta'anjool*	Lime-entrance
Partamona nigrior	*Tsots*	Hair
Partamona nigrior	*Ku'urix*	?
Trigona compresa	*Xnuuk*	Old woman
Trigona fulviventris	*Muul*	Mound
not collected	*Muzen kab*	?
Lestrimellita limao	*Nii'kib*	Wax tree-shoot

Species identified by: Dew Makhan

[11]The Cordemex Maya dictionary spells the name *Kolel kab*; however, people in the Maya Zone clearly pronounce the glottal stop as in *ko'olel*.

considered 'female'. Some authors have suggested that the name *Ko'olel kab* is used in a certain geographical area, while elswhere the bee is called *Xunan kab* (Campos López *et al.* 1990: 25). However, in the villages where I interviewed beekeepers, the two names were used interchangeably. Other names given to *M. beecheii* are: *(d)el País*, '(of) the Country'; *Santo kab*, 'Holy bee'; and *Colmena kab*, 'Hive bee'. To avoid confusion, I generally refer to the species as *Xunan kab* in this dissertation.

Xunan kab is *alak'*, she lives in the homestead within the village and stays among the people as God ordained, unless they fail to care for her properly. However, *Xunan kab* no longer dwells only among the Maya; she also lives in the forest. This is what happened:

"Once there was a gentleman, a prince. He fancied *Xunan kab*. He asked if he could marry her and they told him he could. But there was no house where they could live [and consummate their marriage]. Again and again the man came to visit her ... but eventually he could bear it no longer and, during one of those visits, he violated *Xunan kab*. She flew away. She fled to the forest. Ever since then, we have had to search for her in the forest and take her home with us. *Xunan kab* was the first bee, then came *E'hol*, *Nii' kib*, *Xnuuk* and the others" (Don Pedro, Chan Chen Comandante).

According to this story, then, *Xunan kab* has not always been a forest-dweller. Redfield and Villa Rojas state that new beekeepers were generally advised to obtain their colonies from a fellow-beekeeper and not from the forest (1934: 49 and see quote in Section 4.4). Nowadays, some Maya living in Yucatan State even claim that *Xunan kab* cannot survive in the wild as she depends upon the care of people (Zwaal 1993: 23). The latter notion is certainly consistent with the recent widespread deforestation of many parts of Yucatan State. Be that as it may, both statements indicate that these bees are in some way dependent upon people; arguably, to the extent that they cannot reproduce without human nurture. In the homestead, people keep *Xunan kab* in horizontal hollow logs stacked up in a special bee-house (the *nail kab*; see Sections 5.1 and 5.2). The logs are never placed upright: the beekeepers argue that the *Xunan kab* of the forest live in horizontal branches of trees and therefore do not like to live in a vertical hive.

Xunan kab produces honey of incomparable quality. The Maya explain this by saying that *Xunan kab* goes to *Xmaben* to collect honey. According to some, *Xmaben* (literally 'canoe', Cordemex Maya dictionary) is a honey-filled canoe at a place in the sky called *u Gloria* (its Glory), which is guarded by rain gods, the *Chakob*. There among the gods dwell the *Ba'baalob*, giants of a sort, who love to bathe in the honey and therefore tend to spoil it.[12] For this reason, the canoe is guarded by the dogs of the *Chakob*. According to other Maya, *Xmaben* is a celestial field of flowers which belongs to the *Chakob* and where *Xunan kab* collects honey. As this is the only species which has access to *Xmaben*, its honey is said to be divine in both origin and quality. Some people also acknowledge that *Xunan kab* collects nectar and pollen from earthly flowers, but only from a few of the finest species. (see Sections 5.3.1 and 9.1, 9.7). Some Maya have come to accept that *Xunan kab* collects food from flowers on earth. A few of them have therefore adapted the traditional belief, claiming that this bee goes to *Xmaben* to collect not honey, but water. This is not without a certain logic, as water is indeed a precious commodity on the Yucatan peninsula.

Americano kab, the honeybee familiar to Europeans (*Apis mellifera*), has not always lived in Yucatan. Considered as 'male', he was imported to the peninsula from the United States (Section 2.3), as the Maya name indicates. In some parts of the peninsula, he is also called *Italiano kab* (Italian bee)[13] or *el Extranjero* (the Foreigner). This species can sting, unlike the native bees. Recently, a new variety has invaded the peninsula: *Africano kab* (the infamous Africanized honeybee), which is also thought of as 'male'. Among the Maya, there is some confusion concerning the classification of these bees. *Americano kab* and *Africano kab* should be kept in the undomesticated domain beyond the village. As one can capture untamed colonies of both these bees in the forest or *milpas* (cornfields) it would seem logical to include them in the category of *kaaxi kab* (forest bees). However, all beekeepers agree that they can domesticate these bees with the greatest ease, that they are far more under human control than any native bee species. For this reason, most people tend to classify them as *alak'*. In a sense, they are *alak'* by origin and *kaaxi kab* by virtue of their usual, misappropriated habitat.

4.3.2 Bees occasionally cultivated

The species of bees commonly known as *Xiik'* (*Frieseomellita nigra*), *E'hol* (*Trigona fulviventris*) and *Kansak* (*Scaptotrigona pectoralis*) are *kaaxi kab*: forest bees. Like the deer and other animals of the forest, they may occasionally live among the people of

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[12]The shaman Don Hipólito took great pleasure in mentioning this habit of the *Ba'baalob*, though he could not account for it and, indeed, had little more to say on the subject of the giants.

[13]Calkins states that *A. mellifera* was introduced to the Yucatan peninsula several times, once from Italy (1974).

the village, but only temporarily: it is their nature to return to the forest sooner or later:

"*Xiik'*, *E'hol*, *Kansak* and are different; you cannot domesticate them. They don't like to be imprisoned" (Don Fernando, Tepich).

All three of these bees are black. *Xiik'* means 'Whitewing' and white wing tips are indeed the most remarkable morphological characteristic of the species. The thorax of *E'hol* is black and its abdomen is dark orange. It is sometimes claimed that the name *E'hol* is a contraction of 'black' (*ek*) and 'hole' or 'entrance' (*hol*) and therefore means 'black nest-entrance'. This explanation seems reasonable, as these bees typically guard the nest-entrance in large numbers. *Kansak* has a reddish stripe on his head. The name means 'Strongcloud', and these bees do indeed defend their nests in groups resembling small clouds.[14] The Maya also jokingly call this species *Pets pool* 'Crush-head' because, if you try to take his honey, *Kansak* buzzes around your head and gets tangled in your hair, which makes you want to smash his head in! If you do, it is believed, a bee protector comes in the afternoon to cure him. All three of these species are regarded as 'male'. *E'hol* is often referred to as the husband of *Xunan kab*:

"There are *Xunan kab*, *P'uup'* and *E'hol*. *E'hol* is male [...] and *Xunan kab* is female; she's a lady. And *P'uup'* is the *t'uup* [the youngest of the family]. *P'uup'* is the son of *E'hol* and *Xunan kab*" (Don Pepe, Yaxley).

People occasionally keep *Xiik'*, *E'hol* and *Kansak* for their honey or wax, but always at a distance from their hives of *Xunan kab* (see Section 5.2). As beekeepers have observed that *Xiik'* builds a vertical nest, he is also called *el Minero* 'the Miner'. The honeys of these three species are far less prized than that of *Xunan kab*, for they are said to be less selective, taking nectar from any kind of flower. Some people even consider such honey to be somewhat polluted: the bees are seen collecting from human and animal faeces before putting their 'mucky little feet' in the honey. They are even accused of defecating in the hive. Such uncouth behaviour is, of course, quite beneath the ladylike *Xunan kab*. It is therefore not surprising that the wild nests of these three forest bees are plundered without the slightest intention of saving the colony. The Maya take all the wax from the nests and even roast and eat the larvae of *E'hol* and *Kansak*. The

[14] *Sak* means 'white' and 'cloud'; in conjunction with this word, *kan* means 'strong' (Cordemex Maya dictionary).

honey of *E'hol* is often a little acid in the winter. This species also stores *lokok* in the hive, a very sticky yellow resin collected from plants.

These three wild and 'male' species defend their nests against intruders far more furiously than *Xunan kab*. If disturbed, they buzz around one's head in a dense cloud and try to bite, aiming mostly at hair or eyelashes. They also try to enter one's nostrils or ears, which is extremely irritating. Most people react to such an attack by lashing out wildly, yet very few will actually abandon the attempt to rob the bees of their crops. To contrast such behaviour with that of *Xunan kab*, some people maintain that these species sting, which they are in fact unable to do, though their bites may be a little painful.

Another species of forest bee, *Yaxich* ('Green-eyes', *Melipona yucatanica*), is very similar to *Xunan kab*, but a little smaller. Most beekeepers have only heard of this bee in stories; they know no-one who has kept it nor, indeed, anyone who has seen it in the forest for quite some years. The species seems to have been regarded as *kaaxi kab*, a forest bee, by the beekeepers cited by Redfield and Villa Rojas (1934: 49; see extract in Section 4.4). Contemporary beekeepers say that it can be kept in the homestead, yet it has never been cultivated on the same scale as *Xunan kab*. Generally speaking, very little else is known about 'Green-eyes'.

4.3.3 The smaller forest bees

The smaller species of bees are *P'uup'* (*Plebeia* sp.), *Bool* (*Nannotrigona* sp.), *Ta'anjool* (an unidentified species, which I was unable to collect) and *Chechem* (*Trigonisca* sp.), all of which are considered to be 'male'. Even the larger two, *P'uup'* and *Bool*, are no more than about three millimetres long, while *Chechem* measures a little over one millimeter. Like the larger forest bees, these species build nests and live in colonies. However, their colonies consist of fewer individuals, which makes them quite difficult to detect in the forest. They build their nests in all kinds of cavities in natural and man-made structures such as rocks, walls and fences, etc. Like the bees themselves, the nest-entrances are very inconspicuous, so these species are not easy prey. When the bees become aware of any danger, they hide in the nest. They can remain quiet for several hours, during which not one bee will try to enter or leave the nest. This also makes it difficult to find a colony. Only the nest-entrance of *Bool*, which is a small tubular construction, is likely to attract the attention of humans.

The Maya often describe *P'uup'* as the youngest son of *Xunan kab* and *E'hol*. In the following story, however, *Xunan kab* is presented as his elder sister. In all cases, *P'uup'* is the *t'uup*, the last-born and generally the smartest of the family.

"*T'uup* goes to visit *Ko'olel kab*, his elder sister [*k'iik*]. When he arrives there, he says to himself: 'I wish she would lend me her honey.' Hearing this, *Ko'olel kab* replies: 'If you need it, take it, *P'uup'*. Come into my house and look for it.' *P'uup'* enters the house of *Ko'olel kab* and takes the honey home. A long time passes and still *P'uup'* does not return the borrowed honey. His elder sister asks him: '*T'uup*, how long is it going to take you to return that honey you borrowed from me?' He replies: 'It won't take long, sister. If you wish, come to my house and look for it.' One day, *Ko'olel kab* visits the house of *P'uup'*, saying: 'I've come to fetch the honey you borrowed from me!' So *P'uup'* says: 'Enter, *Ko'olel kab*, and take the honey with you.' But *Ko'olel kab* can't get into the tiny house of *P'uup'*, for she is too big. 'Don't you see that your house is too small?', she complains, 'I can't get in!' So *Ko'olel kab* returns home without the honey" (Don Avelino, *hmen*, Tepich).

The notion that *P'uup'* has borrowed his honey from *Xunan kab* explains why it has the same excellent flavour and high quality as hers.

The Maya name for the second of these small species of forest bees, *Bool*, means 'belly- button' (navel). Every night, these bees seal the tiny entrance tube to their hive 'when they go to sleep'. They are so regular in this habit that some Maya keep a colony of them as a clock. As this species produces very small quantities of honey and wax, breeding them for production is not worthwhile for the Maya, although the honey is considered to be good. In any case, they are *kaaxi kab* (forest bees) and do not stay among the people for long.

The name of the third species, *Ta'anjool*, means 'lime-entrance', for these bees are said to use lime to construct their nest-entrance. Unfortunately, this species has become very scarce and nobody was able to find a nest of it during my fieldwork period.

The smallest of these four species is jokingly called *Chechem*, which means 'Eye-smut'. Indeed, he seems scarcely large enough to be accorded the status of a bee. The name actually refers to his rather unpleasant habit of alighting at the corner of one's eye to suck up sweat. These bees also collect sweat from other parts of the human body.[15] For this reason, and also because they collect from faeces, their honey is disliked.

[15]These are the so-called 'sweat bees'.

4.3.4 Bees living in exposed nests

There are three species of forest bees that live in exposed nests, *Tsots* (*Partamona nigrior*), *Ku'urix* (also *Partamona nigrior*) and *Xnuuk* (*Trigona* sp.):

"We call their earthen house *k'amas*. The bees take the resins of the trees *Chakah* [*Bursera simaruba*] and *Nicte'* [*Plumeria* sp.]. They mix it with earth and then start to build their *k'amas*" (Don Baltizar, Tepich).

The *k'amasob* of these species vary considerably in size: according to one beekeeper, the nest of *Ku'urix* is half a meter smaller than those of *Xnuuk* and *Tsots*. The nests are often built high up in trees and, on account of this and their form, are very conspicuous. They may also be built in cavities in walls. In fact, these species do not seem to be at all critical in selecting nesting sites, which may explain why they are quite abundant, nowadays even in villages and cities. However, beekeepers do not keep these bees, arguing that they do not naturally inhabit tree- hollows and therefore cannot be kept in logs. There are other reasons why none of the beekeepers have ever tried to keep them in the homestead: they are *kaaxi kab* and defend their nests rather aggressively. In addition, their honeys are not much appreciated, though that of *Ku'urix*, is used to cure coughs. Like the other forest bees already described, these bees collect from faeces. Although their honeys are sweet, the storage pots (*chu*) are made of mixtures of wax, resins and earth, and are too brittle for honey to be harvested without becoming polluted. Moreover, if honey is harvested, it easily becomes mixed with pollen because honey and pollen are not stored in pots in separate compartments of the nest. *Tsots* means 'Hair'. According to the Maya, this bee is so named because it has the habit of 'cutting one's hair' (i.e. biting into one's hair) when disturbed. The meaning of the name *Ku'urix* is not clear. These two species are regarded as 'male' bees. *Xnuuk* is the only 'female' of this category. Her name means 'Old woman' or 'Grandma' (on the father's side of the family). Because these three species of bees defend their nests so furiously, their honey is difficult to harvest. Furthermore, their larvae are not regarded as a delicacy. For these reasons, they are usually left undisturbed.

4.3.5 Bees living in the ground

It is because of his laziness and impatience that *Muul* (*Trigona* sp.)[16] lives in a *k'amas* in the ground:

"*P'uup'* summoned all the other bees. He also asked *Muul* to come. All the bees showed up, except *Muul*, who was late. By the time he came, the other bees had taken all the seats. *Muul* was annoyed. He sat on the floor, irritated, complaining that there was not even a seat for him. 'No,' said the other bees, 'we were just looking for a seat for you.' So *Muul* cannot live high up in the tree in a bee-log. Although he is a big bee, he cannot live in the heights but only in the pure soil. He was impatient. His *ah kanul* [protector deity] condemned him. He saw him sitting on the ground and said: 'You're not going to live high up, you will always stay there in the earth'" (Don Vincent, Yaxley).

Muul means 'Mound', indeed a small mound betrays the presence of this species' nest, a *k'amas* built quite deep in the ground. For this reason, excavating it is hard work and people argue that they cannot breed this forest bee. *Muul* is regarded as 'male'. Most people find his honey sweet and edible. However, when the bees return to their nest they often fly slowly, which is why the Maya believe that eating their honey makes one slow and lazy. Some elderly people know of another ground-dwelling species called *Muzen kab*. Unfortunately, during my fieldwork nobody knew where a nest of *Muzen kab* could be found, so I was unable to collect this species. Note that *Ah Muzenkab* is the bee-deity who died in the flood (Section 4.2).

4.3.6 Pillage bees

Nii' kib (*Lestrimelitta limao*) is a pillage bee: it lives solely by plundering the nests of other bees and stealing their honey. It is a black forest bee, smaller than *Xunan kab*. When attacking, *Nii' kib* secrete a lemon-scented liquid from which all other species of bees flee. Beekeepers protect their colonies from these raiders by sealing the entrance to the bee-log with leaves. Some Maya claim that *Nii' kib* take the stolen honey back to their own nest; others maintain that they take over the victims' nest by constructing

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[16]The *Muul* that I collected with an informant were examined at Utrecht University and proved to be of the genus *Trigona*, although the species has yet to be identified. In some cases, *E'hol* (*Trigona fulviventris*) also inhabits a nest in the ground; because of this choice of habitat people assume that it is a different species to the *E'hol* that live in tree hollows. They therefore call it *Muul*, like the other ground-nesting species.

on it their own distinctive nest-entrance.[17] The Maya do not use the honey of this species because they dislike its acidic taste. Some say that when you rob these bees of their honey, they 'urinate' their lemon-scented liquid into it. The nest-entrance of *Nii' kib* could hardly be easier to recognize: a huge wax trumpet-shaped tube, sometimes with finger-like appendages dangling from it. When the Maya need wax, they go into the forest to search for *Nii' kib*, for the nest-entrance alone can consist of as much as 500 grams of 'black' wax. The tube appears to sprout from the tree. This remarkable characteristic also gives the species its name: *nii'* means 'tree shoot' and *kib* means 'wax'.

4.4 Meliponiculture in ethnographic literature

Only a few basic concepts related to the keeping of stingless bees are dealt with in the literature of ethnographers who studied the Maya. Of these, Redfield and Villa Rojas describe the practice the most extensively. They noted that *Xunan kab* hives were never placed in the cornfields, nor anywhere else outside the villages (Redfield & Villa Rojas 1934: 48):

"The bees that occupy the hives just described are known as *colelcab* ('lady bee') [*Ko'olel kab*, i.e. *Xunan kab*, *M. beecheii*]. They furnish almost all of the honey and wax consumed. Occasionally, swarms of these go off in the bush, but essentially this is a domesticated insect, living for generations under human care. A man wishing to begin keeping bees, secures some from the hive of a neighbor, not from the bush. There are, however, a number of wild, honey-producing *Hymenoptera* that are known and utilized by the Maya. Five varieties have been mentioned in Chan Kom: *kantzac*, *xik*, *ehol*, *yaxich* and *niitcab* [i.e. *Kansak*, *Xiik'*, *E'hol*, *Yaxich* and *Nii' kib*][...] the honey of all these insects is taken and used, when found in the bush. Occasionally, moreover, a man will put some of any of the first four kinds into a hive, such as he uses for the domesticated bee, and hang the hive under the palm leaves of his house. He never puts the wild bees on the racks with the domesticated bees, and such hives of wild bees apparently do not multiply or become of real importance" (ibid.: 49).

In the 1930s, when this description was written, the Maya had yet to adopt apiculture (i.e. the cultivation of the introduced stinging honeybee *A. mellifera*, as opposed to meliponiculture, the keeping of indigenous Meliponine or stingless bees). The extract illustrates that the practice of keeping the forest bees at a distance from *Xunan kab* is

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[17] Observations by biologists have confirmed that *Lestrimelitta limao* uses both strategies (Dr. M.J. Sommeijer, personal communication).

not new. In addition, it is clear that the Maya make a distinction between domesticated (*alak'*) bees and forest bees (*kaaxi kab*), for *Xunan kab* is not obtained from the forest, but from other hives in the village.

4.5 Ceremonies for the animals and their *ah kanulob*

Since the *ah kanulob* are, as I have argued, the essential and collective spirits of animals, the Maya are obliged to offer them something in return for their willingness to share individual animals with people. Such offerings are made during a ceremony normally known as a *loh*, which means "to redeem, to rescue, to exchange" (Cordemex Maya dictionary). There are various types of *loh*, not all to do with animals: for example, there is a ceremony for the crops grown in the *milpa*, one for the village, another for the *solar* (homestead) and yet another for the hunt.[18] The principal common aspect is that the gods are invited to participate in a meal. Such ceremonies are therefore also called, for example, 'The Dinner for the Bees' (*U Hanli Kab*) or 'The Dinner for the *Milpa*' (*U Hanli Kool*). Interestingly, ritual discourse reflects the differences between domesticated animals (*alak'*; e.g. *Xunan kab*, pigs and chickens), forest animals (*ba'alche' k'aax*; e.g. forest bees, deer, peccary) and other animals that do not fit smoothly into any category of the Maya classification system (e.g. *Americano kab* and cattle). In particular, the distinction between *ba'alche' k'aax* and *alak'* is maintained even if a forest animal has physically crossed the boundary, coming from the untamed into the tamed domain.

The differences between the types of rituals may be expressed in various ways, including the arrangement of the offerings on the altar, the gods who are invited and certain passages of prayer. For example, in the prayer intoned during the ceremony for the hunt (*loh tsom*), the shaman may petition the *ah kanulob* to put deer or other animals in the path of the hunter, whose rifle is laid in full view on the altar (*mesa*). There is, of course, no gun in the ceremony for the *ah kanulob* of the *alak'*. Not only are there different established types of ceremonies, but individual *hmenob* also have their own views on the best way to perform a particular ritual. This leads to minor differences in, for example, altar arrangements or invited deities. Generally, the scale of

[18]Don Rocío spoke of four kinds of tables or altar-settings for such ceremonies. However, there are also *lohob* for the harvest of the bees, for the inauguration of the meliponary or bee-house and for the human dwelling (see Sections 5.2 & 6.2), each with their own arrangements.

ceremonies for animal spirits of protector deities depends upon the number of animals one keeps or kills. The essential aspect of such *lohob* is that they enable people to pay their dues to the appropriate *ah kanulob*.

Along with *Xunan kab*, swine and fowl, the Maya usually keep cats and dogs in the homestead. All these animals are *alak'*, yet no ceremonies are performed for cats and dogs. This seems to be because they live alongside the human residents of the homestead and are fed but not eaten, nor do they produce anything which is eaten. In other words, the people take nothing from them and therefore do not need to appease or petition their *ah kanulob*. Although the people ought to pay dues to the spiritual protectors of pigs and chickens in return for slaughtering them, most people do not perform specific ceremonies for these animals. Instead, they perform a general *loh* which may be for various kinds of *alak'*. This ceremony is usually performed if people, especially children, or animals have fallen ill (see Section 6.2.2), the shaman requesting health for all the people, swine and fowl that live in the *solar*.

If a beekeeper only possesses a few logs of *Xunan kab*, the *loh* for *Kun K'u* (chief of the *Chakob* or rain gods) and *Yumbil Dios* (Almighty God) may be incorporated in the general ceremony for the domesticated animals in the homestead. More often, however, people make a special small offering after harvesting honey. Beekeepers with large meliponaries should perform the special *loh* known as *U Hanli Kab* (The Dinner for the Bees or Hive). Beekeepers do not perform ceremonies for the few forest bees that they may keep. If they frequently collect honey, wax or larvae from *kaaxi kab* in the wild, they might decide to leave an offering in the forest. Such an offering is called a *tsom*, like the ceremony for the hunt. This is rather theoretical, however, as nobody frequently 'hunts' these wild species. In addition to *Xunan kab* and forest bees, some people occasionally keep *Americano kab* in the homestead, though the normal place for apiaries is outside the village. This is an animal that does not seem to fit in any of the Maya categories. Most people consider *Americano kab* to be *alak'*, which implies that he should have an *ah kanul*, though the Maya are not familiar with this spiritual protector. Indeed, as the species was introduced by colonists, many doubt whether it can be protected by a Maya spirit. The vast majority of people regard this bee as an unprotected foreigner.

Cattle do not fit smoothly into the Maya classification either. Like *Americano kab*, they are normally kept outside the village (in special enclosures, *corales*), though occasionally a single cow may be kept in the homestead. Cattle do not live in the untamed forest and are therefore *alak'* by nature. However, possibly because they are were originally introduced, the *hmenob* of Tepich are not acquainted with their protector deity and do not perform special ceremonies for them. This is in contrast to what is documented in the literature, for Redfield and Villa Rojas (1934), Sosa (1985) and Re Cruz (1996) all describe ceremonies for *Juan Tul*, the protector deity of cows. Re Cruz and Sosa point out that the Maya accord a distinct status to this deity and these ceremonies respectively. Re Cruz argues that the Spanish name *Juan* may indicate "how the Maya use the filter of oral tradition to incorporate a colonial economic system into their cultural logic" (1996: 113). However, other Maya deities have also been given Spanish names (for example, *San Eustacio*, who keeps deer according to Don Rocío) even though these deities are unrelated to economic concepts introduced by the Spanish colonists. The distinction that is made between the ceremony for cows and those for other animals is more clearly defined in Sosa's work. The focal point of the cow ceremony is an effigy of a virgin with pronounced female genitalia, about which there is a great deal of sexual joking. Sosa remarks that, as a setting for ritual activity, the ceremony is regarded as inferior and some shamans therefore refuse to perform it (1985: 339).[19]

To conclude, then, the Maya classification of animals is reflected in the distinction they make between ceremonies for the tamed (*alak'*) and untamed animals (*ba'alche' k'aax*). In the case of the former, either a single joint ceremony is performed for all the *alak'* or different ceremonies are performed for specific sub-groups. Some variation is evident in the appropriation of animals for which the system of classification adopts conflicting criteria: for example, those whose *alak'* nature conflicts with their *k'aax* habitat, as is the case with *Americano kab* and cattle. (It is important to understand that this is essentially different to the cas of animals being physically transferred from one domain to the other.) Furthermore, both these species are non-indigenous *alak'* whose *ah kanulob* have not revealed themselves to the *hmenob* of Tepich. In several other villages, the shamans are familiar with the *ah kanul* of cows but, in ceremonies, this protector deity is treated quite differently to those of the native species. As previously stated, this aspect of ritual practice reflects the distinct status accorded to the cow and its *ah kanul*.

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[19]Of course, cows and *Americano kab* are not the only animals to have been introduced to Yucatan. However, many of the other introduced animals have an 'untamed related species' in the forest. It could be argued that the stingless bees are the closest relatives of *Americano kab*, yet this species was introduced quite recently, as the name indicates. People are well aware that this bee is a foreign species.

4.6 The transformation (*helep*) of the animals

Sensible Maya stay in their villages on the fifteenth and sixteenth of September. These are very dangerous days to venture into the forest, for animals metamorphose into others and one is likely to have terrifying experiences:

"On the 15th and 16th of September, the animals start to change. It is because of the *helep*, when all things change. Long ago, I was walking along the highway with Don Vacio - my late father - and some other people. We stopped to fetch some water from the lagoon.[20] Suddenly, we saw the shadow of this enormous thing. The belly of the animal was as wide as the highway. It was a very big animal indeed, about 5 *mecates*[21] [100 metres] long! As soon as we saw the huge shadow, we looked up. One of us, Don Vacio, grabbed his rifle. We shouted: 'Don't shoot it!' But he had already fired. The animal fell near the lagoon. One part of it fell in the water; the other part came down on the shore. [...] Then the whole part of the animal that was out of the water was dragged out of sight. But Don Vacio had hit it. The water was really churned up when the animal hit it. We saw foam coming out of its body; it was the blood of the animal. It was dead. So you'd better not leave your house on the 15th of September!" (Don Medardo, *hmen*).

This animal is a huge snake. At a certain time of the year it burrows into the ground, wings and feathers start to grow from its body and it becomes the Feathered Snake, *Kukulkan*. On the fifteenth of September, it takes to the air and starts heading for the sea:

"My grandfather told me that the *Kaníkula* starts in August. During the rainy season, there is a period of drought; this is called the *Kaníkula*. It starts with a lot of thunder and lightning, but there is no rain. The snake that lives in the ground stirs. During the *Kaníkula*, lots of children have diarrhoea. The snake feels unwell, as if he is burning. On the 15th and 16th September, the snake begins his flight. He searches for water because he feels that he is burning. Wherever he passes over, animals change into other animals when his shadow touches them. The snake heads for the sea. When he reaches the sea, he falls into the water and dies" (Doña Pilar, Tepich).

In another version of this story, the snake flies not to the sea but to God, intending to kill the Apostles. When the snake draws near, God smites it with his hand, smashing it into a myriad pieces. These are the meteors that are seen in large numbers at that time of year.

Snakes shed their skin every year. This is called *helep* (transformation, change), as are

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[20]The lake near Bacalar.

[21]The *mecate* is a standard measure of Aztec origin. The Maya use it as a unit of length (20 metres) and as a unit of area (20 x 20 = 400 square metres).

the two September days marked by the flight of the Feathered Snake. This huge beast casts a large shadow on earth, and any forest animal that is 'touched' by it is transformed into another species. The *ha'leb* (Mexican agouti) and the *kitam* (peccary) turn into snakes: the *Tsa' kan* and *taba* respectively. All three types of deer which live in the forest around Tepich (*yuuk'*; *cerecke* and *chiik*) turn into large snakes. Meanwhile, such snakes become the deer. Like the Feathered Snake, ants can develop wings and may therefore become wasps or termites, while these winged insects may turn into ants. This change is called *xmahan-iik*.[22] Other kinds of animals, not yet referred to in this section, are also thought to transform: the bat (*xotz*) turns into the snake *kame'* or a mouse; the turtle (*xkok ak*) into the parrot; the armadillo (*weh*) into the vulture (*zopilote*); spiders into *maz* (as yet unidentified species of beetles); the rabbit into the snake *Otz kan*; the fox into the snake *buhul*, etc. According to the *hmen* Don Medardo, there are many more changes of which the people are unaware. It is important to note that all the above-mentioned transformations also take place in reverse.

Although the Feathered Snake only flies on the 15th and 16th of September, the whole month is often said to be a dangerous time to shoot animals. The hunter may not realize that his prey has undergone a transformation, and this can take place after the animal has been shot or even after its meat has been prepared, as the following story testifies:

"My grandmother told my mother this story about one of the girls. It happened a long time ago. Well, there was this *ha'leb* meat, I think, a rather yellowish meat with white spots. Anyway, they say that, in September, the *Tsa' kan* [snakes] turn into *ha'leb*. So once, the girls had got this *ha'leb* meat and they were allowed to eat it. Somebody had told them they could eat the meat. But instead of eating it, they just prepared it. And after preparing the meat, they poured honey over it, *Xunan kab* honey. They covered it with another plate and put the grindstone on top. Now you see what happened ... [...] Because the girls used honey to keep the meat fresh. Some time later, they saw that it was moving, the whole thing was moving. They saw that there was nothing but snakes. I cannot say if it really happened. My late grandmother saw it. So the girls didn't get to eat the meat. Their father came and killed all the animals. He took the girls and made them kneel in front of the Cross, to ease their minds. Even if you eat this meat first and then eat honey, it will change the meat. The honey gives them life. Snakes will be born, through the honey of *Ko'olel kab* [i.e. *Xunan kab*]. So you have to be careful if you eat this kind of meat, you shouldn't eat this kind of honey afterwards" (Don Hipólito, *hmen*).

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[22] *Xmahan* generally refers to pupation, e.g. of caterpillars into butterflies (Cordemex Maya dictionary). It seems plausible that transformation into or from ants is thus specially named because ants also change naturally, without the influence of the Feathered Snake.

The transformation of animals follows fixed rules. An animal on which the shadow of the Feathered Snake falls always changes into another particular species; in many cases, into the animal which usually hunts it or on which it usually preys. In such cases, the normal roles of hunter and hunted are reversed. According to Don Medardo, this is because the prey wants to experience being the animal that hunts it. Conversely, because the hunting species take the lives of many animals, they should find out what it feels like to be the prey. Similar rules of role-reversal apply for other animals: some ground-dwelling species (e.g. armadillos, turtles and ants) would be delighted to fly, and the winged species (e.g. vultures, parrots and wasps) should know what it is like to crawl on the ground. That turtles change into vultures and vice versa is attributed to the similarity of their heads!

Significantly, the shadow of the Feathered Snake has no power to transform the *alak'* that live in the village. According to Don Rocío, such animals are protected against change because people have performed a *loh* for their *ah kanulob*. Therefore, *Xunan kab* never changes into another animal. In addition, although it is not advisable for people to walk in the forest or even to leave the village on the two most dreaded days of September, the Feathered Snake does not change humans themselves. They may, however, catch an ill wind or be traumatized by the bizarre spectacle of animals undergoing transformation. Furthermore, it is a dangerous time for pregnant women, for if the shadow falls on them, they will give birth to an animal instead of a baby. In this context, it is significant that, several months after a child is born, the Maya perform a special ceremony called *hetzmek* (literally, 'fix-embrace'; Hanks 1990: 529, note 7). The ceremony involves the selection of god-parents and the establishment of a *compadre* relationship.[23] As is the case with the wild animals of the forest, an unborn baby is unprotected. It may therefore be changed into an animal by the power of the Feathered Snake's shadow.

4.6.1 Why does the Feathered Snake elicit change?

After shedding its skin, as the story-tellers claim, a serpent of mythic proportions

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[23]Before this ceremony has been performed for a child, the mother always carries him or her in recumbent position across the supporting arm. After the ceremony, the child is carried astride the left hip, the left arm supporting it in this position. The *hetzmek* for boys is performed four months after birth because the *milpa* has four corners. The corresponding ceremony for girls takes place three months after birth because the kitchen fire has three stones (Redfield & Villa Rojas 1934: 188-190).

causes certain species of animals to interchange their identities according to fixed rules. This is an enthralling concept, but what is its deeper meaning, its function, in the mind of the Maya? Clearly, we need more information about the *helep* and the Feathered Snake.

According to the Cordemex Maya dictionary, *helep* means "the shedding of a snake's skin, the turn of the year, the changing of authorities". The feathers growing from the Snake's body may be regarded as his skin being shed. The contemporary Maya place the turn of the year in January; however, the period from the 16th to the 20th of July is the turn of the year for deitic authorities (see Section 8.5). There does not seem to be a direct conceptual link here to the time of the Feathered Snake's own metamorphosis, for the dates do not correspond. However, it should be noted that Mexicans celebrate independence day on the 16th of September. Could the flight of the Feathered Snake possibly be related to a change of human authorities?

Although gathering evidence to answer this question seemed beyond the scope of my ethnographic fieldwork at the time, some documentary sources of information on pre-conquest and early-colonial Maya society appear to point in this general direction. According to Schele and Freidel (1990), *Kukulkan* became the second-greatest abstract symbol of kingship. Before the Spanish conquest, the cult of *Kukulkan* was celebrated and an associated pyramid constructed at Chichén Itzá. This cult, controlled by the *Can* lineage, was primarily associated with the 15th calendrical day. As a calendrical deity, *Kukulkan* was represented in five guises: as God of Death, God of Wind, Venus, Rain and Fire (Edmonson 1982). According to Freidel *et al.*, some of the great battle-leaders at Chichén Itzá were feathered-serpent warriors. Their power became legendary.

"By Postclassic times, myth and history had merged into one, producing stories of a great wise man, Quetzalcoatl [*Kukulkan* in Maya] who was driven from the Toltec to Yucatan. Some legends, manipulated by the Spanish who knew them to support their subjugation of the Indians, said that Quetzalcoatl had disappeared in a canoe to the east and that Cortés himself was the returning god" (Schele *et al.* 1990: 289).

According to the same source, contemporary groups of Maya still commemorate ancient clashes with the enemy. Although this presents an interesting line of inquiry, no conclusions can be drawn at this stage. Further fieldwork is necessary to explore whether such a link is drawn by the Maya of Quintana Roo.

Is the flight of the Feathered Snake, *Kukulkan*, linked to cosmological notions? According to Carlson (1982: 146), among the Maya, *Kukulkan* is regarded as the manifestation of the planet Venus at dawn. Venus is called *Xuux ek*, 'Wasp star'. On the 16th of September, Venus rises at 03.33 and sets at 16.23 (Romero Conde 1994). In other words, Venus is seen at dawn on the day the Feathered Snake takes flight; however, there are no indications that the people of Tepich relate the Snake to this planet. According to Romero Conde, the period from the 16th of September to the 5th of October is influenced by the constellation known as *Canhel* (the stars Alpha, Beta, Gamma, Delta and Lambda Draco). Citing the Pérez dictionary's translation of this compound utterance as "drake, fabulous serpent", he concludes that its true meaning is "transformed serpent". He also indicates that the image thus emerging is similar to the Feathered Snake, *Kukulkan*. Unfortunately, he does not clarify in this work how he concluded that the Maya relate certain constellations to certain periods. Nowadays, the Maya of Tepich do not attach much importance to the stars (see Section 8.1) and therefore this view, however interesting it may be, must also be set aside.

Miller and Taube briefly discuss the Snake in the context of pre-Hispanic Mesoamerican concepts. Apparently, snakes were seen as vehicles of rebirth and transformation. They argue that the Feathered Snake at Chichén Itzá may be related to the channelling of water and life-giving forces from the sky to the earth, for the rain god *Chak* is often depicted in the company of a snake. Among the Aztecs, two snakes were believed to bear the sun on their backs and were thus a vehicle for the sun's apparant movement. They were also known as the 'fire serpents', similar in morphological aspects to the snake associated with the Maya god of lightning. In Central America, the snake *Mixcoatl* was the personification of the Milky Way (Miller & Taube 1993: 148-151). Throughout Mesoamerica, snakes were thus linked to various astronomical phenomena by such pre-Columbian notions.

It is striking that several residents of Tepich relate the flight of the Feathered Snake to the *Kaníkula*, a short dry period within the rainy season, in which lightning regularly flashes in the sky. Nowadays, many people in the Maya Zone say that lightning is produced by one of the *Chakob*. The Snake feels uncomfortable because he is so hot. Since the heat is sometimes unbearable on the Yucatan peninsula, this concept might be related to climatological conditions and astronomical phenomena, particularly the sun. The heat of the sun results in the movement of the Feathered Snake. Like fire, his life ends when he touches water. Bearing in mind the pre-Columbian link between snakes and astronomical phenomena, one annual event is particularly noteworthy. On the archeological site of Chichén Itzá, there is another serpent which is invisible for most of the year. However, on the days of the vernal and autumnal equinoxes in March and September, on the pyramid of *Kukulkan*, the sun casts a shadow on the stairs which resembles a descending snake. The sun is thus responsible for both events: the flight of the Feathered Snake from the earth and the movement of the serpentine shadow on the pyramid.

4.7 Conclusions

The Maya distinguish domesticated animals (*alak'*), which live in the human domain, from the wild animals of the forest (*ba'alche' k'aax*). The distinction between these two categories, which is inherent in the nature of the animals as assigned by God, is maintained even if animals are physically transferred from the tame to the untamed domain or vice versa. For people, the main difference between the animals of these two categories is the degree of control they can exercise over them: they have far more control over *alak'*, which depend on human care, than over *ba'alche' k'aax*, which live independently from people and must therefore be hunted. In fact, when people make use of animals, they enter into a relationship of exchange with the protector deity or collective animal spirit, the *ah kanul*, of the species. People may perform ceremonies to invoke the help of the *ah kanulob* in order to be able to shoot individual animals. Alternatively, they may obtain certain attributes whereby their power approaches that of the animal spirit over the species. However, if the hunter does not make ceremonial offerings in exchange for this power, he comes into direct conflict with this spirit. Because of his inferior strength, he is fated to lose the fight and generally pays for his insolence with his life.

The distinction between tamed and untamed species extends into the category of social insects, which explains why *Xunan kab* (*M. beecheii*) can be kept and cultivated by people while others cannot. This distinction is manifest in various concepts and practices. Firstly, in the unusual event that forest bees are kept in the homestead, they are physically separated from *Xunan kab*. Secondly, the Maya refer to the social insects of the untamed domain as 'children of the forest' and, as the word *alak'* is sometimes used for human children, it can be inferred that the Maya symbolically regard the bees classified as *alak'* as their own offspring. After all, *Xunan kab* was entrusted to humans by the grace of God and needs special care, just like human children. A third manifestation of the distinction is that the beekeepers dedicate the ceremony for the harvest of the bees to the chief of the rain gods and to Almighty God himself: by keeping *Xunan kab* they do not enter into an exchange with any *ah kanul* of bees. In fact, beekeepers themselves constitute the protectors of *Xunan kab* and are thus members of a larger category which includes the non-human protectors of animal species.

There is also an important gender distinction: the domesticated *Xunan kab* is a very special 'female' bee, the 'Lady bee' or 'mistress'. She produces honey of the finest quality - a divine honey. This is in contrast to the forest bees, which are predominantly 'male'. However good their honeys may be, they can never come close to the quality of *Xunan kab* honey, even though some of them are not without interest or appeal. Yet the Maya take their peculiar respect for *Xunan kab* even further. They suppose, for example, that only forest bees collect from faeces (in fact, all stingless bees, even the most ladylike, exhibit this unappetizing behaviour). More importantly, the Maya also believe that only *Xunan kab* collects its honey from the realm of the gods. In Sections 7 and 8, I describe another important distinction made between the honey of *Xunan kab* and that of forest bees, which raises further, gender-related questions. Why should supposedly 'male' forest bees produce honey of lesser quality? Why is the forest bee *Xnuuk* regarded as a producer of distasteful honey, even though the species is said to be 'female'? I address these issues in Section 7.

People make offerings to the *ah kanulob* in exchange for animals they have killed and thus re-establish the harmonious relations on which life itself depends, although the precise details of how this is achieved remain open to conjecture. In the domain of the *ba'alche' k'aax*, the wild animals of the forest, affairs seem to follow a somewhat different course. For example, I know of no story about the *ah kanul* of the jaguars paying dues to the *ah kanulob* of the animals devoured by jaguars. How is this imbalance redressed? It seems possible that the airborn Feathered Snake and his awesome shadow play a beneficial role here, re-establishing harmony by reversing the roles of animals on the earth below: the hunters becoming the hunted and vice versa. This is borne out by the fact that the transformations caused by the Feathered Snake, at least all those known to shamans, are directly related to the Maya classification of animals as well as to the system of rules governing relations with the *ah kanulob*, the collective spirits of the various species. By performing a *loh* (i.e. an exchange of spiritual food for favours) in respect of the animals kept or cultivated in the homestead, humans maintain the delicate equilibrium of give-and-take in the domestic sphere of influence, so no roles need to be reversed there. A transformation of species may even occur in unborn babies, on whose behalf relations with human companions including god-parents have yet to be established. The Maya, even their shamans, do not know all the animal transformations that may occur. One thing is certain, however: the animals that are obviously of foreign origin do not fit easily within the traditional framework. The shamans of Tepich are not acquainted with the *ah kanulob* of foreign species.

In the course of this section, some questions have gone unanswered, while many new ones have arisen. Why, for example, should the *ah kanulob* wish to exchange animals -their own flesh and blood- with people? Is their any homology between the relationship of the beekeeper to his insect family and that of the animal spirits to their livestock? Finally, bearing in mind that wild animals are transformed whereas domesticated ones are not, does it not seem contradictory that the honey of the most important domesticated bee can turn the dead flesh of a wild forest animal into live snakes? I return to these questions in Sections 7 and 8. First, though, I discuss beekeeping practices in the next two sections.

5 The keeping and breeding of stingless bees

This section examines the 'emic view' of meliponiculture: how the Maya who keep and breed stingless bees understand and explain the particular techniques they use. By confining the discussion to this subject for the time being, I do not wish to imply that it exists in isolation: on the contrary, the Maya knowledge of beekeeping relates to and is indeed an integral part of a far larger system, other elements of which are dealt with elsewhere in this dissertation. In fact, the views of the Maya beekeepers are so inextricably bound up with their entire culture that we cannot appreciate them without reference to their own terms and internal logic. At the same time, we must not forget that, while the emic view is culture-specific and therefore differs significantly from the 'etic view' (in the context of this dissertation, current 'Western' biological thinking on meliponiculture), the two bodies of knowledge naturally have much in common. Nor should we be misled into regarding the attitudes of the Maya to beekeeping as fossilized or dogmatic: practical necessity demands that these people, just like biologists, should be adaptable in their thinking. One of the main objectives of this dissertation is to understand the serious problems that indigenous keepers of stingless bees have been experiencing in recent years. In this section, therefore, I am primarily concerned with examining the meliponicultural practices of the Maya (in Sections 5.1 to 5.7) with particular regard to their effectiveness in a rapidly changing environment. Are these practices in harmony with the specific biological characteristics of meliponine bees; with the conditions that biologists deem necessary for colonies of such bees to thrive and be productive? (See section 5.8). Even though the emic and etic systems differ in many aspects, it is true of both that they remain inexplicable unless we can grasp their internal logic. I firmly believe that finding the common ground between these two schools of thought is of paramount importance if contemporary meliponiculture and the threats and challenges facing it are to be properly understood.

Although the Maya make use of several species of meliponine (stingless) bees, they only explicitly classify one of them (*Melipona beecheii*) as domesticated (*alak'*). This is the species I mainly discuss in this section. After attempting to describe the various methods of meliponiculture from the beekeepers' perspective, I address an important question: what effects are the practices and attitudes of the Maya likely to have (had) on the stingless bees in their keeping, given the biological characteristics of the insects? In particular, can the decline of meliponiculture among the Maya be ascribed to disadvantageous aspects of the methods used? In Section 5.8, I draw links between some of the beekeepers' more important views and characteristics of the bees as understood and described by biologists.

5.1 The bee-log *hobon*

The *Xunan kab* of the forest build their nests in tree-hollows, so it seems fitting that, when these bees are captured in the forest and brought to the homestead for permanent keeping, they should inhabit a hollow log there too. The Maya are highly reluctant to evict such bees from their original homes, and will only move them into a substitute log if the original sustains damage. *Xunan kab* are never put in a box or any other structure that we would recognize as a hive, for they are said to dislike artificial objects and only to feel at home in a cylindrical hollow. In striking contrast, the Maya sometimes keep forest bees, which they regard as only temporary residents among humans, in boxes or other artificial objects. There seems to be a contradiction here, for we might expect such bees to be even more particular in their choose of home than *Xunan kab*. However, this practice appears to reflect the 'natural' preferences of the forest bees, which are found not only in tree-hollows. A nest of *P'uup'*, for example, was discovered in the wall of a house in Yaxley; *Tsots* inhabit the walls of the cemetery in Tepich; certain other species are said to live in man-made poles. Be that as it may, wild colonies of *Xunan kab* are found exclusively in forest tree-hollows. *Xunan kab* are indeed the choosiest bees when it comes to nest sites.

The Maya take their hollow logs from the high (i.e. mature) forest (*monte alto*), where the trees tend to be older and therefore more often have hollows in their trunks or branches. Ever since the Caste War, deforestation has increased inexorably and there is not much high forest left in the *ejidos*; only the village of Yaxley is still surrounded by it. Some forty years ago, a fire destroyed two-thirds of the forest in the Tepich *ejido*. Hollow logs are therefore scarce and the people frequently make their own. This practice is, however, not new; in the past, beekeepers used to have larger meliponaries and more often multiplied their colonies by splitting, so they actually needed more hollow logs than their present-day successors.

To hollow out a log, the beekeeper wedges it upright between three stones[1] and, little by little, scorches the core with a glowing piece of charcoal and removes the charred wood. Some use a *bahab*, a sort of hammer, and a gouge to scoop out the wood. For *Xunan kab*, a log with an outside diameter of about 50 to 55 cm and a length of about 80 to 100 cm provides enough space for the brood and for future storage of food pots.[2] The species *Xiik'*, *E'hol* and *Kansak* are accommodated in logs similar to those used for *Xunan kab*, whereas the smaller *Bool* and *P'uup'* are housed in logs of approximately 30 to 50 cm diameter. Scooping out a log is a laborious task which takes several hours, so some beekeepers prefer to buy a hollow log for 10 pesos[3]. A little entrance-hole, about 1.5 cm in diameter, is cut halfway along the log, which is then often marked with a square or cross around or near the hole (see Photo 4). The ends of the log are plugged with loose-fitting stones or discs of wood and then sealed with mud.

The beekeepers favour hardwood bee-logs, as these last longer. They have a strong preference for the particularly durable wood of *Yaax niik* (*Vitex gaumeri*). Other, relatively hard woods in use are *Zapote* (*Manilkara* sp.), *Chakah* (*Bursera simaruba*), *Cedro* (*Cedrela* sp.) and *Tsalam* (*Lysiloma latisiliquum*, according to Sosa *et al.* 1985), but any species in which wild bees are found nesting in the forest will do. *Yaax niik*, *Zapote* and *Cedro* often develop hollows and are therefore popular nest sites for *Xunan kab* in the wild. One beekeeper prefers the wood of *Chakah* (*Bursera simaruba*) because its odour is believed to repel Phorid flies (*xnenel*), which may totally destroy a bee colony if they penetrate the hive. The best time to cut the wood for the *hobon* is at full moon. Wood cut at other phases of the moon is said to be more likely to rot. A very good log can provide shelter to bees for a hundred years or more, as long as it is not exposed to rainwater.

Most logs are well maintained, yet an estimated 15 per cent of those housing *Xunan kab* are found to be in poor condition, usually showing signs of rot. In a few cases, such logs prove to have been exposed to rainwater. In exceptional cases, the logs have not been properly closed at the ends. This endangers the colony, allowing *xnenel* and

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[1]Although beekeepers often speak of this placing of the log between three stones, they seem to be concerned with the symbolism rather than the act itself. Various accounts of Maya archaeological sites and Pre-Hispanic pottery suggest that the three-stone setting was closely related to the creation of the universe (Friedel *et al.*, 1993). It may well be that this conceptual link to the creation still survives in the hive-making process (see Section 8.2.4). The Maya also build the kitchen fire on a base of three stones (see Section 6.2.2).

[2]A beekeeper in Señor prefers a smaller hollow because this forces the bees to construct several small brood chambers instead of a single large one.

[3]Approximately 1.50 US dollars in 1996.

ants to enter the hive. To protect themselves, however, the bees often use batumen (a mixture of wax, plant resins, mud and other materials) and propolis (plant resins) to seal any cracks or small openings left by the beekeeper. One reason why so many logs have been found to be defective is the fact that good logs are becoming increasingly hard to find, as beekeepers frequently complain, while elderly Maya, in particular, often find the task of fetching a new log from the forest too arduous. In addition, if a bee colony is weak in number or impoverished, as is so often the case nowadays, transfer to a new log is regarded as a too great risk. An open hive, however temporarily the nest is exposed, is highly attractive to *xnenel* and not even a colony at full strength may always successfully repel these invaders. Beekeepers are loath to endanger their precious colonies in any way and will only do so when there is extreme urgency. Even though a *hobon* may appear to be in bad shape on the outside, this does not necessarily mean that the colony will die out or flee, for the bees are quite capable of sealing the hive from the inside.

5.2 The bee-house *Nail Kab*

The traditional meliponary (*nail kab*), a bee-stand accommodating multiple colonies of stingless bees, is a structure resembling a long house with no walls (see Photo 5). Sturdy upright poles support a double-pitched roof thatched with palm fronds, which shelters the bee-logs from the sun and the rain. Several rows of bee-logs run parallel to the longitudinal axis, stacked up on both sides of A-frame racks. Each A-frame is actually the lower half of an oblique cross (X) formed by a pair of poles set between the stamped earth floor and the longitudinal outer roof-beams. The largest bee-houses may contain a hundred hives. In almost every village, elderly beekeepers recall the days when *nail kabob* housed 200 hives or more. Nowadays, though, big meliponaries are rare and a bee-house of some thirty hives is even considered to be on the large side. Indeed, most beekeepers possess fewer than ten hives of *Xunan kab* and, although really big bee-houses are no longer needed, bee-logs are still placed on A-frame racks under a roof of palm fronds or corrugated iron. If there are only a few bee-logs, these may be suspended from the roof.

Custom requires that a newly completed bee-house should be inaugurated with a *loh* ceremony. However, as construction of bee-houses has stagnated in recent years and contemporary beekeepers have inherited most of their colonies from an existing *nail kab* (see Section 5.5), this ceremony has not been performed for a long time. The *hmenob* relate that the inauguration of a bee-house was much the same as that of a new house for people. The bee-house *loh* is briefly described by Redfield (1934: 146), who infers that moving a hive is comparable to moving a village (ibid.: 117, note).

Nail kab are usually located at least one *mecate* (20 m) from the house and kitchen, where human activity and, more importantly, smoke from the cooking fire is less likely to disturb the bees. There is, however, another reason why beekeepers separate the *nail kab* from the house:

"You must build the *nail kab* a little way from your house because the God of the bees [*Kun K'u*] sometimes pays a visit. If you happen to pass by the *nail kab* just when the God is there, you get a headache because of the wind of the God. You get sick. You should place it at some distance" (Don Fernando, Tepich).

"It isn't a good idea to put the bee-house too close to your own house. Of course you can do it if you want, but there are people who have got what we call *k'inam*, and the bees flee from it. That's why you have to place the bee-house at a little distance. If the bees flee because of *k'inam* and you then open the hives, the insides of the logs look whitish. If the *chu* [food-storage pots] are in good condition, though, they're almost black" (Don Avelino, *hmen*).

K'inam means 'energy', 'pain', 'vitality', 'virtue' and the 'ferocity or poison of animals'. The diving crystal or *sastun* of the shaman (see Section 8.5) and medicinal herbs also have *k'inam* (Cordemex Maya dictionary). Bees are very vulnerable to *k'inam*; when they come into contact with it they either die or flee into the forest. The concept is dealt with in more detail in Section 5.7.

The available literature states that most *nail kab* have been found to be constructed on an east-west axis, and some beekeepers do indeed maintain this tradition. Of course, the alignment of large bee-houses is more obvious than that of small structures with only a few hives. Most beekeepers explicitly state that it is the weather which dictates that the bee-logs run east-west. If too much rain were to fall on the bee-logs, they would soon rot and the beekeeper would have to work hard changing them, unnecessarily exposing the colonies to attack by *xnenel* in the process. Some beekeepers claim that, since the prevailing wind is from the east, if the *nail kab* is built on an east-west axis, the worst damage will be restricted to a few east-facing ends of log. If it is true that most of the harmful rain comes from the east, the east-west orientation does have an obvious advantage, for the *nail kab* have no walls. A few beekeepers make another point: that bees in logs on an east-west axis get more benefit from the morning sun, as it shines through the entrance hole to wake them. Since bee-logs are placed on both sides of the racks, however, this argument can only apply to the south-facing logs; bees in logs on the north side would be at a distinct disadvantage.

Although some beekeepers put forest bees and *Xunan kab* together in one bee-house, others explicitly state that the two types should be kept well apart. It is also vital that, instead of being laid horizontally like *Xunan kab*, logs of the forest bees *Xiik'*, *E'hol* and *Kansak* should be set upright (see Photo 6):

"They have to be kept standing up because that's the way these bees work, upright" (beekeeper, Tepich).

"It's not so good to keep these bees at home. You have to stand the *hobonob* on end, away from the others because the *arux* [a dwarf] takes care of *E'hol*. So if you start taking care of them yourself and get honey from the hive, the *arux* will harm you" (Don Cipriano, Señor).

The role of the arux is discussed in Section 7.8. The important point here is that no beekeeper has ever built a special bee-house for forest bees. As *kaaxi kab*, they are treated differently and, in homesteads, are often kept at a distance from the *Xunan kab*.

5.3 Timing harvests

The Maya say that, whereas *Xunan kab* used to fill hives to the stoppers with honey, nowadays some colonies of stingless bees are so impoverished that to extract honey from them would be tantamount to destroying their chances of survival. Perceiving the bees as impoverished, they take great care not to overstrain the colonies by harvesting them too frequently. All beekeepers agree that the best time to take honey from the hives of stingless bees is the period following the *man ha' che'* rains (see Section 5.3.1), i.e. in or around April. The *man ha' che'* also coincides with the seasonal peak in honey production by *Americano kab* (*A. mellifera*). However, as Table 5.1 shows, most hives (73.1%) are opened at least twice a year and harvesting is not restricted to April. In fact, 14,0% of the hives are opened four times a year, i.e. approximately every three months, 16.5% are opened three times a year and 42.6% twice a year. About 23% are opened only once a year, mostly in April or May. This information would appear to contradict the previous statement that the beekeepers are careful not to overstrain the colonies. It also reveals what seems to be a disparity between individual beekeepers: why, even though their bee-houses are often located in the same village, can some only take honey from their hives once a year (provided that the bees are not too impoverished), while others are able to harvest four times a year? In order to answer this question, I must first examine each harvesting period separately. Table 5.1 shows that, although hives are opened during a particular season, the calendar month varies. For example, some beekeepers state that the opening of hives in the *man ha' che'* occurs in March, while others say April or May. One reason for this disparity is that the *man*

Table 5.1: Months of harvesting stingless bees per beekeeper and number of colonies for different locations

	Number of beekeepers	Village	Months	Number of hives in 1994	
				Melipona beecheii	Forest bees
Opening hives: 4 times a year					
	1	Senor	1,4,7,9	5	
	1	Yaxley	1,4,7,9	0	
	2	Epedz	1,4,7,9	15	
	4	Tepich	1,4,7,9	30 (of which 8 in cornfield)	
	Total: 8 beekeepers: 13.8%			**Total: 50 hives: 14.0%**	0
Opening hives: 3 times a year					
	2	Senor	1, 4-5 , 10	3	
	1	Yaxley	2,4,9	3	
	3	Rancho Flor de Mayo	3,4,9	48	
	1	Tepich	1,4,9	5	
	Total: 7 beekeepers: 12.1%			**Total: 59 hives: 16.5%**	0
Opening hives: 2 times a year					
	2	Senor	3, 5-4, 9	3	
	1	Ch. Ch. Comandante	4,9	1	
	1	San Jose	1,5	0	
	1	Yaxley	4,9	3	
	1	Kimbila	4,9	21	
	1	Tabi	5,9	32	
	8	Tepich	4-5 , 9-10	24	1
	1	Epedz	5,9	68 (1 in cornfield)	
	Total: 16 beekeepers: 27.6%			**Total: 152 hives: 42.6%**	**Total: 1 hive: 0.3%**
Opening hives: once a year					
	2	Senor	4 or 5	6	
	1	Ch. Ch. Comandante	4 or5	13	
	2	Yaxley	4 or 5	0	
	1	Tusik	5	7	
	14	Tepich	4 or 5	55	8
	Total: 20 beekeepers: 34.5%			**Total: 81 hives: 22.7%**	**Total: 8 hives: 2.2%**
thers					
	3	Senor	when needed	1	
	1	Rancho S. Lucia	when harv. Apis	1	
	2	Pino Suarez	when needed	1	
	1	Tepich	when needed		3
	Total: 7 beekeepers: 12.1%			**Total: 3 hives: 0.8%**	**Total: 3 hives: 0.8%**
	Total 58 beekeepers			**Total: 345 hives: 96.6%**	**Total: 12 hives: 3.4%**

ha' che' rains do not fall in the same month every year. It is also true that the beekeepers understandably find practical considerations more important than the prescribed times for particular tasks.

5.3.1 In and around April: the *man ha' che'* light rains

On the Yucatan peninsula, the most abrupt annual change in the weather is the transition from *yaax k'in* (dry season) to *hahali'* (rainy season). As I emphasize in Section 6, rain is vital to the subsistence agriculture of the *milpero* and his family. The bee colonies are no less dependent on rain: they cannot survive without storing their staple food, honey, which they make from the available nectar. As nectar is only found in abundance once there has been some rain to stimulate foliage growth and bring trees and plants into flower, the most important period of honey-harvesting is during the short dry season following the *man ha' che'*. These are showers borne by easterly winds in March or early April. In this period, also called *nik che'* ('flower tree'), nectar starts flowing and the bees make large quantities of honey. They produce their best honey in March, April and May. When heavy rain starts coming from the west in June, however, honey production decreases dramatically, and whatever honey the bees produce tends to be a little sour. The Maya generally claim that, whereas light showers stimulate nectar production, heavy rain 'purges' the flowers by flushing out the precious nectar. The steady downpours marking the onset of the main rainy season are heralded by thunder, said to be the work of *Kun K'u*, chief of the *Chakob* (rain gods). These are the drenching rains so essential to the *milpas* and the forest. They continue until November, when the air turns relatively chilly, marking the transition to the long dry season.[4]

More than 98% of the hives are opened for harvesting during the *man ha' che'*. Some trees, including the *Habim* (*Piscidia piscipula*) and citrus trees, come into flower before the *man ha' che'*. While they are considered to be important sources of food for *Xunan kab*, they do not supply enough nectar for the bees to fill the hives with honey. Three weeks after the *man ha' che'*, in marked contrast, the hives may well be brimming with

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[4]Don Medardo explained the succession of seasons as follows: "The *hahali'* is the time for planting, when there is much rainfall. Then comes the *k'e'el*, the cold. The *yaax k'in* cannot start unless there has already been a period of cold. After the *man ha' che'*, there is another, shorter period of *yaax k'in* before the *hahali'* starts again."

honey, but only if there have been enough bees in the hive to go foraging. The *Ts'its'il che'* (*Gymnopodium floribundum*) blossoms at this time of the year, exuding a sweet aromatic scent. Some beekeepers say that *Xunan kab* needs the nectar of this plant to fill the hives. If the *man ha' che'* rains fail, the *Ts'its'il che'* does not flower and there is not enough honey in the hive for the beekeepers to harvest. In a good year, the bees are said to be able to re-fill the hive with honey within three weeks of the first harvest, although this is only confirmed by a few beekeepers living in outlying ranches. For example, three beekeepers of the Flor de Mayo ranch harvest twice during this period, in March and in April, provided that there have been enough showers to bring the plants into flower. Yet several beekeepers recall the days when there were double harvests in the village too.

5.3.2 July

July is the middle of the rainy season, when almost no flowering plants important to the bees are in bloom. In any case, heavy rainfall keeps the bees in the hive and flushes the nectar and pollen from whatever flowers there are. As food for the bees is scarce, they can only survive if they have stored enough honey and pollen. The *Ak* (Convovulaceae), one of the few flowers which the beekeepers regard as useful during this period, does provide some pollen, but is not found in sufficient numbers for the bees to be able to stock up their hives. Of course, beekeepers who open their hives in this period do so not to harvest honey but just to inspect the colonies. If they find cockroaches or Phorid flies in a bee-log, they try to eradicate them. If everything is in order, the beekeepers just cleanse the hollow with *Chakah* leaves and very carefully close the hive again. Any honey or pollen present must be left for the bees if they are to endure the difficult period ahead. Routine maintenance is the only justification for opening hives in this period, though most beekeepers argue that it is better not to expose the colonies to the dreaded Phorid flies, which are abundant when the weather is cloudy and humid. In fact, only eight beekeepers say they open their hives in July (one of them recently lost an entire colony of bees as a result), which means that only 14% of the total number of hives are opened in this period. Many beekeepers recall that hives used to be opened every three months, including once in July, but nowadays the July opening is the most likely to be skipped.

5.3.3 November

When the rainy season draws to a close in October or November, the end of a period devoid of important nectar-producing plants in flower is heralded by the blooming of the *Xtabentun*, which the bees use to make a delicious 'greenish' honey.[5] The beekeepers open their hives at the end of October, in preparation for 'the day of the deceased' (*el día de los difuntos* or *hanal pixan*). On the 31st of October, the souls of deceased children visit their surviving relatives; a day later they are followed by the souls of deceased adults. The Maya decorate their houses and welcome their celestial visitors with festive meals, gifts and prayers. It is important that the entire homestead be thoroughly cleaned and tidied in advance, otherwise the souls of the departed will have to do the sweeping instead, which may incur their wrath. As the *nail kab* is an integral part of the homestead, the beekeeper inspects the hives and does any necessary maintenance. The visiting souls must not be allowed to roam around aimlessly, so candles are needed to light their way to earth and back. 'Black' wax of stingless bees is favoured for its colour (actually very dark brown) and perfume, and because gods and the souls of the departed naturally prefer the wax and honey of *Xunan kab* to wax produced by *Americano kab*. Although there is not usually much honey in the hives at this time of the year, 30 beekeepers open their bee-logs (73.1% of the total number of hives: Table 5.1) to clean them and to take out some 'black' wax.

It is the 13th of October, two weeks before the day of the deceased. The elderly Don Pepe of Kimbila is going to open his hives of *Xunan kab*. He owns 21 *hobonob*, rather a lot for just one person and even more so for a man of his age. Since his wife may not take part in the harvesting, he has invited his grandson to help. As soon as the boy arrives, Don Pepe starts preparing mud. He takes red earth (*kan kab*) from part of his homestead (*solar*) and mixes it with water. Then, one by one, he takes the logs from the racks and places them on the tree-stump in front of which his grandson is sitting. As Don Pepe moves from one stack to another in the *nail kab*, the boy opens the hives one by one. No important nectar-producing flowers have bloomed yet, so the bee-logs are nearly empty. By gently pressing each storage pot (*chu*), he can determine whether it contains honey or pollen: those with pollen feel a little harder. To remove a pot, the

[5]An as yet unconfirmed report from Cuba indicates that consuming honey made from the nectar of this tree (*Xtabentun*, *Turbina corymbosa*) can produce hallucinogenic effects (personal communication: an informant of Austin & Staples 1991: 276).

boy uses a small stick to break the ribs that join it to neighbouring pots or to the wall of the bee-log. He takes great care not to damage the internal structure of the nest. From some hives he extracts a pot from both ends; others he leaves undisturbed, finding the bees too impoverished. He puts the pollen and honey pots into separate calabashes (made from fruit of *Crescentia* sp.). Each time he finishes with a hive, he passes the bee-log back to Don Pepe, now sitting beside him, who cleanses the inside of the log with *Chakah* leaves and water before closing the hive with the stoppers and red mud he prepared earlier. When the hives are properly sealed, Don Pepe puts them back onto the racks. Having arranged the bee-logs in logical order on the ground, he knows the correct place for each one. With a little puzzling, he puts the logs back into the positions they have occupied for years, so that the bees that left the hive earlier will be able to rejoin their own families.

Don Pepe's yield is just one calabash of pollen pots and another with only three storage pots of honey. He takes the honey into the house to be strained and stored by his wife. Don Pepe, his grandson and Maria take the calabash with pollen pots and sit down in front of the house to separate the pollen from the wax. Having discarded the pollen, which will be burned with the household refuse, they are left with a tiny quantity of wax. However, Don Pepe still has some black wax that he has kept since robbing a colony of *Nii' kib* last year. He can now rest assured that he will be able to light the way of the visiting souls, as custom demands, with the best wax available. A few days after this harvest, Don Pepe offers a calabash of corn-gruel (*saka'*) to the protector deity of the bees (observed by me in Kimbila).

Taking too much honey and pollen from the bees would be a severe blow to the colony in a lean period. After harvesting, many Maya save the wax of stingless bees specially for the day of the deceased. Others also go into the forest to search for wild nests of stingless bees. The forest bee *Nii' kib*, in particular, produces a lot of wax; its very elaborate nest-entrance alone can weigh half a kilogram. Although the nests of the other species of forest bees, *E'hol*, *Kansak* and *Xiik'*, do not have such large entrance structures, their wax is considered to be good enough for the ceremony. However, the forests have been decimated and wild bees' nests have become so scarce in the remaining pockets that many people, especially those who do not own beehives, will have to buy candles from the shops.

5.3.4 January

In January, the roadsides all the way from Valladolid to Felipe Carrillo Puerto are painted yellow by the *Tajonal* flower (*Viguiera dentata*) which grows in abundance in poor soil and, as a rule, blooms from December to February. The beekeepers say *Xunan kab* flock to the *Tajonal* for its pollen (*iis*), storing large quantities in their hive. In the period before this month of yellow verges, no important nectar-producing plants flower, so there is not much honey in the hives. In February, though, the *Habim* (*Piscidia piscipula*) blooms, the first of a series of important nectar-producing plants which flower before the *man ha' che'* sets in. This period of plentiful nectar culminates in the blooming of the *Ts'its'il che'*, just after the short period of light rains already described. The beekeepers argue that if the bees store too much pollen in the hive, there will not be enough space for honey pots later. Some of them therefore open their hives in January to remove excess pollen. Once again, they also cleanse the inside of the bee-logs with leaves of the *Chakah* tree and check whether *xnenel* have invaded the hive (see Section 5.6.2). They regard this extraction of pollen as just another round of routine maintenance.

Not many beekeepers open their hives in January: 19% of those involved in this study open 16.8% of the total number of hives (based on Table 5.1). One of these beekeepers has recently lost all his colonies. Most keepers are reluctant to open the bee-logs in January, when the sky is often overcast and there may be occasional rain. It is believed that the humid air is favourable to *xnenel* (Phorid flies), so most beekeepers do without the advantages of cleaner hives with more storage space rather than endanger their colonies. Actually, some beekeepers argue that it is better to open the hives to treat them against Phorid flies, while the others claim that it is precisely this practice which attracts the bees' deadly enemies. It should not be forgotten that, generally speaking, the bees are not very productive nowadays, so it is unlikely that a glut of pollen will reduce the subsequent honey yield. It may well be wiser, then, to keep the hives closed.

5.3.5 Irregular harvesting

Of the beekeepers covered by this study, 12.1% (Table 5.1) do not open their hives for harvesting on a regular basis. This may seem to be a fairly significant proportion, yet they own only 1.6% of the total number of hives (*Xunan kab* and *kaaxi kab*). They open them whenever they need honey or other bee-products, irrespective of the time of year. Most of these beekeepers possess only one or two hives and have no intention of building large bee-houses. In a sense, they regard their bee-logs as little medicine chests, to be opened only when the contents are required.

5.4 Harvesting *Xunan kab*

5.4.1 Preparing for harvest: *Chakah* (*Bursera simaruba*) leaves and red earth

Harvesting comprises a series of tasks which must be done in the correct order to reduce the risk of *xnenel* or ants attacking the colony. Before opening his hives, the beekeeper must gather leaves of the *Chakah* tree (*Bursera simaruba*). If none are available in or near the homestead, he must look elsewhere. Once, Don Jose opened his bee-logs out of season to show me the condition of his colonies. As there were no leaves on the *Chakah* tree in his back yard at the time, he spent more than an hour on his bicycle searching for a suitable tree. He eventually returned with some leaves from the forest. Don Jose would certainly not have risked opening his bee-logs without the leaves. They are kept submerged in a bucket of cold water ready for use, but are not softened, only moistened, by this soaking. Having obtained *Chakah* leaves, the beekeeper fetches *chak luum* or *kan kab*,[6] red earth found in abundance in the homestead (*solar*). He then mixes it with a little water to make a paste of just the right thickness for re-sealing the hives after harvesting. The red earth is ideal for this purpose, consisting typically of 28.8% sand, 27.9% lime and 43.3% loam (Herrera Castro 1994: 72). Because of the high loam content, it dries in just a few hours without cracking. It is essential to have this mud close at hand so that the bee-logs can be sealed as soon as possible after harvesting. As the above anecdote illustrates, it can take a lot of time to find *Chakah* leaves, so the mud must not be prepared until they have been gathered, otherwise it may dry out before the hives can be sealed. Of course, if a beekeeper is lucky enough to have a *Chakah* tree with leaves in the homestead, the sequence is not critical.

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[6]A beekeeper from Yaxley explained the difference between *chak luum* and *kan kab*: both are red earth, but *chak luum* is found closer to the surface than *kan kab* and contains more small stones.

5.4.2 Opening and closing the hives

To minimize exposure of the colonies, the bee-logs should be opened and closed one at a time. If there are many hives, several people co-operate in this task. The beekeepers ensure that, after harvesting, the bee-logs are put back in their original positions on the rack so that bees returning from foraging can rejoin their own colonies without difficulty. The keepers often emphasize how important this is:

"The bees know when they are at home. A bee from one family must not enter another bee's house" (Don Pascual, Señor).

To avoid confusion, beekeepers with a large *nail kab* work on the bee-logs in series as opposed to parallel and following a standard sequence: they start with the hive at the bottom of the first stack; opening, harvesting, re-sealing and putting it back in its original position on the rack before tackling the next one up. Only when the last hive of that stack has been returned to top position do they move on to the second stack. Even if all the bee-logs of one stack are taken off the rack together, the same bottom-to-top serial procedure is followed, two hives never being left open at the same time. Another system ensures that hives are not accidentally put back on the rack upside-down: nearly all the bee-logs are marked with a square, circle or occasionally some other figure inscribed around the nest-entrance. A cross above this figure has the same function as the wine-glass symbol on a cardboard packaging. Some logs only bear a cross. Such markings also have symbolic meanings, which are discussed in Section 8.2.1 *et seq.* To open a log, the beekeeper lays it on a tree-stump, chair or other suitable support, high enough to be able to peer into the hive without uncomfortable back-bending. In the past, beekeepers with large *nail kabob* would often use a stand with a special labour-saving mechanism to rotate the bee-log through 180° so that they could open both ends without having to lift and turn it. Having harvested from the hive, the beekeeper cleanses the inside of the log with water and *Chakah* leaves, immediately re-closes it with a stopper, and seals the joints with red mud (*chak luum* or *kan kab*). The stopper is a flat stone or a disk of wood.[7] The mud glues the stopper to the log and hermetically seals it.

[7]For a brief discussion of bee-log stoppers, see Crane 1992.

5.4.3 Extracting honey and pollen

Beekeepers harvest honey and pollen from their hives by removing fragile clusters of storage pots, which the bees make from wax. If pots containing honey are damaged during removal, the honey will run through the hive. The spaces between the stoppers and the outermost food- pots may contain fragments of dried red sealant mud, which inevitably crumbles when the stoppers are removed, intra-nidal waste dumps containing faeces from the bees, and even small black beetles[8], which sometimes live in the wood of the bee-log. Before harvesting, therefore, good beekeepers clean out the bee-log. Knowing that honey ferments rapidly after coming into contact with water, they just sweep out the rubbish with a brush or some dry leaves. A few beekeepers, however, do use water to clean out their bee-logs, arguing that the wood fully absorbs it before any honey runs through the hive. Cleaning is, of course, impossible if the hive is filled to the stoppers with storage pots. Before removing the clusters of honey pots, beekeepers always cleanse their hands, preferably with moistened *Chakah* leaves. However carefully the beekeeper handles the pots, and even though the wax of which they are made has a certain flexibility, almost inevitably some get broken and honey oozes through the hive. Bees inside the nest get covered with honey, which sticks to their bodies and wings, making flight impossible. The beekeeper knows this cannot be avoided. He takes the honey-drenched bees one by one, rinsing them in a bucket of water and leaving them to dry on the hive or in a sunlit spot nearby. Meanwhile, the honey is collected in a calabash or other vessel, together with the honey pots that have been extracted. With the hive open to attack by enemies such as ants, Phorid flies or even bees from other colonies, and the pollen and sweet-smelling honey acting as a lure, the bees are in great danger. Therefore, the beekeeper must clean the hive carefully after harvesting. He takes the *Chakah* leaves that have been soaking in water all this time and rubs the inside of the log with them, removing all traces of spilled honey. Only then can the hive be closed again and put back on the rack.

With his intimate knowledge of the regular intra-nidal architecture (see Appendix I), the beekeeper can roughly estimate the amount of honey he can safely harvest. Some honey must be left in the hive for the bees to feed on, especially outside the honey-making season or when it is drawing to a close and the bees will have little

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[8]The beetles feed on waste matter in the hive, such as fungi, and do not harm the bee colony in any way; they are removed only to prevent pollution of the honey.

opportunity for further foraging. When the beekeeper reaches the section containing both honey and pollen pots, he stops extracting clusters and turns his attention to the other end of the hive. If the honey season is almost over, the beekeeper leaves about one-third to a quarter of the honey in the hive. The beekeeper's rule of thumb is to divide the bee-log mentally into three equal parts; ideally, the central third contains only the brood nest and pollen pots, while the two outer parts are full of honey pots. The beekeeper then extracts two-thirds to three-quarters of the available honey at both ends. The rest is for the bees. Some beekeepers take all the honey from one side of the hive and leave the other side undisturbed. Out of season, beekeepers normally harvest only a few pots of honey. Some claim that it used to be possible to harvest two-thirds or three-quarters of the honey in a hive once every three months.

5.4.4 Harvesting from forest bees kept in the homestead

The Maya cultivate far fewer colonies of forest bees (*kaaxi kab*) than of *Xunan kab*, which occupied approximately 97% of the total number of hives for stingless bees in 1994 (see Table 5.1). The Maya cultivate three species of *kaaxi kab*: *Xiik'*, *E'hol* and *Kansak*. In isolated cases, the small species *Bool* is also kept in the back yard. As described in Section 5.2, the hives of these *kaaxi kab* are kept vertical rather than horizontal, and they are usually placed some distance from the *alak'* (*Xunan kab*). This policy of separateness is also apparent in harvesting. Beekeepers who set their forest bees apart from *Xunan kab* also take care to prevent cross-plundering: by harvesting from the two classes of bees at different times and places. The procedure for hives of *kaaxi kab* is much the same as for *Xunan kab*, and although the beekeepers do not worry so much about *k'inam* (potentially harmful energy) in their handling of the former, they do cleanse their hives with *Chakah* leaves if these are close at hand. An important class difference is that larger quantities of pollen and wax can safely be taken from the forest bees. In contrast to the common practice with hives of *Xunan kab*, pollen stored by *kaaxi kab* is not removed and discarded just to make space for honey production, but is consumed, for it is said to be sweet during the dry season (*yaax kin*). As we have seen, the Maya treat the *kaaxi kab* kept in the homestead with a certain respect, though this is far less than that which is afforded to the *Xunan kab* in their bee-houses. When a colony of one of the former species is found in the forest, however, the whole nest is ransacked and not even the larvae (*u yaal*, 'the children') are spared. Obviously, no colony can survive such damage.

5.4.5 Processing honey, wax, pollen and larvae

The harvest usually yields a calabash or bucket of honey mixed with wax and possibly some intra-nidal waste dumps and/or red sealant mud. Most beekeepers try to ensure that pollen does not get mixed with the honey, but are not always successful. Some beekeepers use a strainer of homespun or purchased fabric to separate the larger pieces of intra-nidal material from the honey as it runs out of the log. Wax is easily separated from the honey, but quite a finely woven cloth is needed to remove fine grit. Normally, *Xunan kab* honey is crystalline and caramel-coloured, though other shades are possible, depending on the species of flowers that are visited by the bees. The bottle or jerrycan in which the honey is to be stored must be clean and dry. If there is moisture in the container, the honey will start to ferment as soon as it is poured in, and bubbles will have formed by the next day. After the harvest, a few women boil the honey to evaporate some of the water, but this is not common practice.

To refine the wax, the beekeepers' wife boils it in water. The melted wax floats, while the dirt sinks. When yellowish bubbles appear at the surface, the wax is ready. It is left to cool, but is cut loose at the rim before it solidifies. The wax of stingless bees is very dark brown in the hive, hence the name 'black wax', but takes on a lighter, caramel shade after being refined. The Maya use most of it to make candles: they re-melt the refined wax and repeatedly dip a wick of henequen fibre into it until the required thickness has built up.

Xunan kab pollen is not normally used by the Maya, who dislike its taste and say it can cause vomiting. Any pollen extracted from hives is disposed of along with the household refuse. Some beekeepers throw wax and pollen from the hive into a bucket of water, which is kept close at hand. The water and pollen is later dumped in a corner of the back yard. The pollen of forest bees, however, is considered to be edible. Some people eat it straight from the nest with red peppers; others mix it with honey and cinnamon and toast it a little. Care should be taken, though: even the pollen of forest bees may cause vomiting or diarrhoea, especially if water is drunk after the meal.

The larvae of the forest bees *Xiik'*, *E'hol* and *Kansak* are also eaten. When the brood comb is roasted, the larvae fall out. They are then given a further roasting along with the pollen (the larval food) still sticking to them and a little added honey. The larvae of *Xunan kab* in contrast, are considered inedible.

5.4.6 The honey yield

Because the beekeepers of the Maya claim that *Xunan kab* hives no longer produce sufficient quantities of honey, it is important to examine closely the yields obtained. Unfortunately, no representative data could be collected in 1996: that year, the 'April showers' of the *man ha' che*' did not fall until the first weeks of May, so the beekeepers were unable to harvest honey from their *Xunan kab*. At my request, two beekeepers opened their hives and, indeed, there was hardly any honey in storage: only the brood, some pollen pots, and empty spaces where honey pots would normally have been. Some beekeepers probably opened the hives in late May and managed to extract a little honey before the main rainy season started, but I had already left the area by then because my fieldwork period was over. Fortunately, the data for 1994 serve to clarify the issue. Table 5.2 shows mean yields per hive for each village or ranch over that whole year. The figures show significant differences in the quantities of honey

Table 5.2: Mean yields of *Melipona beecheii* in liters in November 1993 and April 1994 per location in Yucatan

Location	number of hives	November	April
Tepich	114		0.65
Senor	18	2 (one beekeeper)	1.6
Yaxley	6		1.25
Rancho Flor de Mayo	48	1	2
Tabi	32	1	1
Rancho S. Lucia	1		*
Tusik	7		1.5
Kimbila	21		0.75
Epedz	83	0.25	0.25
Pino Suarez	1		*
Chan Chen Comandante	14		0.5
San Jose	0		0

* no regular harvest

harvested at the various sites. While the highest reported mean yield per hive for that year was three litres (on the Flor de Mayo ranch, with about 14% of the total number of *Xunan kab* hives included in the survey), the lowest figure was approximately half a litre. In the villages of Tepich, Chan Chen Comandante, Kimbila and Epedz (some 67% of the *Xunan kab* hives), beekeepers only harvested 0.5 to 0.75 litre per hive on average. In the other villages and ranches (Señor, Yaxley, Tabi, Tusik; 19% of the hives), the mean yields per hive for that year are spread out between the two extremes. Under-productive colonies are thus more common than normally or highly productive colonies. The beekeepers of the under-productive colonies claim that they used to be able to extract approximately two litres of honey per hive every year. They therefore conclude that the *Xunan kab* colonies have become impoverished. This seems to be borne out by that fact that, in November 1993 and 1995, they were unable to harvest any honey from their bee-logs because the *Xunan kab* had not stored sufficient quantities. The Maya pay far more attention to the productivity of their *Xunan kab* than to that of the forest bees cultivated in homesteads. All the forest bee species make less honey than *Xunan kab* are capable of producing. Hives of *Xiik'*, for example, yield about half a litre of honey per year; whereas *E'hol* and *Kansak* give about three-quarters to one litre annually. Normally, no honey is harvested from the smaller bee species. Because they attach less importance to honey production by the forest bees, the Maya cannot say whether these have also become impoverished.

5.4.7 The Dinner for the Bees (*U Hanli Kab*)

As beekeepers extract honey from their hives, they accumulate a debt to the gods; in particular to the chief rain-god *Kun K'u*, who, in his beneficence, has supplied sufficient rain. Repayment is in proportion to the perceived size of the debt: the number of hives and their yields having declined dramatically with each seasonal supply of rain, most beekeepers no longer perform the elaborate ceremony known as *U Hanli Kab*, 'the Dinner for the Bees'. Nowadays, they just make a small offering after the 'crops' of the bees have been harvested. Nonetheless, I wished to gain a better understanding of the place occupied by stingless bees in Maya society and was therefore eager to observe the *U Hanli Kab*. The *hmen* Don Hipólito, who has a meliponary with five logs of *Xunan kab*, was willing to perform the ceremony, though only on a small scale. Normally, the breadstuffs and other solid foodstuffs to be offered to the gods are baked in a *pib*, a pit oven dug in the ground. On the eve of the ceremony, the men dig the pit, lay dry logs side-by-side across it, and cover these with a layer of large stones. They then set fire to the logs. When these are charred through, they break and the hot stones fall into the pit. All the foodstuffs are then placed in the oven and covered with palm leaves and earth. The stored heat radiated by the stones slowly bakes the buried foodstuffs overnight. At dawn, the shaman consecrates the pib by sprinkling mead (*balche'*) over it before removing the baked offerings. In preparation for the ceremony I observed, Don Hipólito did not make a *pib*; instead, the foodstuffs were cooked on the *comal* (metal plate or griddle) over the kitchen fire. According to the shaman, this was the only departure from custom.[9]

5.4.7.1 The *U Hanli Kab* offerings

This ceremony requires two liquid offerings - *saka'* and *balche'* -, two types of bread - *xnohwahob* and *hostias* - and three other solid foodstuffs - *k'ol*, chicken and *xnabal* - (all the new Maya words are clarified in the following description). In addition: Doña Teresa coarsely grinds a portion of the corn, pours some *Xunan kab* honey over it and divides the resulting mixture between two calabashes (fruit of *Crescentia* sp.), which are henceforth referred to by all present as 'The Bees'. All the ritual foodstuffs require special preparation according to custom. Don Hipólito prepares the *balche'* first (see Prologue) so that he can consecrate the solid foodstuffs with it. *Saka'* (also known as *santo uk'ul*) is corn-gruel: cornflour, coarsely ground and stirred into water. This offering is poured into 14 calabashes. The rest of the corn is finely ground and used to prepare the *xnabal*, *xnohwahob* and *hostias*. Since early morning, the chickens have been simmering over the fire. Now the liquid is drained off and used to make a broth or bouillon with garlic, *achiote* (*Bixa orellana*), chili, salt, cloves, cumin and oregano. This is the *k'ol*, with which another 14 calabashes are filled. The remaining *k'ol* is used to make *xnabal*. In the first instance, the word *xnabal* refers to a kind of bread, the dough for which is made from cornflour mixed with *pepitas* (squash seeds: *Cucurbita* sp.). This dough is wrapped in palm leaves and baked on the *comal*. When ready, the *xnabal* is torn into small pieces and dunked into the remaining *k'ol*, producing a thick porridge which, from then on, is also called *xnabal*. Doña Teresa prepares the *xnohwahob* ('great tortillas'). These are thick corn-cakes inscribed or indented with special decorations: one unique *xnohwah* bears a cross and a superscribed arc; five others have set numbers of dots (12, 11, 10, 9 and 8); and there is a *xhohwah* marked only with a cross. Whereas Don Hipólito does not intervene in the preparation of the other foodstuffs, he carefully supervises the making of the *xnohwahob* and ensures that the quantities of all the foodstuffs match the number of deities he is to invite to dinner. He needs 14 *xnohwahob*: one set of seven as described and the rest bearing only a cross. Using a leaf

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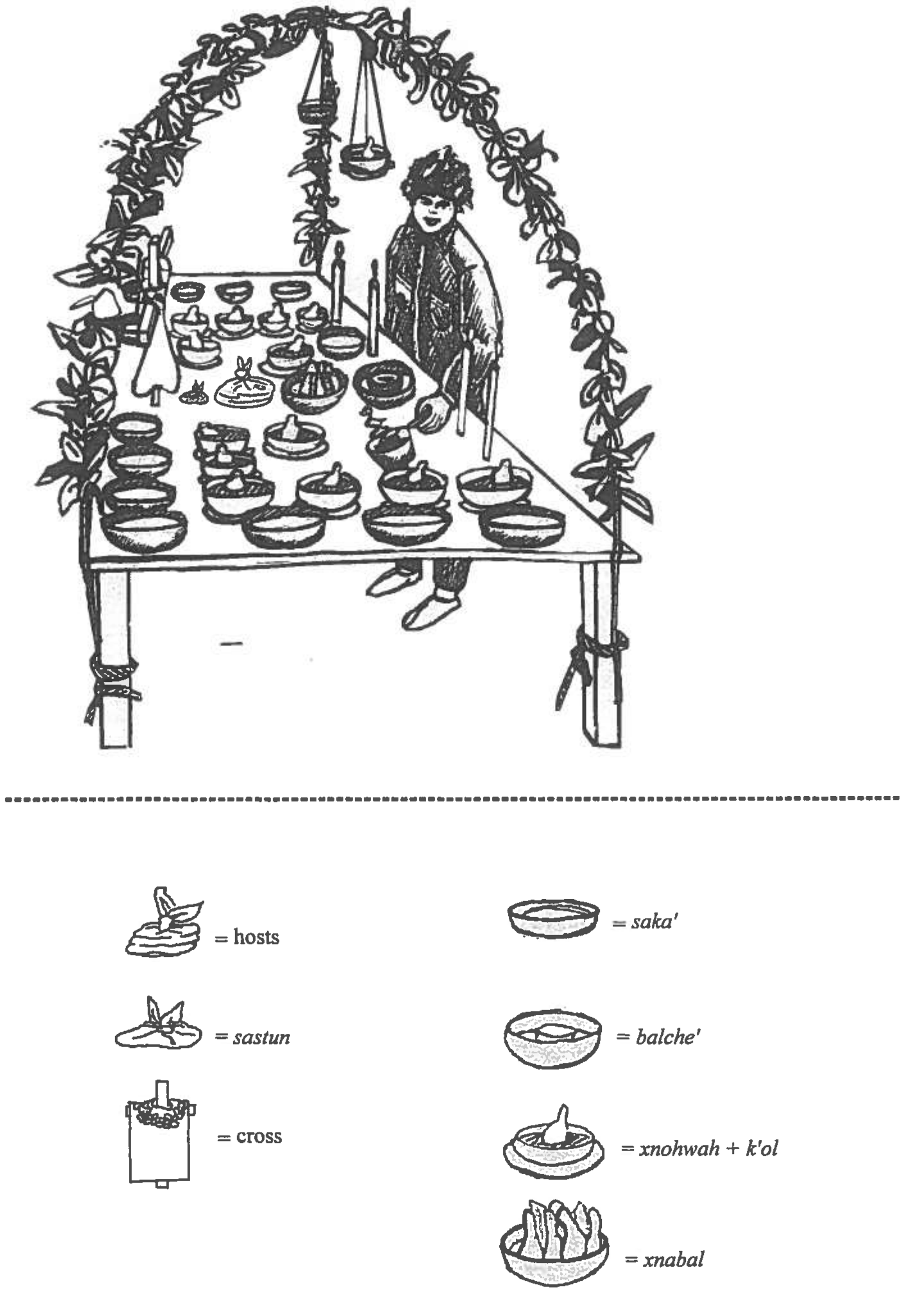
[9]Don Hipólito performed this *loh* (ceremony) in my presence on two occasions, in May 1994 and April 1996. The second time, the proceedings were recorded on video by Dr. M.J. Sommeijer.

of the *Habim* tree (*Piscidia piscipula*) as a small scoop, Doña Teresa fills the indented dots, crosses and the arc with a mixture of *balche'* and ground *pepitas*. She then wraps these breadstuffs in palm leaves and bakes them on the *comal* over the kitchen fire of her house. To make the *hostias* (hosts), three of which are needed, she mixes a little *Xunan kab* honey with cornflour. Like the unique *xnohwah*, each of these special ritual breadstuffs is marked with an indented cross and a superscribed arc, the indentations being filled with mead and squash seeds. The hosts are also wrapped in palm leaves before being baked on the *comal*. When ready, the hosts are wrapped in an embroidered cloth. While the women put the finishing touches to the food offerings, Don Hipólito starts building the altar outside, in front of the meliponary (observed by me in Tepich).

5.4.7.2 The *U Hanli Kab* altar

There, close to the bee-house, Don Hipólito sets up a square table and builds two arches of *Habim* leaves and twine. The arches must run diagonally from corner to corner of the table, crossing directly above the centre-point. All the twine he uses to tie this construction together and to suspend the offerings from it is handmade. He covers the table-top with *Habim* leaves before placing twigs bent into hoops on it: these serve as supports for the offerings and ensure that the calabashes containing liquid offerings cannot topple over. He then carefully positions a cross, his *sastun* (divining crystal), the hosts, *xnabal* and *balche'* to form a straight line down the middle of the table (see Figure 5.1). On both sides of this row of ritual objects and offerings, on every hoop, he places either a calabash of *saka'*, or a *xnohwah* and a calabash of *k'ol*. Six of each are placed on one side and seven of each on the opposite side. From the mid-point of the arches, the shaman hangs two more calabashes: one filled with *saka'*, the other with *k'ol* and the unique *xnohwah* decorated with its cross and arc. The two special calabashes called 'The Bees' are placed on the bee-logs in the meliponary. Under the table, Don Hipólito keeps a tin with *chal* (resins) extracted from the beehives. This will serve as incense, its smoke drifting to the sky. Two candles will light the path of the gods as they descend to the altar. Everything is now ready: the ceremony is about to begin (observed by me in Tepich -see Prologue, final paragraph).

Figure 5.1: The *u hanli kab* altar



5.5 Acquiring new colonies

With meliponine hives declining in strength and number, it is important to examine how beekeepers may acquire new colonies. There are four ways: taking one from the forest; keeping a hollow log and hoping that bees will settle in it of their own accord; purchasing a colony from another beekeeper; and dividing an existing one, as the beekeepers of the Yucatan peninsula do when they wish to increase their numbers of colonies. It would have been interesting to know by which of these methods (described in detail in Sections 5.5.1 to 5.5.4) the bee colonies owned by contemporary Maya beekeepers were originally acquired. Exact information is, however, no longer accessible: many of the hives in present-day bee-houses were inherited from parents or grandparents, so the owners no longer know where the colonies originated. Loss of colonies by natural causes blurs the picture even further: some die out or flee and, from time to time, beekeepers replenish their bee-houses by one or more of the four methods stated above but are unable to recall the details later. Nonetheless, it is possible to form some conclusions on the basis of verbal accounts given by beekeepers. These indicate, approximately, that 50% of the colonies are inherited, 30% are obtained by splitting, 10% are bought from other beekeepers and 10% are taken from the forest.

5.5.1 Taking a colony from the forest

Men often pass through the forest on the way to their *milpas* (cornfields). Although deforestation has severely affected the *ejidos*, all of them still have some pockets of forest (see Section 9). Before the forests were decimated, men would often go into them to hunt, or to collect *chicle* (latex from the tree *Manilkara zapota*, the raw material from which chewing gum is made: see Section 6.3.3). Sometimes, the men would stay in the forest for weeks before returning home. This is now very uncommon. In the forest belonging to the Xmaben *ejido*, though, the men still go hunting and do a little selective logging, while a few occasionally collect *chicle* from other areas. In Tepich too, some men still go hunting and, every now and then, someone goes beyond the *ejido* to get *chicle*. Although the forest is greatly reduced in area and men spend less time in it than ever before, they still pass through it on a regular basis. On these walks they may find a bees' nest. Some men set off sporadically in search of bee colonies. Yet it is difficult to find *Xunan kab*, for nests of stingless bees have become scarce indeed.

Once a beekeeper has detected a colony, he may well decide to take it home with him, unless the nest is so inconveniently situated that it can only be reached by felling the tree. This is not to be undertaken lightly, however: some people assert that the *ah kanul* (collective spirit) of the trees may wreak vengeance upon the over-enthusiastic woodcutter, and nowadays there are legal obstacles too. In Tepich, for example, the law of the *ejido* prohibits felling within two kilometers of the village. If the nest is accessible, on the other hand, the beekeeper will simply cut off the branch housing the colony. He must do this with the utmost caution, as the colony would be unlikely to survive the fall to the forest floor. The branch from which the log is to be taken is roped to another nearby limb so that, once cut, it can be gently lowered to the ground. This is not the end of the beekeepers' problems, though. In the daytime, many bees are out foraging and would be lost if the beekeeper were to take the log home immediately. So he leaves the log containing the nest as close as possible to its original position, usually hanging it from an adjacent branch, so that the bees can easily find their way home. If the log were to be left lying on the forest floor, the returning bees might not be able to find their nest, which, furthermore, would be very prone to attack by enemies. The beekeeper must also ensure that the hollow-log is closed at both end; inserting temporary stoppers, if necessary. Only then can he go off on other business. When night has fallen and all the bees are safely back in the nest, the beekeeper will return to the spot, close off the entrance hole with a leaf and take the colony home. However, some beekeepers claim that a number of bees in a colony sometimes go foraging so far from home that they cannot return in just one day. They say such bees will 'camp out for the night' under the leaf of a tree before returning. It is also said that all the bees stay at home on Saturdays, so a beekeeper will sometimes leave the newly acquired nest hanging in the forest until the next Saturday, when he finally brings the bee colony to his homestead (see Section 8.6 - paragraph including Don Rocío's story). He then installs the new log alongside the others in his bee-house. As already stated, however, wild colonies of *Xunan kab* are so scarce in the forest that beekeepers also use other methods to increase their collection.

5.5.2 Catching a wild colony by chance

Hives are sometimes abandoned by bee colonies when they 'flee' into the forest. Quite often, colonies just die out. In both cases, the empty logs are cleansed and, usually, put back in the bee-house for future use. Some beekeepers, however, leave empty bee-logs lying in their back yards in the hope that one day, quite by chance, a wild or fleeing colony will select one of the vacant homes as a nesting site. A few beekeepers relate how, occasionally, colonies of forest bees have taken up residence in their back-yard logs, yet none of them appear ever to have succeeded in 'catching' a colony of *Xunan kab* in this way: the chances are so slim that the Maya have to obtain new colonies in other ways.

5.5.3 Buying and inheriting colonies

Most beekeepers would, of course, like to have more colonies in their bee-stands, so very few are willing to sell even a single colony of *Xunan kab*. Occasionally, someone who has no ambitions as a beekeeper comes across a colony of stingless bees in the forest and tries to sell it. There is a beekeeper in Tepich who used to have a large meliponary. He regularly multiplied his colonies by splitting, selling the surplus to other beekeepers. Nowadays, though, most beekeepers have so few colonies left that they are reluctant to part with them. Nor is it easy to create daughter-colonies from the logs in a bee-stand. As a result, colonies are rather expensive: in 1994, a single colony of *Xunan kab* in a log cost 40 pesos (then approximately 13 US dollars). That year, 40 pesos represented the labour costs incurred in clearing four square *mecates* (1600 m^2) of forest for *milpa* production.[10] Buying a colony, then, is a major investment with a high risk, as the bees can easily be lost to marauding *xnenel* or ants, or the colony may simply become too impoverished to survive a period of food scarcity. To summarize: meliponine colonies are seldom traded because they are such a rare and vulnerable commodity, both in the wild and under cultivation, and because their market price is so high as a result.

In fact, most *Xunan kab* hives are acquired by inheritance. Although the queen and all other individuals in a hive are mortal, the colony is perennial: it naturally regenerates and can survive for many years. Beekeepers measure the longevity of their most resilient colonies in centuries, which indicates that many outlive their keepers and are then passed on to the immediate family. Both men and women may inherit

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[10]In 1996, I paid 200 pesos (then about 30 US dollars) for two hives of *Xunan kab*. That year's devaluation of the peso due to inflation was not compensated by wage increases, so the 1994 comparison to forest clearance is not relevant to the situation in 1996. It is doubtful whether a beekeeper would be willing to pay 100 pesos for a colony (equivalent to the clearing of 10 *mecates*). When two beekeepers bargain, the final price is bound to be much lower than the sum demanded from a visiting anthropologist! Therefore, I felt it was more appropriate to equate the price per hive to the clearing of 4 *mecates*.

hives, though this is highly exceptional for women.

5.5.4 Making daughter-colonies

There is a crescent moon of four days. Only a few days earlier, Don Baltizar opened his one and only hive of *Xunan kab* for inspection. It was full to the stoppers, and not just with honey pots: the hive was *xaal kab* (rich in brood). One of the brood chambers could be seen at the open end. Although it was mid-May, Don Baltizar decided to make a daughter-colony from this hive. He reckoned that there was enough time for both colonies to recuperate, as the bees were still very active.

Over the years, Don Baltizar has lost 13 colonies of *Xunan kab*. He has kept the empty bee-logs in his back yard and now he's going to use the best one. His wife has washed it out with water and it is drying in the sun. Don Baltizar starts to prepare *chak luum*. He then rubs the log with dry *Chakah* leaves so that the aroma of the wood will be acceptable to the bees and they will not flee because of *k'inam* (energy). Taking two strands of vine, he fashions them into rings which fit snugly into the hollow of the log. He pushes the rings in at opposite ends, to a depth of about 10 centimetres. When everything has been properly prepared, he places the brood-rich mother-log beside the empty one before opening it. Using a small stick, he separates the brood chamber from the storage pots and extracts it in one piece. Honey runs through the hive. He places the brood chamber with bees clinging to it between the two vine rings, close to the entrance hole. Although the bees had built the brood chamber a little askew, Don Baltizar makes sure that, in the new hive, it is fixed squarly in the hollow log. He discovers a second brood chamber, constructed behind the one just removed, and also places it in the new bee-log. He knows that there is yet another brood chamber at the opposite end of the mother-log, so he will not be depriving the mother-colony of larvae. He fills the remaining space between the two vine rings with pollen pots and honey pots from the mother-hive. Many of the pots are broken, exposing the pollen grains and honey inside. This doesn't worry Don Baltizar, though; he says the bees will mend them. He places two short sticks diametrically across the hollow of the log, adjacent to the rings, to hold the brood and storage pots in place. He then plugs the ends of the log, stuffs *Chakah* leaves into the gaps and seals the stoppers with *chak luum*. Even so, a little honey from the mother-colony leaks past one of the stoppers, but he stems the flow with more mud. "*Listo*" ('ready'), he says. He puts the mother-colony back in its original place on the rack, with the new hive above it. Five minutes later he shows me how the bees in the new hive are already busy in the nest-entrance 'making the door'. The final stage is to make an offering: three calabashes of *saka'* (corn-gruel) that his wife has cooked and sweetened with honey are placed on logs propped up between three stones, and a cross is erected behind them. Don Baltizar recites a short prayer for the *ah kanul* of the bees and, with that, the creation of the new hive is complete (observed by me in Tepich; see Photo 7).

Two years later I learned that the new hive had not survived the split, that the log had been abandoned after only one month. The mother-colony did survive, however, and the following year Don Baltizar harvested a single bottle of honey. What could have caused that premature demise of the daughter-colony? It had been invaded by *xnenel*, but Don Baltizar did not know why. As other beekeepers split colonies in rather different ways, I now review their methods to shed light on what went wrong when Don Baltizar tried to split his.

5.5.4.1 The right time to split a colony

Among the beekeepers, there is general consensus that a hive should always be split at full moon, when the bee larvae (*u yaal*, the children) are understood to attain maturity. After splitting, it is vital that the number of bees in each hive quickly increase, otherwise there will not be enough workers to build storage pots and forage for honey and pollen. Bees do not live long, and young, vigorous bees are essential to the colony's survival. At only four days after the new moon, Don Baltizar appears to have split the colony too soon. Although he was fully aware of this and accepts the customary timing, the fact that the colony appeared to be mature and there was still some time for the two colonies to recuperate from the split was of overriding importance to him.

Daughter-colonies are usually created during the *man ha' che'* light rains. While it is true that Don Baltizar followed this practice when splitting his only remaining colony, he did it rather late, in mid-May, leaving only about a fortnight before the heavy rains normally start coming from the west on a regular basis. From then on, it is difficult for the bees to go out foraging and they must therefore have ample food in reserve. Knowing this, beekeepers are more inclined to create daughter-colonies in April.

5.5.4.2 Selecting brood for the new hive

Did Don Baltizar select the right brood for the new hive? Most beekeepers will not attempt to create a daughter-colony unless the hive is *xaal kab*, i.e. furnished with more than one brood chamber. This is by far the most common practice. A few beekeepers combine brood taken from more than one hive when creating a new colony:

"If you see that they do not have a lot of brood, you just take one brood comb from each hive to complete the new one" (Don Fernando, Tepich).

In contrast, Don Avelino says you should never merge brood from different hives (and he is not alone in claiming this):

"You cannot join brood from different *hobonob* because everyone knows which is home. Bees cannot enter a house which is not theirs, so you must take brood from only one *hobon*. You have to keep things apart. It is like having a house. If it is not yours, you cannot enter just like that, you have to call first" (Don Avelino, *hmen* Tepich).

According to some, the new hive should be furnished with 13 brood combs, yet others say seven or eight are sufficient. By putting two entire brood chambers in his best log, Don Baltizar had certainly furnished the daughter-hive with enough larvae. However:

"There is another secret (*secreto*) concerning the brood: you must only put combs which are whitish into the new hive because the black ones are not yet mature" (beekeeper, Flor de Mayo ranch).

According to this beekeeper, newly-emerged bees are pale so it follows that mature larvae are also white. The bees emerge from their larval stage after about forty days of life. For the development of the daughter-colony, it is vital that bees emerge soon after the splitting of the old hive to reinforce the work-force in the new hive. Don Baltizar placed two brood chambers in the new hive, which therefore probably contained some mature brood at its inception. Another possible factor in the demise of the daughter-colony is that he paid no attention to the presence of a queen.

5.5.4.3 A latent queen

Would it not have been wiser for Don Baltizar to ensure that there was a queen in the new hive? It should be noted that many Maya assume that there is a queen in the hive without having seen her. The queen is easily distinguishable from her subjects, being far bigger. She usually lies somewhere between the several layers of brood comb in the brood chamber, so most people will not see her unless they subject the hive to very close examination. The queen is called *na' kab*, 'mama bee', and is deemed responsible for the colony's productivity. When splitting a hive, however, the beekeepers do not usually take the whereabouts of the queen into account. Only two of those I interviewed remarked that if you want the daughter-colony to develop quickly, you should search for the queen and put her in the new hive. In fact, if you do not, a new queen will hatch out automatically (see Appendix I). As hives are usually split successfully without deliberately transferring the queen to the new hive (she may, of course, be transferred unseen within the brood chamber), this factor does not seem to explain why Don Baltizar lost his daughter- colony.

5.5.4.4 Uniting a family?

The only adult bees that Don Baltizar put into the new colony were those on the brood at the time of transfer. Were there enough of them to establish the daughter-colony? Probably not. In the process of transferring the brood chamber to the new *hobon*, most beekeepers also transfer some of the bees that are elsewhere in the hive at the time:

"You move the larvae and half of the *gente* (people) in the hive to the new *hobon*, and then the bees know what they have to do" (beekeeper, Señor).

Another commonly heard remark is that the extra bees are transferred to the new hive to take care of the larvae and the newly emerged adult bees. There were very few bees in Don Baltizar's daughter-colony, which may have been a factor in its premature demise.

5.5.4.5 Positioning the mother- and daughter-hives

Where should the mother- and daughter-hives be placed after splitting? Colonies are always divided in the daytime, when many bees are out foraging, unaware of the dramatic change that has taken place at home. They expect everything to be the same when they return. Don Baltizar put the mother-hive back in its normal position and placed the daughter-hive above it. The returning bees must therefore have rejoined the mother-hive. Other beekeepers claim that it does not matter whether the mother-hive is returned to its original position or the daughter-hive is put there instead:

"It doesn't matter how you arrange them; if one of your children leaves home and gets separated it will still be living in the right neighbourhood" (Don Kante, Señor).

Several beekeepers, however, do not agree with this statement. They always put the daughter- colony where the mother-colony was, so that returning bees will join the work-force of the new hive. One of them (Don Pascual of Señor) goes to even greater lengths: he advocates placing the mother-hive one *mecate* (20 m) from the daughter-hive to prevent the foraging bees from returning to their original colony and leaving the new hive low in population. According to this logic, Don Baltizar did not put the new hive where the mother-hive had been, so returning foragers did not reinforce his new hive. This, and the fact that Don Baltizar transferred few bees to the daughter-hive, meant that he created a particularly weak colony.

5.5.4.6 Endowing the daughter-colony with food

When creating a new hive, the brood combs enclosed in their chamber are never transferred alone. The Maya also put into the new hive a number of storage pots filled with honey, and occasionally even some with pollen. While they all agree that the colony of bees in the new hive needs a stock of food for the often difficult period ahead, individuals differ as to the precise amount of food with which the daughter-colony should be endowed. Is it a good idea to put both honey and pollen in the new hive, or is just one type of food sufficient? As can clearly be seen in the brood cells, the larvae are fed pollen. However, about 25% of the beekeepers also endow the new hive with honey, whereas some 19% favour honey alone. The rest either have never split a colony or do not explicitly state how it should be done. One thing is clear: none of the beekeepers only put pollen into daughter-hives, which is remarkable since they know perfectly well that the bees use it to feed the larvae. Those beekeepers who only transfer honey argue that the pollen stored by the bees attracts *xnenel* (Phorid flies) to the hive. Many of those who transfer both types of food are also aware of this danger and therefore stress that great care should be taken that none of the storage pots (*chu*) get broken. Some of the pots which Don Baltizar transferred were indeed broken, exposing pollen grains. This seriously endangered the colony and may well have been the main reason why the colony was invaded by *xnenel*.

5.6 Natural enemies of *Xunan kab*

No Maya beekeeper would dispute that the arch-enemies of *Xunan kab* are ants (*síinik*) and Phorid flies (*xnenel*). Who among them has not lost a colony to these marauding insects? While other animals are indicated as troublesome, the threat they pose to the colonies is far less significant. The *sam jool* (anteater) and the *tlacuache*[11] do raid colonies from time to time. Anteaters only feed on bees' nests in the forest, whereas *tlacuache* may also venture into villages to plunder hives. In 1995, a beekeeper in Tepich lost six of his hives to a *tlacuache*. Lizards and birds eat individual bees but are no threat to entire colonies. Bee colonies of nearly all the other species may launch mass attacks on hives of *Xunan kab*, yet this happens only occasionally and if the beekeeper is on the spot at the time, he can protect his colony simply by closing off the entrance hole with leaves. Although beekeepers often tell stories of colonies lost, it is doubtful whether statistical analysis of such information can throw much light on the actual causes. One day, for example, a beekeeper will relate with conviction how he lost his bees because of *k'inam*, only to shift the blame to ants the following day. Although these concepts may be linked, such contradictory accounts, which are not uncommon, make statistical data meaningless. What follows is a brief summary of the enemies of *Xunan kab* as indicated by beekeepers, including the defensive measures usually taken.

5.6.1 *Xulab* ('Devil') and *Chak Wayah Kab* ('Beehive-Destroying Red Ant')

Beekeepers fear the onslaught of two species of ant: *Xulab* ('Devil') and *Chak Wayah Kab* ('Beehive-Destroying Red Ant'). Both are carnivorous army ants (*Eciton* spp.), which are said to be most active during the rainy season and, according to some,

[11]According to Jacinta Pool May (my field assistant in Tepich), the *tlacuache* is a kind of fox. The animal is identified in the Maya Cordemex Dictionary as the species *Urocyon cinereoargentus fraterculus*. In some areas the *tlacuache* is understood to be a kind of rodent.

especially at night.

"This ant, *xulab*, bites - *putchica* (dammit)! They also devour the bees, even the *Americanos*. They head straight for the *hobonob* and start eating, not only the honey but also the bees. There are certain times when they come; at *nortes* (the windy period) or in times of rain" (Don Baltizar, Tepich).

Xunan kab fiercely defend themselves against attacking ants. There is always one bee posted on sentry duty at the entrance to the hive, clearly visible and checking every incoming insect. This sentinel bee *(cintenela)* is 'covered' by two or three other soldiers, according to the beekeepers. At the slightest hint of danger, the *cintenelas* block the entrance with their bodies, sacrificing their lives in defence of their fellows, if necessary. Meanwhile, some Maya believe, other bees work frenziedly to close the entrance behind these sentinels with wax or *lokok* (resins) so that no ants can enter the hive. Some people claim that the best soldier bees are enlisted from the colony's ranks to form this essential first line of defence. The Maya greatly admire the defensive behaviour of the bees. Nonetheless, *Xunan kab* are often defeated by *Xulab* or *Chak Wayah Kab*. Therefore, the beekeeper does everything in his power to help the bees defend their colonies. Beekeepers are especially alert to the danger during the rainy season, and patrol the area around the hives (particularly at night, if they believe it to be the time of greatest peril). When the marauding hordes of ants arrive, the beekeepers incinerate them using burning palm fronds (*huano*). Unfortunately, several colonies have been lost in this way because the *hobonob* also went up in flames. If an ants' nest is detected anywhere near the bee colonies, the beekeepers pour boiling water into it to drive off the ants. Most beekeepers avoid putting down poison to kill the ants or to prevent them from attacking, as bees are known to be very sensitive to toxic substances.

5.6.2 *Xnenel* (Phorid flies)

Many beekeepers declare that, once *xnenel*[12] enter the hive, it is doomed. The bees are exposed to possible incursion by Phorid flies whenever the bee-log is opened at one or

[12]*Xnenel* (humpback flies) are a small species of the Phoridae family that oviposit in the pollen and brood of the bees. The larvae hatch out, feed on the pollen and brood, and then crawl into a corner of the hive to pupate.

both ends. The flies are especially attracted by the scent of pollen. When the hives are properly sealed at the ends, *xnenel* can only enter the log through the nest-entrance. This is, of course, permanently guarded by a sentinel bee, which is believed to be perfectly capable of preventing flies from passing. According to Maya beekeepers, whereas there are relatively few *xnenel* during the *man ha' che'*, the worst time to open hives is in July, in the main rainy season. They say *xnenel* increase at that time because the air is humid and the trees bear many leaves under which the flies can lay their eggs.[13]

The most important precaution beekeepers can take against *xnenel* is to seal the hives hermetically at both ends. Before inserting a stopper in a bee-log, some beekeepers first place leaves of *Chakah* in the open end. As soon as the stopper is in place, they seal it to the log with mud. To minimize the risk of incursion by Phorid flies, many beekeepers do their harvesting in a patch of direct sunlight, where the humidity tends to be lower. Some beekeepers say that smoke is the most effective means of warding off the flies. Others rub the inside of their hives with *Chakah* leaves, believing them to be the counter-charm (*contra*) of the flies. As the beekeepers attach so much importance to *Chakah* leaves, I look at them in greater detail in Section 5.7. Despite the efforts of the beekeepers, *xnenel* often succeed in entering the hive, in response to which the beekeepers may try to remove the brood and the pollen pots. They say they sometimes succeed in saving the colony in this way. Some beekeepers re-open mother- and daughter-hives and treat them with *Chakah* a few days after splitting a colony, when the bees are considered to be too weak physically and in number to defend themselves effectively. The beekeepers do everything humanly possible to prevent *xnenel* from invading a hive, yet once the enemy has penetrated the defences and oviposited in various parts of the hive, it is all but impossible to save the colony.

5.7 *Chakah* leaves and *k'inam*

Beekeepers will not open their hives unless they have *Chakah* leaves (*Bursera simaruba*); some beekeepers may even open a hive just to rub its internal surface with *Chakah*.

[13]Phorid flies are known to shun light, which is why they usually appear when the weather is cloudy. Bee colonies in shady and/or humid places are more susceptible to invasion by these flies than colonies in sunny and/or dry places (Tóth 1995). There is, however, no biological evidence that they oviposit under tree leaves during the rainy season (personal communication, Dr. M.J. Sommeijer).

Why are these leaves so important to the Maya beekeepers (see Photo 8)?

Chakah leaves protect the bees against people who have *k'inam*. This term was explained to me as a form of energy which everybody radiates to some degree. If you have too much of it, you can cause illness in other people who have less of it. Elderly people have more of it than the young and, as a rule, men have more than women. Women's *k'inam* increases when they are menstruating or pregnant. This energy is not only related to the living; the dead have a lot of *k'inam*, and this can easily be transmitted to people who touch or approach a corpse. Nor is *k'inam* restricted to humans. Gods possess it, as do the *sastunob* of the shamans, according to the Cordemex Maya dictionary. Even winds may have *k'inam*. It is not an evil energy as such, yet it can be very strong and even harmful. In some ways, the Maya relate it to heat. In Section 7.3, I take a closer look at their conceptions of *k'inam* and heat, and the relation between them. It is important to note that bees, especially *Xunan kab*, are considered to be very vulnerable to *k'inam*.

If people with *k'inam* in their hands open hives, they pass the energy on to the bees, which then flee or die. Some Maya say that *k'inam* can turn hives white on the inside. For this reason, beekeepers should always use *Chakah* when washing their hands prior to opening hives for harvesting, and rub the inside of the bee-logs with the leaves before closing them. The Maya tell of large numbers of hives lost as a result of *k'inam*. People with a lot of it must not touch the hives. No one is completely without the energy, so every beekeeper must take precautions. Not only people transmit *k'inam* to the hives. A beekeeper in Epedz is said to have lost many hives after an evil wind stayed in the *hobonob* following a cyclone. If he had opened the hives and treated them with *Chakah*, *k'inam* would not have harmed his bees, people claim.

How, then, do *Chakah* leaves counteract *k'inam*? In contrast to *k'inam*, which is related to heat, *Chakah* leaves are considered to be cool and therefore bring the hive back into equilibrium.

"When you put your hand into the *hobon*, you feel that it is cool inside, thanks to the *Chakah*" (Don Nico, *hmen*, Tepich).

When rubbed against the log, the leaves release a juice which neutralizes the energy to which the bees are so vulnerable. In addition, the Maya say that the bees like the pleasant odour which lingers in the hive, too faint to be detected by humans. New *hobonob* and beekeepers' hands are rubbed with the leaves so that they smell nice to the bees. The above explanations mainly refer to the transmission of *k'inam* when hives are being harvested. Why do beekeepers recommend that hives should be opened once every three months, just to rub them inside with *Chakah*? Some Maya are convinced that *Chakah* counteracts pests:

"You have to clean the *hobonob* every three months. You must rub the logs with *Chakah* because the leaves give the wood an odour, they cleanse the logs. If you don't do this, the hives will become poor; they will become infested with worms [larvae of Phorid flies (*xnenel*)]" (Don Nico, *hmen*, Tepich).

Even though some Maya beekeepers do not accept that *Chakah* is effective against *xnenel*, all of them use the leaves when opening hives. Two of them mention other leaves which can be used instead: *Yaax niik* (*Vitex gaumeri*) and *Albahaca* (*Ocimum basilicum*, Souza-Novelo 1981). Other beekeepers, however, deny that these leaves are effective. In any case, *Chakah* are the only leaves which are considered to be of any use against *k'inam*.

5.8 Meliponiculture in the light of biological characteristics of *Melipona beecheii*

So far, I have reviewed various beekeeping techniques as explained by the keepers themselves. Although some of these explanations may not appeal to adherents of 'Western' scientific logic, the methods of the Maya are indisputably based on considerable experience of keeping the native species, and may well have an empirical biological foundation which Western science has yet to appreciate. An important question arises: what value might the Maya practices have in the light of our current biological understanding of meliponine bees and, in particular, *M. beecheii* (see Appendix I)? Another pertinent issue is raised by the striking differences in production per hive described in Section 5.4.6: why are some colonies of stingless bees more productive than others elsewhere? Are changes in beekeeping methods responsible for the recent decline in production?

5.8.1 Have methods of keeping stingless bees changed?

Beekeepers are often heard to remark how successful *los abuelos* ('the grandparents', i.e. the ancestors) were as keepers of *Xunan kab*. They claim that all hives used to be opened for harvesting once every three months, which is now rare (see Table 5.1).

Ideally, we could compare these statements with the available ethnographic accounts of beekeeping among the Maya. Unfortunately, the references to methods and practices are very brief. The most detailed description is Redfield's, which reads:

"The honey is taken from the hives four times a year: in March, April, May and November. Both stoppers are removed, and about one third of the accumulated comb [i.e. storage pots] removed from each end. Beyond this, no practical attention is given to the hives. As the colonies increase, the owner transfers some bees to a new and empty hive" (Redfield 1934: 49).

Redfield, then, does not confirm that the beekeepers opened the hives every three months. He mentions neither the beekeepers' use of *Chakah* leaves nor their methods of creating daughter-colonies. Perhaps he thought it unnecessary to describe these practices in detail. It is worth noting that, according to his description, beekeepers harvested once a month during the most important period of nectar flow. Unless he was mistaken, we can conclude that the productivity of the colonies has indeed declined significantly over the past six decades. The harvest periods described by Redfield do coincide with the current practice of harvesting in November and in the period from March to April. The removal of honeypots also seems unchanged. Insofar as the brevity of Redfield's description permits any conclusion, it would seem to be that Maya beekeeping practices have not changed very much over the years.

5.8.2 Colony density: a factor in the productivity of *Melipona beecheii*?

Can the current site-to-site differences in the quantities of honey produced by *M. beecheii* colonies be explained by the higher concentration of hives on some sites? Production was at its lowest in Chan Chen Comandante, Tepich and Epedz, where the beekeepers harvested an average of less then one bottle of honey (0.5-0.65 litre) per hive in an entire year. Tepich and Epedz are the villages with the largest number of hives in this survey. One of the three bee-houses in Epedz has as many as 65 colonies of *Xunan kab*, yet its owner harvested only a quarter of a litres per hive in November and the same quantity during the *man ha' che'*. At Tepich, the total number of *Xunan kab* colonies within the village perimeter is higher (114 colonies), but they are more dispersed, with the two largest bee-houses containing only 17 and 16 hives respectively. In Chan Chen Comandante, where the number of *Xunan kab* hives is low (14 hives), the village's two beekeepers blamed the low productivity of their bees on the twenty colonies of *Americano kab* in a nearby apiary. The only beekeeper in Kimbila, who has a bee-house with 21 colonies of *Xunan kab*, reported a harvest of one bottle per hive for the year (0.75 litre). At Señor, which has 18 hives of *Xunan kab*, its largest bee-house containing only five of them, production was significantly higher (1.6 litre per hive). The situation was similar in Yaxley and Tusik (1.25 and 1.5 litre per hive). The beekeepers on the Flor de Mayo ranch reported the highest yield of three litres per hive. They harvested three times; twice during the *man ha' che'* and once before the *hanal pixan* ('the day of the deceased') in November, even though there was an apiary about one kilometre away. Three beekeepers, one in Señor, one in Epedz and another in Tabi, harvested twice that year.[14] Each of these beekeepers reported harvesting the same quantity of honey on both occasions. Roughly speaking, the figures indicate that, if the number of colonies in a given area is high, the production per hive will be low. The biggest anomaly is the bee-stand in Flor de Mayo which, despite being the second largest stand included in the study, with 48 hives of *Xunan kab*, was the most productive. The concentration of colonies on a site, then, cannot be the only factor in the variation in production per hive by *Xunan kab*. Furthermore, bee-houses with hundreds of hives used to exist, a point which I discuss further in Section 9.

5.8.3 Moving the bee-log

Beekeepers stress how important it is always to put a hive back in its previous position on the rack. In the daytime, lots of bees go out foraging. Since bees are not accepted in a strange colony, many would be lost if a hive were moved. This would be a great loss to the colony in question, as the number of individual bees in a hive of *M. beecheii* is relatively low and colonies increase only slowly. Beekeepers also take great care to ensure that bee-logs are never placed upside-down, as the larvae would then drown in the nutriment their brood cells contain. Moreover, jarring the hive easily damages the brood, so a mechanism to turn hives without lifting them, such as those formerly used by the keepers of big bee-houses, not only benefited the bees but also their keepers.

5.8.4 The logic of beekeeping practices in relation to the seasons

The cycle of hive management appears to be adapted to the prevailing weather

[14] Two beekeepers in Epedz opened their hives three times, yet harvested only once.

conditions. As already stated, the beekeepers used to open their hives every three months, and some still do. The main harvest of *M. beecheii* occurs a few weeks after the blooming of the most important nectar-bearing plant, *Gymnopodium floribundum*. At the earlier time of the year when the pollen-producing *Viguiera dentata* blooms in abundance, some beekeepers remove pollen from their bee-logs 'to make space in the hive' before the peak period of honey production. As a rule, they multiply their colonies by splitting when food sources in the surrounding area are at their most abundant and the colonies have the most brood cells. This all appears to be quite logical, except for one aspect: when pollen is removed in January just to be discarded, does this not unnecessarily retard the development of colonies? It most probably does, yet it is precisely this abundance of plants bearing food for the bees which may be the real reason why pollen is deliberately removed; for if a colony were to develop too quickly, bees might swarm and be lost to the beekeeper. Do the beekeepers extract pollen to inhibit this behaviour? Recent biological data indicate that, in contrast to colonies of *Apis mellifera*, *M. beecheii* colonies do not tend to swarm very often, which is consistent with the fact that the bees are generally rather weak nowadays. None of the beekeepers involved in this study had ever seen *M. beecheii* swarming and many of them even refused to accept the possibility. Of course, they contrast this with the dramatic swarming behaviour of *A. mellifera*, particularly the Africanized variant. In fact, *M. beecheii* do migrate to new nest sites, though the process does not involve a sudden mass exodus by the greater part of the colony. Instead, a detachment of bees gradually transfers building materials and food to the new site, where a nest is slowly constructed. In view of this species' limited production of honey, one can question the necessity of making space in the hive for future storage. For two reasons, then, opening hives to extract pollen in January does not seem to be justified and nowadays most beekeepers tend to avoid it, which seems to be an appropriate response to the changed circumstances.

5.8.5 Methods of preventing invasion by Phorid flies

Phorid flies are probably the main pest of meliponine bees in tropical America: once they have invaded a weak colony, its death is inevitable. It is therefore of the utmost importance to close hives as soon as possible after opening them. By using a stone or wooden stopper that fits closely, the beekeeper reduces the chance that the sealant mud, while drying and contracting, will develop cracks through which the pests can enter. Phorid flies are known to shun light, which explains why beekeepers favour harvesting in direct sunlight. Many beekeepers are also aware of the fact that the flies are attracted by the scent of pollen and therefore, when splitting a colony, they do not transfer broken storage pots containing pollen to the daughter-colony, even though they know that the bee larvae need pollen for their growth. The release of pollen and the subsequent arrival of Phorid flies seems to have been the main reason why Don Baltizar lost his newly populated hive. Even the practice of throwing away pollen can endanger a colony, if it is done too close to the hive.

The use of *Bursera simaruba* (*Chakah*) as a possible repellent to Phorid flies requires scientific investigation. So far, however, no experiments have been conducted. It is striking that many beekeepers advocate opening hives every three months to treat them with the leaves, or say that this used to be the customary practice. Is this strategy actually effective against invasion by Phorid flies? The pest may escape the attention of the sentinel bee and simply enter the hive through the nest-entrance. Therefore, if *Chakah* were indeed to act as a repellent, it would be wise to treat the hive with the leaves at a regular intervals.

5.8.6 *Bursera simaruba* (*Chakah*) and *k'inam*

In addition to their possible repellent effect on Phorid flies, rubbing *Chakah* leaves inside the bee-log and on the hands of the beekeeper may have another important function. Bees recognize other individuals of their own colony by means of pheromones, which mingle with the scent of the log, and bees with an unfamiliar odour are ejected or even killed. Giving the hands a scent which attracts the bees, or, at least, is familiar to them because the hive is filled with it, may prevent the ejection or killing of bees that have been touched by the beekeeper during harvesting. The use of *Chakah* leaves to counter what the beekeepers call *k'inam*, cited as a major cause of colony loss, thus appears to have biological effects which contribute to the welfare of the colony. As stated in Section 5.7, the beekeepers claim that *k'inam* can turn the hive white. This whitening is, in fact, a fungus that lives on the wood of the bee-log. Biologists have not yet investigated whether *Bursera simaruba* inhibits the development of such fungi.

5.8.7 Effectiveness of methods used to acquire new colonies

Despite all the beekeeper's precautions, a bee colony may die or 'flee'. He will then have to replenish his stock of bee-logs, or the *nail kab* will go into decline. Some of the strategies for obtaining new colonies are more successful than others.

The fact that beekeepers never 'capture' colonies of *M. beecheii* in vacant bee-logs can largely be explained by the infrequent swarming or migration of the bees. Recent biological data indicate that migration from a colony occurs less than once a year. Regular extraction of material from hives impedes the development of colonies and reduces the natural tendency of stingless bees to migrate, as does splitting in an attempt to multiply colonies.

According to the beekeepers, wild colonies of *M. beecheii* have become so scarce in the forest that nests are rarely brought home. They claim to obtain as many of the precious bees as possible by collecting the nests at nighttime and even waiting until the following Saturday for all foragers to return. There is, however, little biological evidence to support this. Leaving a nest hanging in the forest for one or more nights seems to be an unnecessary risk, as the bees have so many enemies.

In the current situation, splitting cultivated colonies of *M. beecheii* might appear to be the best way of increasing the number of hives in the bee-house. However, many Maya say that the colonies are now too weak to withstand such a drastic measure. Most people only try to make a daughter-colony if the mother-colony is rich in brood (i.e. containing at least two brood chambers) during the *man ha' che'*. In the wild, after migration, a daughter-colony maintains a relation with its mother-colony for several weeks while nest material is being transferred. Beekeepers disrupt this natural behaviour when they abruptly divide the brood and separate the mother- and daughter-colonies. It is therefore essential that the beekeeper transfers nest material to the new hive. Since colony development is a slow process, it is also important to use only 'mature' brood to start a new hive. Combs from which mature bees are about to emerge are light in colour because worker bees scrape cerumen from the outer surfaces of developed cells in order to construct new cells. It is typical of stingless bees that they use cells once only. The remains of cells are removed once bees have emerged from them. The brood must be handled with caution: turning it upside-down or jarring it can kill the young larvae. Generally, beekeepers do tend to be very careful with their colonies, so very little damage occurs during splitting. In the case of *M. beecheii*, in marked contrast to the European honeybee, new queens are produced regularly and a daughter-colony will therefore survive without a queen being transferred to it. A few queens will probably emerge from the mature brood comb, and one of them will be selected by the new colony. Splitting a colony will normally be successful if the operation is performed at a time of year when the bees can find enough food in the surrounding area and if they are properly protected against attack by Phorid flies (i.e. no pollen pots are broken; there are no cracks in the bee-log, stoppers or seals; and the hive is not left open for too long. Also, possibly, if splitting takes place in direct sunlight and *Chakah* leaves are applied). If the beekeepers do not replenish their stocks n some way, the number of active hives in the bee-house will automatically decline as colonies are lost by natural causes. Perhaps this process is accelerated by a shortage of food plants within foraging range of the hive, or by competition from other species. I return to this question in Section 9. The unfortunate truth is that, in practice, splitting colonies - like every other augmentation method employed by the Maya - is doing nothing to halt the observed downward trend in the number of colonies.

5.9 Conclusions

Removing entire clusters of honey pots from a hive leaves the bees with the task of rebuilding much of the intra-nidal architecture. Therefore, this method of harvesting significantly reduces the productivity of *M. beecheii*. However, it appears that this has been the practice among the Maya for centuries; meliponiculture with *M. beecheii* was commonplace and highly successful before the introduction of *A. mellifera*, and methods have hardly changed in the modern era. It has become clear that certain methods of multiplying colonies lead to the death of daughter-colonies, especially if pollen is exposed to the open air. A number of beekeepers are well aware of this and do not transfer open pollen pots or loose pollen. Many beekeepers have no intention of trying to make daughter-colonies because they regard their colonies as too weak and impoverished. This means that the observed fall in the number of hives in the bee-houses continues unchecked. Methods of keeping stingless bees could be significantly improved to reduce the destruction during honey-harvesting. However, harvesting techniques and other methods of Maya meliponiculture cannot be the only factor in its present decline.

In the course of this section, it has become apparent that some of the practices which the beekeepers explain in cultural or religious terms may have a sound basis in the biological characteristics of the bees. Other practices, however, seem to be unrelated to the biology of the bees and may only be understood from a cultural point of view. Why, for example, is it important that the *nail kab* is built on an east-west axis? The beekeepers argue that this makes the hives less susceptible to rain, or that the rising sun wakens the bees. Yet these points do not fully explain the preferred east-west orientation, for the roof of the bee-house is meant to shelter the hives from both rainfall and sunlight, and the bee-logs are stacked up on the north and the south side. In Section 8, I attempt to show that, while both arguments have some validity, there is more to them than meets the eye: they are related to the Maya vision of the cosmos. Finally, as I have so far referred to beekeepers of masculine gender only, some readers may be asking themselves whether beekeeping is a exclusively male preserve. This question is dealt with in Sections 6 and 7.

6 Meliponiculture as part of the agricultural system

"*Soy milpero*" (I am a corn-grower), the typical *Cruzob* Maya replies when asked to state his occupation - the commonest among his people. Essentially, he is proudly identifying himself as a Maya, for it is almost unthinkable for a man of Yucatecan Maya blood not to grow corn (i.e. maize, *Zea mays*). Indeed, many of those who work in urban centres still regularly return to the communal *ejidos* to sow their plots. The contemporary agricultural system, of which beekeeping is an integral part, is so essential to the Maya and so intimately bound up with their way of life and religion that it would be negligent not to subject the cultural aspects of that system, particularly those with a bearing on beekeeping practices, to a thorough examination. That is the aim of this section.

The Maya were practising slash-and-burn cultivation long before the Spanish conquest and still do so today, as indicated in Section 2. While there can be no doubt that the circumstances under which agriculture now takes place are drastically different from those of the early Hispanic period,[1] several traditional practices of the *milpero* have survived intact. When the men living in the *ejidos* of Xmaben and Tepich clear a patch of forest to sow corn, beans and squashes (*Cucurbita* sp.) in a field watered only by rainfall (a rain-fed *milpa*), they are following in their ancestors' footsteps, often literally.

In this section, I describe cultural aspects of the contemporary agricultural system and the place that beekeeping, particularly meliponiculture (the keeping of stingless bees), occupies within it. One by one, I outline the interrelated components of the system, with the ultimate aim of determining to what extent the agricultural techniques used by the Maya to shape the environment in which they live and keep bees have affected the insects' reproductive cycles and food production. Of special relevance to this question is the fact that, in the modern era, the vegetation in homesteads has undergone important changes. That particular aspect is examined in Section 9, where I attempt to demonstrate that, whereas the traditional agricultural concepts of the Maya and their expression in techniques have always been compatible

[1]See Terán & Rasmussen 1992

with the keeping of stingless bees, recent developments have been a key factor in the decline of meliponiculture. Here, though, I initially focus on how agriculture is organized in physical space and within the context of Maya society. This section necessarily reflects the organization of Maya society on gender lines, in that it separately examines the male and female labour domains. I first describe the *solar*, or homestead, where women do most of the work and to which they seem conceptually bound. I then briefly describe the *milpa* production system and other activities in the forest, to which men are so bound. As I explained in Section 4, the Maya classify the various species of bees in their environment as either domesticated (tame) or undomesticated (wild). These classes correspond to the female (homestead) and male (forest) domains. With labour so strictly divided according to gender, what places do meliponiculture and apiculture (i.e. the keeping of stinging honeybees) occupy in Maya society?

6.1 'To Paint and To Repaint': the Maya weather forecast *xok k'in*

The production of corn by the Maya, just like the production of honey by their bees, is strongly dependent upon rainfall. On the Yucatan peninsula, where the most striking difference from one season to the next is the amount of rainfall, one might expect the climate to follow a predicable pattern of alternate drought and plenty. In reality, the rainfall is so irregular that, as Merrill-Sands argued (on the basis of earlier work by Contreras Arias), its unpredictability probably constitutes the greatest risk factor in Yucatan agriculture and beekeeping:

"The timing and quantity of rain varies significantly from year to year. There are wide fluctuations between the maximums and minimums of monthly rainfall recordings, making monthly or yearly averages rather meaningless in Yucatan. The probability of receiving the long-term mean rainfall in any given month is only 40 percent, and it is even less in the dry season. The variation is not caused by changes in the number of days with rainfall, which actually remains quite constant [at] around 90 days from year to year, but [in] the intensity of the rainfall. The uncertainty for agriculture created by this year-to-year variability is further exacerbated by the extreme localization of rainfalls due to the purely convective nature of the Yucatan rainfall. Significantly different rainfall patterns can be recorded in localities very near to one another. The variation is so extreme that one producer's *milpa* plot will receive rain whereas another, 100 metres away, remains dry" (Merrill-Sands 1984: 74).

Because rain is so vital to the success of his *milpa*, the *milpero* relies heavily on carefully calculated forecasts when choosing the best time to sow. Maya communities may also try to persuade the *Chakob* (rain gods) to irrigate their land, though the elaborate and lengthy rainmaking ritual (*Cha chak*) is now seldom performed; in most cases, only when the people have waited several weeks for rain that was supposed to fall at a particular time of the year. The ancient method by which the people forecast rain is called *xok k'in* ('the count of suns or days'). Spanish-speaking Maya refer to it as *pintar y repintar* ('to paint and to repaint'). It is an intriguing method: they base their forecast for February to December on the weather in January, believing that patterns observed during specific periods of the first month indicate when rain will fall in the remaining eleven. As each of the months from February to December is thus represented by four different periods in January,[2] this method tends to give conflicting forecasts: one representative period may indicate fine weather at a particular time later in the year, while another such period indicates rain. So there is still plenty of scope for speculation and, of course, there are radio and television forecasts for those who understand Spanish. The noble efforts of meteorologists are all very well, but rainfall patterns are so irregular that many *milperos* still give much credence to their traditional methods.

The Maya distinguish several recurrent but variable periods of rain. First, there are January's occasional showers, after which a period of drought sets in and the trees shed their leaves. The next light rains, which may fall as early as in March or as late as in May (Section 5.3.1), are produced by *Kun K'u*, chief of the *Chakob*. At that time of the year, he is said to reside in the east; later, he moves to the west:

"Most of the rain falls in the summertime. The first [important] rain of the year we call in Maya *man ha' che'*; it falls in March. In June, the westerly rains come. The thunder you hear in the west is *Kun K'u*. He is the highest authority of the *Chakob* [...]. When the rain moves, *Kun K'u* moves too, but he only thunders when the rains come from the west. One part is for the forest and the other part is for the *milpa*. These rains give a good *milpa* harvest" (Don Beto, Tepich).

Before the sowing of the *milpa* can begin, the soil must be thoroughly moistened by

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[2]The first twelve days of January represent the months of the year; the 2nd of January corresponding to February in its entirety, the 3rd to March, etc. The morning represents the first half of the month and the afternoon the second half (nights play no role in the forecast). The next twelve days represent the year in reverse; the 13th of January corresponding to all of December, the 14th to November, etc. The mornings and afternoons of the next six days (i.e. the 25th to the 30th of January) also represent one whole month each; the afternoon of the 25th of January corresponding to February, the morning of the 26th to March, etc. Finally, the 12 daytime hours of the 31st of January are taken to represent the months in reverse order again, from December to January.

rain. After sowing, the corn needs even more rain to germinate and grow strong. A few showers, however, do not make a rainy season, and sometimes no rain falls for quite a long time after the initial wetting. As the customary time for planting approaches, therefore, the exact date on which to sow the *milpa* becomes a matter for much conjecture and daily discussion.

In addition to the seasonal types of rain described above, the Maya speak of 'hot' and 'cold' rains, believing the former to be disastrous to corn plants because 'they burn the leaves'. They can fall at any time of the year, killing plants and flowers. The difference between 'hot' and 'cold' rains cannot be detected with a thermometer, yet the plants are said to feel the difference. 'Hot' rains are produced by red clouds.[3] To save his crops, the *milpero* must mark a cross on the ground with lime and salt, tossing a little to the clouds as well. One thing is certain: the wise *milpero* keeps a weather-eye on the sky and adopts as many strategies as possible when determining the best conditions for cultivating his *milpa*.

The system of agriculture practised in the *ejidos* of the Maya Zone (part of Quintana Roo State), has multiple components. The basis is formed by crop production in the rain-fed *milpa*, which is worked with hand tools. Crops are also grown in the homestead (*solar*) and on privately owned plots called *parcelas*. In contrast to the *milpas*, these fields may be artificially irrigated. What follows is a brief description of the agricultural subsistence strategies that are prevalent among the Maya.

6.2 The female labour domain: the *solar*

The *solar*, or homestead, is a plot of land within the village boundaries where a nuclear or extended family lives, keeps its domesticated animals and cultivates plants. It is a complete social unit, established by ritual ceremony and enclosed by a stone wall.

Solares are usually occupied by two or three, sometimes four, generations of a patrilocal family. Homesteads with only a married couple are rare. The paternal grandparents share the *solar* with their children and their children's children, but usually live in a separate house of their own. As a rule, the senior male is the highest

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[3]Sosa informs us that the rain god of red clouds is *Chak Babahtun*, who dwells on the eastern horizon and brings warm, salty water from the ocean. This rain is harmful to the cornfields. The other *Chakob*, associated with white, green, black and yellow, bring the good 'cold' rain (Sosa 1985: 455).

authority of the *solar*. Although the dominant pattern of residence is patrilocal, after marrying, a couple may live together with the wife's family for several years in what is known as *haan k'ab* (transitory uxorilocal residence). A couple in *haan k'ab* contribute to, and co-operate in, the running of the homestead and the cultivation of the *milpa*. They will eventually establish an independent household of their own, either in a new *solar* or in that of the husband's parents.

The rectangular *solar* has invisible guardians posted at the four corners of its enclosing stone wall. They are installed during a *loh* ceremony for the homestead, the aim of which is to protect the residents:[4]

"You have to perform a *loh* for the homestead, so that the *Balamob* [guardian spirits] will watch over the people who live there. Whenever there is a threat, like a snake, the *Balamob* will protect them. They ward off any evil that can befall a member of the family. Many crosses are formed when you construct a house, so you must offer this prayer. The same thing happens with the house of the bees; you build it in the same way, you always make crosses" (Don Medardo, *hmen*, Tepich).

"The altar in the *loh solar* is built just as it is in the *loh* for the village. You put a cross at each corner. When you do this, they [the spirits] have to walk around the crosses. You also cleanse the places of the crosses, as in the *loh* for the village; but in this case you have to burn peppers instead of incense. You burn chilies in the *loh solar* because this drives off evil" (Don Crescencio, *hmen*, Tepich).

When a house is constructed, horizontal and vertical poles are bound together with vines, creating a pattern of multiple crosses.[5] Apparently, this is a strong attractor for spirits or winds (*iikob*) which are powerful enough to harm people, though not necessarily malevolent. It is therefore essential to neutralize the attraction of these crosses by creating another, protective pattern. This is accomplished during the *loh solar*, once the *Balamob* invoked as guardians have taken their positions at the four corners of the homestead, forming a barrier to all evil that may threaten the humans and animals within. It is interesting to note that this rectangular zone might in itself pose a danger if it were not cleansed of evil influences. In Maya cosmology, there is also a central point where a spirit resides. According to Hanks, this fifth Maya cardinal

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[4]In the works of Redfield and Villa Rojas, this ceremony is called *chuyenil na* (1934: 146-147), whereas Hanks (1990: 300) gives the name *hetz lu'um* ('fix earth'). People in Tepich simply call it *loh solar*.

[5]When Redfield re-visited Chan Kom seventeen years after the fieldwork in which he collaborated with Villa Rojas in 1931 (publication: 1934), he noticed that the inauguration ceremony for a new house had become less frequent, as people had begun to build houses of masonry. As such houses have no crosses resulting from the intersection of poles, the traditional ceremony (performed by a shaman) was no longer felt to be necessary (Redfield 1962: 123).

Photo 1: Sculptures of bees, *Banco Nacional de San José*, Costa Rica

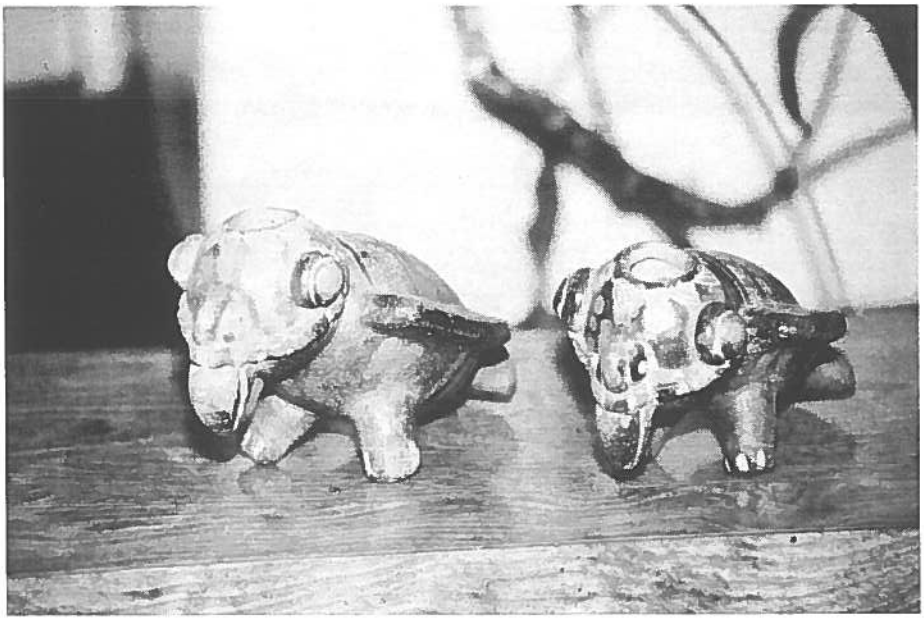

Photo 2: A hive of *Tetragonisca angustula* ('*Chumelo*')

Photo 3: Don Esteban's daughter processes the honey yield of *M. beecheii*

Photo 4: Inscription in the bee-log: *yook'ol kab*

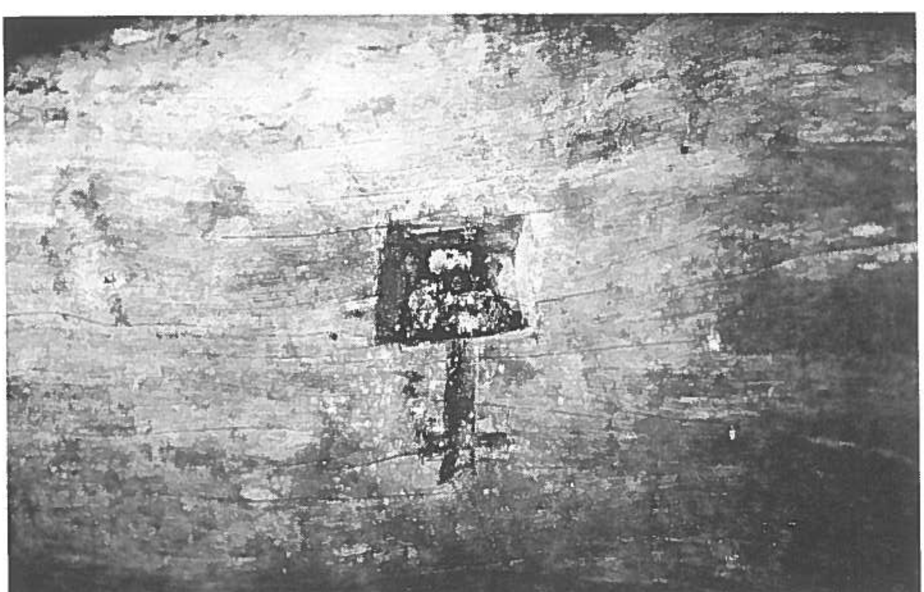

Photo 5: A *nail kab* of the Rancho Flor de Mayo, *ejido* of Tepich

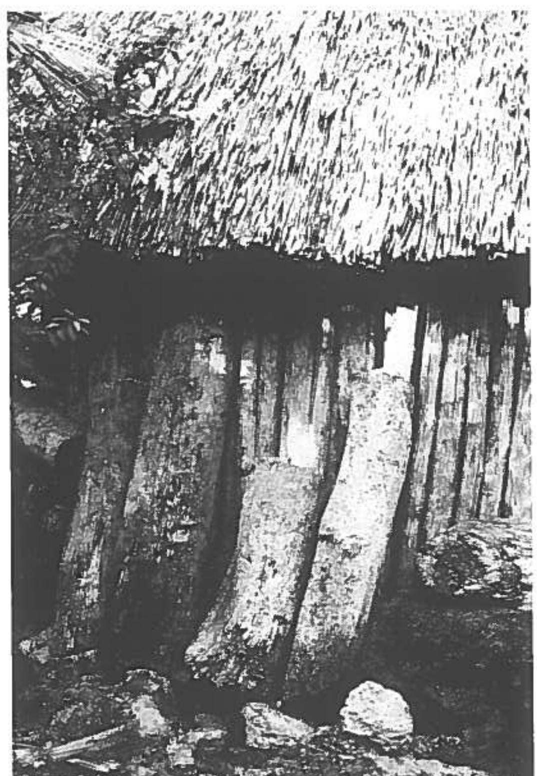

Photo 6: 'Forest bees' are kept upright and seperated from *Xunan kab* (*M. beecheii*)

Photo 7: Don Baltizar dividing the a colony of *Xunan kab* (*M. beecheii*)

Photo 8: Rubbing the bee-log with *Chakah* (*Bursera simaruba*)

Photo 9: Inscription in the *hobon*: a quincunx figure

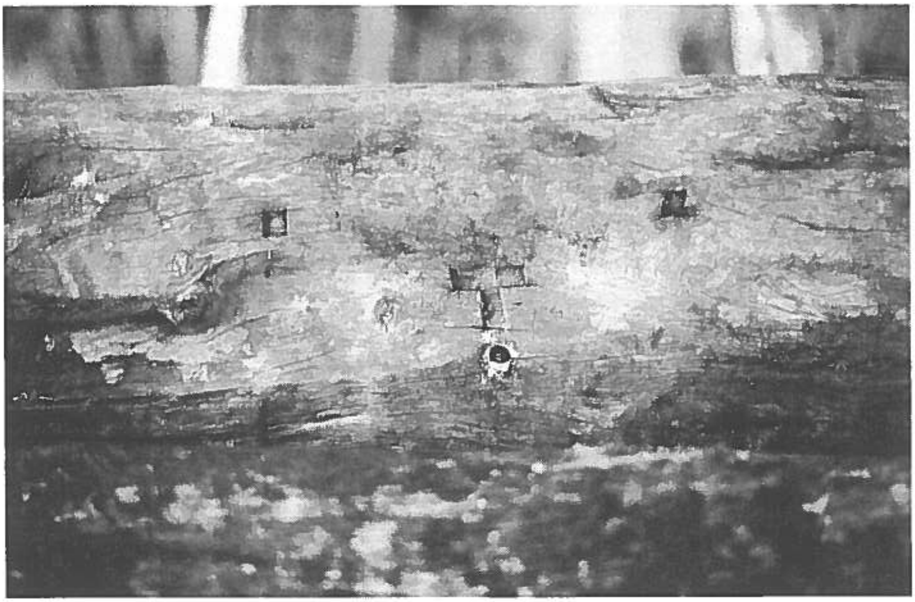

Photo 10: Inscription in the *hobon*: the circle

Photo 11: Xok'en: the cross 'at the centre of the world'

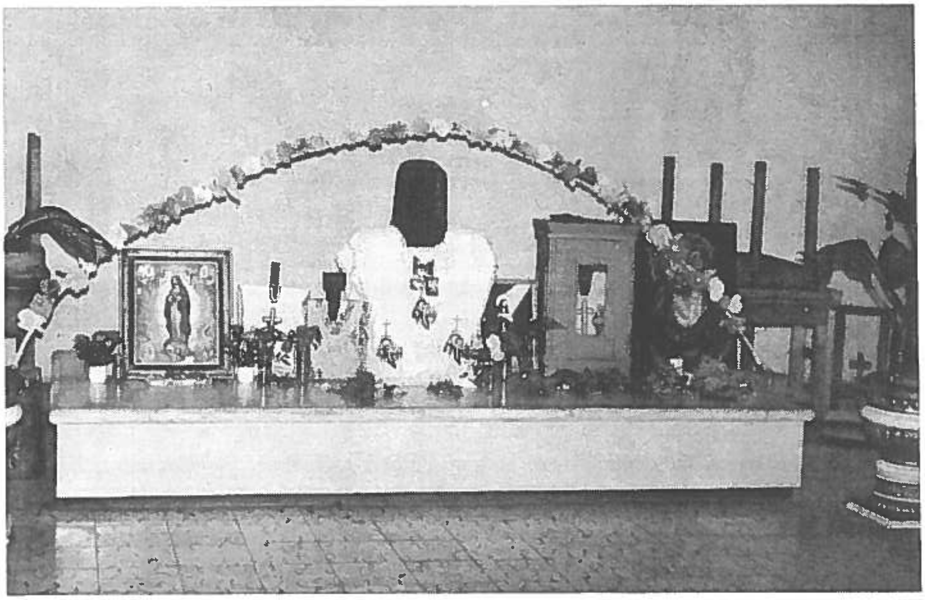

Photo 12: Raising the centre tree at the centre of the bull ring

Photo 13: Shaman checks the spiritual world in his *sastun*

point is also recognized in the *loh* for the *solar* (1990: 336). Some shamans in Tepich incorporate the fifth point by performing the ceremony in the centre of the area to be bounded off. Demarcating space in Maya ritual is described in detail by Hanks. In Section 8, I look at this subject again in relation to *milpa* cultivation, beekeeping practice and cosmological notions.

6.2.1 Sub-divisions of the *solar*

Although the *solar* is a single enclosed area and Maya language and practices clearly indicate that the people regard it as a unit, it does have sub-divisions. Both Herrera Castro (1994) and Hanks (1990) describe the physical organization of the *solar*. Whereas the former examines this subject from the viewpoint of practical use of the *solar*, the latter is more concerned with socially constructed frameworks manifest in customs, language and ritual discourse. Since both views are pertinent to this study, I briefly describe them here.

Herrera Castro went to the village of X-Uilub, near Valladolid, to study the practical use of the *solar*, its hand-built structures and the plants that grow in it. She distinguishes two sub-divisions: "an area of intensive use" and "an area of extensive use" (the latter in the sense of 'use not concentrated in space or time'). The former, the area immediately adjacent to the dwelling, is often demarcated from the latter with a small wall of stones (see Figure 6.1).

The area of intensive use includes the dwelling (*nail, otoch*), the kitchen (*k'ooben*), the washing basin and some structures for animals, such as the hen-house (*sooy*), the pigsty (*chikeroh*) and the bee-house. There is also a little storehouse for corn, which may be used as a shrine during rituals. The plants that grow in this sub-division of the solar are either wild species (weeds) or cultivated species which may be enclosed in specific structures: for example, the *wool koot*, the *ka'anche'* and the *kololche'*.[6] The *wool koot*, meaning 'circle of stones', is an enclosure built to protect saplings as they develop into mature trees. The *ka'anche'*, meaning 'raised wood', is a seedbed supported on four poles in which seeds are germinated for crop growing in the

[6]Maya terms for structures in the *solar* denote forms and building materials rather than the types of vegetation enclosed: for example, the *sup'* is a fence of horizontally woven brushwood, the *kololche'* (or *chuy che'*) is a fence of vertical poles, while the *wool kololche'* and *wool koot* are, respectively, rectangular and circular enclosures of stones.

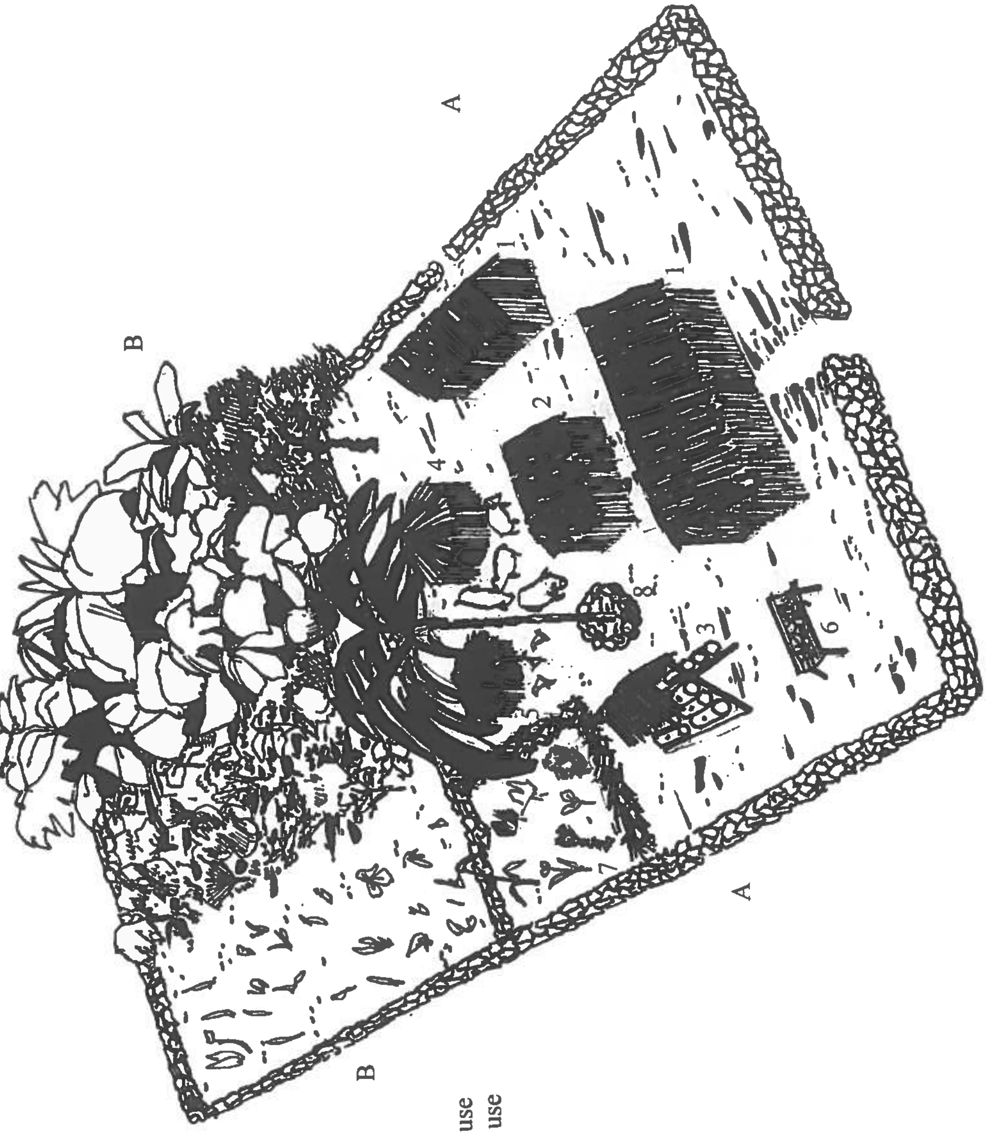

Figure 6.1: The structures and sub-divisions in the *solar*.

A: The area of intensive use
B: The area of extensive use
1: *nail*
2: *k'ooben*
3: *nail kab*
4: *chikeroh*
5: *sooy*
6: *ka'anche*
7: *sup*
8: *wool koot*

homestead. Once the seedlings are sufficiently developed, they are transplanted to the *kololche'*, which is a clearly demarcated plot for the cultivation of crops within the *solar*.

In the area of extensive use, no particular structures or buildings are erected and wild plants are left to grow, some developing into shrubs and trees. Occasionally, some of the vegetation is cut down. The wild vegetation in this sub-division of the *solar* provides shade and acts as a windbreak. It also supplies fodder for animals, brushwood for the kitchen, medicinal plants and seedlings for cultivation, as well as nectariferous and polliniferous plants for the bees. A biologist, Herrera Castro is highly informative about material structures and the use of the *solar*, but pays very little attention to the social aspects of its physical organization.

Hanks went to the village of Oxkutzkab in Yucatan State to study what he calls "referential practices" in everyday speech, custom and ritual. Like Herrera Castro, he noted that the Maya recognize sub-divisions within the *solar*. To some extent, the sub-divisions that he describes coincide with Herrera Castro's practical divisions. However, Hanks identifies three levels, or concentric areas, of inclusion. At the first level, i.e. in the innermost area, a married couple live with their offspring in one house: this is the individual's core home, equivalent to the concept of *iknal*, one of the two Maya words for 'here'. This word (as opposed to the wider 'here', *way e'*, described below) indicates the most personal or private space, which Hanks refers to as "one's egocentric space" (1990: 92). The concept of *iknal* finds expression in etiquette; for example, a guest invited to the house of a married couple does not automatically have the right to visit the other dwellings in that *solar*:

"While there are virtually never walls or fences dividing the inner space of the solar, there are very sharply defined areas corresponding to the property lines of the males [...]. These divisions are not always apparent to the outsider because they are marked only by inconspicuous boundary stones or sight lines between physical features, but they constitute real boundaries which constrain the circulation of actors in daily life" (Hanks 1990: 106).

The term *iknal* is one of several used to indicate 'the place where you are at home'. This first level of the *solar*, including the house, its utensils, the kitchen and a shrine, is part of what Herrera Castro calls the "area of intensive use".

The second level recognized by Hanks is the *solar* itself: the rectangular area bounded by a wall of stones, cleansed of evil and guarded by the *Balamob* (ibid.: 109-110) as described above. Here, co-residents work together, building and maintaining structures whenever necessary while sharing the area, its utensils, structures, etc. Although several households co-operate in the *solar*, its organization also reflects their relative independence of one another, at least economically (ibid.: 107). To distinguish this area from the purely 'egocentric space' (the narrow 'here', *iknal*), the Maya refer to it as *way e'* (the broader 'here', see ibid.: 92). It should be noted that, while *way e'* extends beyond the strict personal space of the individual, it also includes it (ibid.: 406).

The third level described by Hanks transcends the boundaries of the *solar*: it relates to the bond between a number of homesteads whose heads, as a rule, are agnatic kinsmen. These homesteads may be physically dispersed among the *solares* of other families to which the kinsmen have no blood relation. Contacts between agnatic *solares*, being dependent upon the strength of mutual relations between the families, naturally take a wide variety of forms (ibid.: 110).

The two levels that Hanks identifies within homesteads do not fully correspond to Herrera Castro's sub-divisions: the latter's 'area of intensive use' is larger and includes more structures than the former's 'egocentric space'. Another important difference is that, as a biologist, Herrera Castro is primarily concerned with the practical use of the homestead and its vegetation. She does not refer to the link between separate *solares*; a construct which is, above all, social in nature.

The different perspectives of Hanks and Herrera Castro are reflected in the *ejidos* of Tepich and Xmaben Each type of structure described by Herrera Castro can be found in the homesteads there, though not all the homesteads have all the structures. Hanks seems to be correct in noting the individuality that is maintained within the areas of collective use. The outdoor area of the homestead is for sharing and co-operation; nonetheless, contributions by, and possessions of, individuals (or individual families) are acknowledged. The bee-house, located at least one *mecate* (20 metres) from the home and kitchen, lies within Herrera Castro's 'area of intensive use' and Hanks' second level of the homestead. The *hobonob* (bee-logs) may belong to male or female owners living in separate dwellings in the same homestead. Ownership of hives may even transcend the boundaries of the *solar*: agnatic kinsmen living in separate *solares* sometimes keep all their hives in one bee-house. At the same level, rituals performed in one homestead may also be for the benefit of agnatic relatives in other homesteads. In 1994, for example, the family I was staying with had a purification *loh* performed to exorcise evil spirits from their *solar*. Prior to this ceremony, children had been falling ill and chickens dying, quite inexplicably. Although most of the misfortune had struck the homestead of the paternal grandparents, who lived there with one of their sons, the ceremony itself was performed in a *solar* several 'blocks' away, where another son resided. By offering prayers, a *hmen* ensured that both *solares* were cleansed of evil. Although *solares* have sub-divisions, such a ritual is always performed for one *solar* as a whole or several such units, which are then effectively drawn together for the purpose of ritual. This social structure is, in a sense, analogous to the system whereby people from separate homesteads keep their *hobonob* in the same bee-house.

6.2.2 Labour division in the *solar*

So far, I have examined functional aspects of the various structures within the homestead (*solar*), such as houses and enclosures for animals and vegetation, and I have described some social and ritual aspects of how the domestic area is organized. These socially constructed frameworks, not all of which are visible, appear to play an important role in regulating day-to-day life. The next important question is: what is the relationship, if any, between these frameworks and the division of labour and daily routines in the *solar*?

In Maya society, the various types of labour are clearly allotted by tradition either to the men or the women. The men do all the construction work in the homestead: they build the houses, the animal sheds and pens, the boxes in which seeds germinate and the fences around plots in which plants are cultivated. It is also definitely men's work to clear vegetation from the site of a new *solar*, in preparation for building work, and to fence or wall off the domestic area. Once the homestead is established, men are also responsible for cutting access paths through the surrounding vegetation and felling wild shrubs and trees in what Herrera Castro calls the "area of extensive use". All such tasks for man and machete entail the indiscriminate cutting of plants (cf. Herrera Castro 1994), though there are other types of labour in which men occasionally lend a helping hand.

In contrast to the menfolk, the women take responsibility for most, but not all, of the day-to-day tasks and routines in and around the home; in the domestic area, that is. Typically, the wife is the driving force, often assisted by an able daughter. They are most closely bound to the kitchen and its fire, both of which are known as *k'ooben* in Maya. The fire is built between three stones forming an equilateral triangle. The women spend several hours a day at the fireplace preparing food. The wife will rise before dawn to kindle the fire. She, or another female family-member, grinds the corn by hand or takes it to the mill and then prepares tortillas and the other food the husband will take to his *milpa*. While doing other, incidental tasks, the wife then starts preparing the most important meal of the day, which is eaten at midday when the men return from the fields. It is the wife who distributes the food among the family. While the husband and children eat at the kitchen table, the women usually eat their food around the fireplace or wait until the others have finished before going to the table. That the kitchen is regarded as a female domain is clearly indicated by the fact that any produce brought into the kitchen by men automatically comes under female authority. Wives like to point out that, in the event of a marital dispute, they may not hesitate to 'kick the husband off the *k'anche'* ' (a word variously translated in the literature as 'stool', 'bench' or even 'placenta'; see Freidel 1993: 213; Hanks 1990: 112). It is interesting to note here that *k'anche'* (denoting 'nurture' in this tongue-in-cheek expression of female assertiveness) is similar to *ka'anche'* (the seedbed for plants), although the two terms are not interchangeable and may not even be cognate. Preparations for the evening meal, which is eaten at dusk, are less labour-intensive than those for the midday meal, so in the afternoon there is usually time for other tasks. Women clean the house and the 'area of intensive use' as well as its structures, such as the pigsty and the hen-house. In contrast to the men's indiscriminate clearing of plants in the homestead, women do all the selective weeding, leaving only useful plants to grow. They also collect different kinds of soil for the *ka'anche'* and sow food plants and fruit trees in it (Vargas Rivero 1983). Once the seeds have germinated, they transplant the seedlings into the *kololche'*. The women are usually responsible for watering the plants that grow in the domestic area, even if these are species that are normally cultivated in rain-fed plots outside the *solar*. In 1994, for example, following the failure of *milpa* production the previous year, the family of my assistant, Jacinta Pool May, took the unusual step of planting corn in the homestead.[7] Although the cultivation of corn is an exclusively male task normally practised outside the homestead, it was now Jacinta's job to water the plants every day. In this example, transferring the corn plants to the domestic area made them, at least to some extent, a female responsibility. Similarly, women take care of all the animals in the *solar*. They raise hens and pigs, and in the unusual event that a cow is kept within the domestic area, they tend it, too. It would seem reasonable to conclude that, in addition to the 'egocentric space' (*iknal*) of

[7]These corn plants were of the short-cycle variety: see Section 6.3

the dwelling, where women also give birth to and raise their children, the female working domain encompasses all daily routine in the 'area of intensive use'. To put it another way, it would appear that Maya women are the nurturers (in every sense of the word) of all that lives in the homestead. It therefore seems strange that, even though the bee-house is located in that outdoor sub-division of the *solar* which is part of the female working domain, the bees are always taken care of by the men!

6.2.3 Female labour outside the domestic area

Although the women are in charge of nearly all the day-to-day activities within the homestead, this does not mean that their responsibilities are restricted to the domestic area. In the village or at local markets, women buy and sell fruit and vegetables; they also do needlework, selling their products (*huipiles*, i.e. embroidered dresses) outside the homestead. When the crops in the *milpa* are ripe, many women accompany their husbands to lend a hand harvesting the corn, beans and *pepitas* (squash seeds). Often, women and men also work together in the *parcelas* to cultivate, for example, fruit trees and vegetables such as tomatoes, radishes and onions. The *parcelas* seem to occupy a distinct place within Maya society. The products grown in them are often sold to traders at Valladolid and Felipe Carrillo Puerto, or to travelling merchants who come to the villages. In contrast to *ejido* land for *milpa* production, the *parcelas* are privately owned and mostly located in the villages. Furthermore, in contrast to the homestead plots and the *milpas*, the *parcelas* do not require any ritual enclosure for protection and are permanently cultivated.[8] Men and women take equal responsibility for agricultural activities in *parcelas*. Yet women do not only transcend domestic boundaries in physical labour, they also establish social relationships by distributing food beyond the household.[9] For example, it is the women who send food to other homesteads when

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[8]When Redfield re-visited Chan Kom (Note 5 of this section), he reported that *A. mellifera* had been introduced and there was a new land-use involving permanently cultivated fields (while *milpa* production continued). He comments: "It was felt that the new hives 'did not need the ceremony'. Something of the same process is involved when, as now happens, a tract of land is persistently cultivated and it is said that 'that land does not need *u hanli col*' " [his spelling of *U Hanli Kool*, the ceremony I describe in Section 6.3.1.2] (Redfield 1962: 123-124).

[9]Govers studied gender roles in a Totonac highland village. In her paper, she argues that women played a prominent role in establishing, maintaining and reinforcing social relationships within the community by preparing and distributing food on a regular basis. Men, in contrast, only shared out food in two situations, and uncooked food at that. By distributing food, claims Govers, women were also responsible for reproducing the social structure (1996). The Maya women of Yucatan also distribute food within the

relatives or friends cannot feed their own immediate family because of illness or some other incapacity. Even though custom demands that women in certain phases of life should not participate directly in public ceremonies (see Section 7.4), they do prepare the special food which is ritually offered to deities before being distributed among family and friends. Strikingly, even ritual food offerings are prepared at home, away from the men, who prepare for the ceremony in church or at a temporary outdoor altar. In some cases, however, such as the installation of crosses at the village boundaries, the food is prepared on the site of the ceremony. While the men dig the pit oven (*pib*: Section 5.4.7) and put up ropes on one side of the altar, the women prepare food on the opposite side. Normally the *hmen* is the only person who traverses the physically separate gender-domains. In their professional capacities too, men and women often occupy separate domains, though these are not necessarily demarcated in the spacial sense. For example, nearly all *hmen* are men and midwives women. However, men and women are equally liable to be accused of *brujeria* (witchcraft or sorcery), the practice of which influences social relationships beyond the *solar*. Even though there are a few areas of overlap, then, the female labour domain is clearly circumscribed and differentiated from the male labour domain, to which I now turn.

6.3 The male labour domain: the *milpa*

In Yucatan, a *milpa* is a plot in which corn, beans and squashes (*Cucurbita* sp.) are cultivated together. The word, of Aztec origin, was used in Mexico and the humid tropical regions of Central America to refer to a maize field and was later adopted by the Spanish colonists in the region (Romero Conde 1994: 13). Since *ejido* land is communal by law, every member (*ejidatario*) can claim rights to a plot within its boundaries. According to the *milperos*, they cultivate plots of between four and nine hectares (100 to 225 *mecates*); the typical area of about five hectares (125 *mecates*) being large enough to supply the basic needs of the nuclear family. As already indicated, working the *milpa* is a predominantly male activity. The process has various stages: selecting a plot; clearing the bush; burning the cut vegetation; then planting, tending and harvesting the crops. The whole process, from the first slash of the machete to the removal of the last corn cob, takes about one year and produces a single yield, which is

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community and establish social relationships in this way. However, food prepared by women for public ceremonies is mostly distributed by men.

taken to the homestead little-by-little over a period of several months. The same plot can be used again for a second year, but the yield will be less than the first, since the growing of crops extracts nutrients from the soil. If conditions are still favourable, the *milpero* may decide to sow the same plot for a third consecutive year. To spread the risk, most households work at least two plots simultaneously: one recently cleared and another in its second or third year of cultivation. Properly speaking, this is 'swidden' agriculture, because cultivation shifts from plot to plot. For the plots to be productive, the *milpero* requires the co-operation of several deities. He believes, for example, that whether the plants get sufficient rain depends on the whim of the *Chakob*. Practices aimed at obtaining supernatural co-operation are therefore regarded as an integral part of the production process.

I now describe the various stages of the *milpa* production process. (For a summary of how the corn growing and beekeeping cycles correspond, see Figure 6.2.) The potential yield depends largely on the quality of the plot selected. Most *milperos* of the Maya Zone fertilize the soil only with the ashes of the natural vegetation they cut down when clearing their plots. When the plot is no longer sufficiently productive, cultivation ceases and the field lies fallow for several years. Secondary vegetation grows quickly, starting with colonizing herbage and developing into shrubs and small trees within a decade. The *milpero* may decide to cultivate the plot again; in which case, the older and higher the secondary vegetation, the greater the slash-and-burn labour (costs) and, concomitantly, the greater the potential yield. Selecting a plot to be cultivated is always a question of weighing up the labour investment against the expected yield. In their language use, the *milperos* distinguish various stages in the development of vegetation: *pok che'* (up to three years of growth), *hub che'* (three to five years), *taankelem k'aax* (five to ten years), *k'eelen che'* (ten to twenty years) and *k'aanal k'aax* (mature forest of forty years or more). This system of classification is not universal in Yucatan; there are regional variations (see Hanks 1990: 358-360, Terán & Rasmussen 1992, Koeyer & Remmers 1989). For optimal results, the *milpero* may decide to wait until a plot has reached the *k'eelen che'* stage before clearing and cultivating it. Even though some of the added ash-nutrients remain in the soil after the first year's harvest has been brought in, the yield from a second-year *milpa* (*sak'ab*) is significantly reduced.[10] Therefore, while cultivating a plot for the second or third year in succession,

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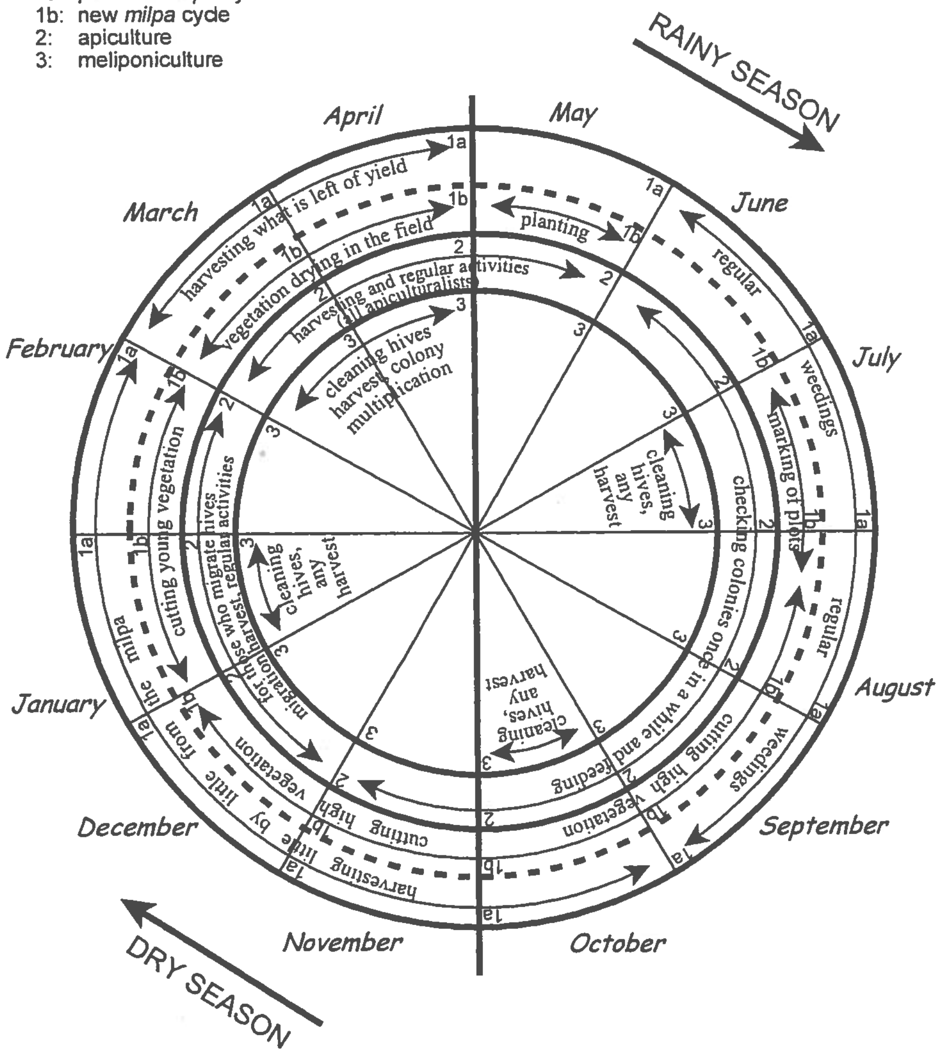
[10]From the first to the second year of cultivation, cornfield production typically decreases by 40-50% as nutrients are exhausted and more weeds invade the plot (Vargas Rivero 1983: 157).

Figure 6.2: Corresponding cycles of corn growing and beekeeping

1a: previous *milpa* cycle
1b: new *milpa* cycle
2: apiculture
3: meliponiculture



*regular activities: hive construction, furnishing hives, colony multiplication, treating of pests, etc.

the *milpero* also plants a more recently cleared field. When a meeting of *ejidatarios* is held, all the *milperos* have to declare where they are planning to cultivate *milpas*. Most people prefer to cultivate plots within 3 or 4 kilometres of the village. Once the *ejidatarios* have approved the earmarked plots, the *milperos* start marking them off, in July or August. Carrying a one-*mecate* (20 m) rope, known as a *k'aan*, and stones, they walk around the plot, tracing its perimeter with the rope and marking each rope-end point and corner with a stone. With the boundaries of the plot thus established for all to see, a small offering of *saka'* (corn-gruel) is made to the *Yumtzilob*, the spirits of the forest.[11]

The next stage in the process is one of sustained, hard labour. Armed only with a machete, the *milpero* hacks down all the vegetation on the plot, except for a few trees with trunks of about one metre in diameter and larger. These trees are left intact to provide a little shade in the cornfield.[12] Obviously, far more time is needed to clear *k'aanal k'aax* (high forest) than young secondary vegetation such as *hub che'*. Whatever stage of development the vegetation is in, the work must be planned in such a way that, by the time the sun is at its hottest, towards the end of the dry season in March or April, all the wood and foliage will have been cut down and can dry out properly before being burned in April. The felling of *k'aanal k'aax* needs to start as early as in August; *hub che'*, in contrast, can be cut as late as in January or February. The *milpero* therefore does the work in phases, clearing the plot with more developed bush first and then moving to the young vegetation in the previous year's *milpa*. In March and April, the heat is so sweltering (and the flow of nectar so copious) that, with the year's most arduous task accomplished, work in the *milpa* stops for a while. The *milpero* needs a good blaze to produce the ashes that will make his land fertile,[13] so, before lighting the fire, he performs a small rite to obtain the co-operation of the wind gods (*Pahatunob*). The burning of the wood and foliage only takes a few hours.

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[11]In the ceremonies for village or homestead, *saka'* is apparently used to absorb evil (Sosa 1985: 363-364). In these two forms of *loh*, the area within the perimeter is cleansed of potentially harmful influences, as in this minor rite for the cornfield. It therefore seems logical to conclude that, here too, the *saka'* offering is intended to absorb evil.

[12]Redfield and Villa Rojas cite one of their Maya sources as explaining that, if the larger trees were burned as well, too much ash would be produced (1934: 43). Reports from the colonial era also speak of the felling of only some of the fully grown trees (see Terán & Rasmussen 1992).

[13]The Yucatecan soils generally have a low phosphorus content. The ashes of the cut vegetation not only add this element to the soil but also make more potassium and nitrogen available to seedlings, resulting in an initial flush of fertility (Merrill-Sands 1984: 85).

With the vegetation reduced to ashes, there comes a time of rest and uncertain anticipation. The uncertainty is warranted, given the irregular rainfall patterns, which *milperos* claim are the result of the widespread deforestation in the modern era. Some see this purely as an interaction between environment and climate; others say it is because many Maya have grown indifferent to the trees and, in their failure to perform the required rituals, disrespectful of the forest spirits and other deities. The *Chakob* are particularly important, for they bring rain. As the dry season draws to a close, predicting rain and choosing the right day to sow the *milpas* becomes the main topic of conversation between men. Some rely on the traditional Maya weather forecast, the *xok k'in* described in Section 6.1, whereas others also give credence to certain omens (see Section 8.6). Whatever the prognostications, the *milpero* cannot sow until the soil has been moistened by the initial showers and he feels confident that rain will continue to fall regularly. If he sows too early, the seeds will germinate with the first showers and die in the subsequent short drought. If he sows too late, the young corn plants will have to compete with too many weeds for the nutrients released by the ashes (Merrill-Sands 1984: 327). If the expected rains do not come, the people may become so concerned that the decision is taken to perform a rainmaking (*Cha Chak*) ceremony, in which every male villager may participate, irrespective of his lineage. The women prepare the ceremonial meals, yet it is strictly taboo for them to be present at the overnight prayers. Formerly, the *Cha Chak* ceremony would be held whenever there was a prolonged drought, but it has not been performed in Tepich or Señor for some years.[14]

When the *milpero* finally feels certain that the rains from the west will fall steadily, he sows his corn together with beans (*Phaseolus vulgaris*) and squashes (*Cucurbita* sp.), throwing a corn kernel, a bean and a squash seed into each sowing hole. Two varieties of corn are sown: one bearing large cobs (*xnuk-nal*), which take six or seven months to develop; the other bearing small cobs (*xmehen-nal*), which take about three months. The beans grow in the shade of the corn, sometimes alongside watermelons and chilies. At sowing time, *milperos* always make a small offering; some to the *Yumtzilob* (the forest spirits); others to *Yumbil Dios* (Great Lord God), who, they believe, will then ensure that the responsible deities fulfil their duties. Every now and then, while the

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[14]This ceremony is described by Redfield & Villa Rojas (1934: 138-143). More recently, the *Cha Chak* ceremony has been described by Sosa (1985: 376-396) and Hanks (1990: 367-377), while *Cha Chak* prayers have been published in Montemayor (1994) and Love & Peraza Castillo (1984).

crops are growing, the *milperos* return to their *milpas* to do some weeding.

When the 'first fruits' of the *milpa* are ripe for harvesting, in October or thereabouts, another offering must be made. At that time, all the corn cobs are bent down so that they will dry in the field as the plants reach full maturity in the period from December to February. The *milpero* brings in the harvest little-by-little until about March or April, when he harvests all that remains in the field. Some of the corn is stripped from the cobs; the rest is stacked up in the storehouse within the *solar*. The Maya believe that the day of the full moon is the best time to bend down the corn cobs, for this makes the corn less appealing to insects, and it can therefore be stored for a longer period. The final harvest is also timed to coincide with the full moon. Once all the corn has been harvested, the *milpero* can determine the total yield and offer up the *cuenta* (the count or tally) to the gods in the ceremony known as *U Hanli Kool* (Dinner for the *Milpa*) or *loh kool* (see Section 6.3.1.2).

6.3.1.1 The minor rites in the *milpa*

At every important transition from one stage of *milpa* production to the next, the *milpero* must secure the co-operation of the responsible deities. To this end, he offers up a small quantity of foodstuffs brought from the homestead and says a simple prayer. In contrast to more extensive, formalized village ceremonies such as the *lohob* described above, the rites in the fields are modest affairs; they do not require the ministrations of a *hmen*, and therefore exhibit greater personal variety. The variations are minor, however: the core practices are standard. When marking the boundaries of a new plot and before burning the vegetation to enrich the soil, the *milpero* makes a 'cold' liquid offering of *saka'*[15]. The boundary rite cleanses the plot of evil spirits and ensures that guardian spirits are installed at the four corners. There is an obvious parallel between this practice and the installation of spirits to protect the homestead during the *loh*, in the sense that both the *solar* and the *milpa* are physically and ritually demarcated. Some *milperos* offer *saka'* and a prayer at the centre of the *milpa*; others place crosses at its four corners. I demonstrate in Section 8.2 that these two forms are effectively equivalent. As a *hmen* explained to me, the only real difference is that, in a rite with

[15]In the *ejido* of Xmaben, the equivalent of *saka'* (corn-gruel) is called *santo uk'ul* ('sacred breakfast' or 'sacred drink'). The drink is prepared in the same way as *saka'* and is also considered to be 'cold' (*sis*).

four crosses, the *milpero* must pray and make offerings at the four corners of the plot as well at the centre. Several people in the *ejido* of Xmaben say that *Xunan kab* honey is highly appropriate as a *milpa* offering. At the demarcation and burning stages, however, honey is not offered; just *saka'*:

"You always offer *saka'* in the same direction. The fire burns from *la'kin* (east) to *chik'in* (west), so that's how you arrange the *saka'*. There are those who place seven *jiceras* (calabashes of *Crescentia* sp.) in a row; others use thirteen, as I do. You set up a small table in the *milpa* and put the *jiceras* on it. But you must not put honey in the *saka'*. You immediately make a cross, which you place behind the *jiceras*, because the *mozon-iik*[16] that burns the *milpa* is alive. He comes tumbling within the burning fire. As soon as the whirlwind reaches the *saka'* and starts spinning around in it, it is doused. Because the *saka'* heats up, if there were honey in it, the whirlwind would not be smothered at all. Honey is hot, so the fire would burn even more fiercely" (Don Crescencio, *hmen*, Tepich).

It is important to realize that, as this rite is actually performed before the vegetation is burned, the concept of the liquid offering smothering the fire is purely symbolic.

The next rite in the annual sequence is performed at sowing time. Evidently, most people in Tepich offer *saka'* again, but this time with ritual breadstuffs. Some people in the *ejido* of Xmaben specifically mention that they offer *hostias* (hosts), thick corn-cakes of the standard breadstuff dough, though with added *Xunan kab* honey. The hosts are wrapped in palm leaves and baked; preferably in the *pib* (a pit oven, specially dug for the occasion: Section 5.4.7), but often on a *comal* (metal plate or griddle) over the kitchen fire. Most Maya offer hosts in the *primicia*, or 'first fruit' ceremony, which is performed as soon as the first ripe corn cobs appear in the *milpa*:

"When there are new corn cobs in the *milpa*, you bake *hostias*, slaughter some chickens and take all this food to the *milpa*. It is very important that you take three *hostias*. You make them from corn dough and *Xunan kab* honey." (*Milpero*, Yaxley).

The offerings of the 'first fruit' ceremony are made more elaborately than those during the minor rites described so far. At the altar, the hosts are wrapped in an embroidered cloth. In contrast to what is customary with most other offerings, which are simply left on the altar, this sanctified food is symbolically handed over to the gods by raising it towards the sky. In addition, candles are used to illuminate the prayer's path to the gods. *Milperos* in the *ejido* of Xmaben also tell of an offering of *kaliz*, a mixture of

[16]The *mozon-iik* is the whirlwind that carries the flames across the *milpa*.

Xunan kab honey and water, which is sprinkled to the four corners of the *milpa* and towards the sky. In Tepich, the *milperos* do not use honey in this way in their minor *milpa* offerings as in Xmaben (it is added to the dough which is baked to make hosts), and they sprinkle *saka'* instead of *kaliz*. Unfortunately, *Xunan kab* honey has become scarce in both communities and even more so in Señor, where only seven people now keep *Xunan kab* hives. As a result, many *milperos* are no longer able to perform the rites and ceremonies as custom demands, and some believe that this is why *milpa* harvests so often fail nowadays.

6.3.1.2 The *U Hanli Kool* ceremony

Once all the corn cobs have been harvested and brought to the homestead, the *milpero* can tally up the yield and present the count (*cuenta*) to the gods in the ceremony known as *U Hanli Kool* (Dinner for the *Milpa*). Whereas other ceremonies may often be neglected until someone in the family inexplicably falls ill, most families dutifully perform the *U Hanli Kool* every year, even if the Maya deities are not recognized by all the participants. Some *milperos* perform the ceremony on their own account; others come together in family groups and present a collective *cuenta*. In 1996, for example, I witnessed the shaman Don Hipólito performing a *U Hanli Kool* for of his brother, Don Cipriano at the latter's homestead. Under normal circumstances, Don Cipriano would have performed the ceremony annually, but a series of misfortunes had made it impossible for him to present the count in 1995, so it remained 'in limbo'. Don Cipriano eventually became ill: suffering from continual headaches despite several visits to the doctor, he consulted Don Hipólito, who, after looking in his *sastun* (a crystal which shamans use for divination), concluded that his brother's failure to perform the ceremony had angered the gods. Don Cipriano realized that he *U Hanli Kool* would have to be performed twice in 1996, to redress his original error and to present that year's *cuenta*. This was quite a burden on the family budget: properly, a *U Hanli Kool* requires no less than four chickens, as well as several kilos of squash seeds (*pepitas*), corn and other commodities. What follows is a description of the offerings made at the first of those two ceremonies. Note that the consecrated bread was not cooked in the pit oven (*pib*); neither was it when Don Hipólito performed a minor form of the *U Hanli Kab* (a similar ceremony relating to the honey harvest: described in detail in the Prologue and 5.4.7, *et seq.*; for a comparison of the two ceremonies, see Section 6.3.1.4). According to the shaman, this was the only departure from normal custom. In preparing for the *U Hanli Kool*, Don Hipólito followed the same procedure as for the *U Hanli Kab*:

On the eve of the ceremony, Don Cipriano's wife boils several kilos of corn kernels. After dawn on the day itself, Don Hipólito prepares mead (*balche'*). When the drink is ready, he uses some of it to consecrate the four chickens, which the women then slaughter and boil on the *k'ooben* (kitchen fire). When these are cooked, they drain off the stock and use it to make a broth or bouillon (called *k'ol*) with garlic, onion, *achiote* (*Bixa orellana*), cinnamon, salt and pepper. Ground squash-seeds (*pepitas*) are mixed with corn dough to make several breadstuffs of a kind known as *xnabal*. Later, these are broken into half the bouillon, the resulting mixture also being called *xnabal*. The women bake 14 flat breadstuffs of another special kind, known as *xnohwah*. Each of these is said to weigh 48 kilos (a symbolic, not actual, weight! See Section 6.3.1.3). They are decorated with indented patterns in a pre-determined sequence. The first *xnohwah* bears a cross, a superscribed arc and 13 dots or holes. [Often, these circular depressions actually form the cross and arc: 7 in the cross; 6 in the arc. Alternatively, the cross and the arc are imprinted using wooden stamps or simply inscribed with a pointed tool, in which case the decorations represent the corresponding numbers 7 and 6). Each of the following five *xnohwahob* has a set number of holes in descending order (12, 11, 10, 9 and 8); all the remaining breadstuffs of this kind are marked only with a cross (made as described above and representing the number 7]. Each indentation is moistened with *balche'* and then filled with *pepitas*. Hosts made with *Xunan kab* honey are also offered in the ritual; they are all decorated with a cross and a superscribed arc, like the 13-hole *xnohwah*, and baked in palm leaves. Breadstuffs of a third kind, *tuti wah*, are baked from corn-and-*pepita* dough and represent the rodent *ba'* (*tuza* in Spanish). According to Don Hipólito, these rodents must participate in the ritual (albeit symbolically) because they eat the corn in the *milpa*, the annual production of which is inversely proportional to their appetites![17] In the *U Hanli Kool*, liquid offerings of *saka'* and *balche'* are also placed on the altar.

At noon, Don Hipólito starts setting up the altar. He constructs two arches of forest vines and *habim* leaves over the full length of the table. They run diagonally from corner to corner and intersect above the centre point. He uses more *habim* leaves to cover the table and then arranges on it 26 hoops made of forest vines. Half of these are used as supports for calabashes (*Crescentia* sp.) of *saka'*; the others for calabashes

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[17]This animal probably eats the roots of the corn plants, not the cobs.

containing a food offering of *k'ol*, *xnohwahob* and chicken. Four *xnohwahob* bearing crosses are positioned at the corners of the table. From the arches, two calabashes are hung: one filled with *saka'*, the other containing *k'ol*, the 13-hole *xnohwah* and some chicken. In the middle of the table, a decorated cross, the *sastun*, hosts, *xnabal* with seven chicken feet and the *balche'* are placed in a row. In the process of 'laying the table', Don Hipólito consecrates the cross and the *sastun* with *balche'*. The *tuza* breadstuffs are placed under the table. The shaman has brought resins (*chal*) from the beehives, to be burned as incense. Finally, there are two candles to light the path of the gods as they descend to the table with its offerings.

Don Hipólito is left alone to invoke the gods so that they may partake of the meal and accept the delayed *cuenta*. His words of prayer rise to the sky with the smoke from the incense as he sprinkles first *saka'*, then *balche'*, to the four corners of the table and to the sky. After a while, he suddenly stops praying and shouts to Don Cipriano, who is waiting in the house: "Hey, how many *mecates* did you plant?" He then conveys the *cuenta* to the gods. After half an hour of prayer, he leaves the gods to feast themselves on the offerings for a quarter of an hour. Then there is another quarter of an hour of prayer, after which he directs the gods back to the sky. With this, the ceremony is finished and the people can eat (observed by me in Tepich).

6.3.1.3 Other forms of *U Hanli Kool*

Although the *U Hanli Kool* is often performed even more elaborately, for the purposes of this section, Don Hipólito's scaled-down version of the ceremony is adequately representative of normal practice are minor. I have included the preceding description, in preference to others, to facilitate the comparison (in Section 6.3.1.4) with a minor form of the similar *U Hanli Kab*, also performed by Don Hipólito (described in detail in the Prologue and Section 5.4.7). In this way, I hope to have eliminated discrepancies which would arise if two ceremonies of different scale, or the interpretations of two different shamans, were compared. During my fieldwork periods, I observed the *U Hanli Kool* being performed on two other occasions, in Señor and Tepich, in a form more closely resembling the descriptions in the literature (Hanks 1990; Redfield & Villa Rojas 1939). On both occasions, the breadstuffs were baked in the *pib* and the *saka'* was offered in the morning, quite separately from the afternoon offering of solid food. Normally, a tree resin called *pom* is used as incense. Don Hipólito had none of this resin left, so he used *chal*, a mixture of wax and resins produced by stingless bees.

Instead of *balche'* (mead), which this shaman used, the people in Señor generally make *kaliz*, which is simply *Xunan kab* honey mixed with water. The difference between the two drinks is that the bark of the *balche'* tree is used to prepare the former, but not the latter. It used to be customary to prepare the *balche'* several days before the ceremony so that it could ferment sufficiently. Nowadays, however, *balche'* is prepared on the same day as it is consumed and therefore has no intoxicating properties,[18] like kaliz. The two drinks are used in exactly the same way in rituals: they are sprinkled to the four cardinal directions and the centre of the altar and the *pib*, as well as being used to consecrate ceremonial objects and materials. In Señor, I watched Don Abundio, the senior male of an extended family, leading his agnatic relatives in a collective ceremony for the *milpa* they had cultivated together. Don Abundio presented the *cuenta* to the gods, counting the *xnohwahob* to be offered and ensuring that the number corresponded to the collective yield. Meanwhile, one of them explained to me:

"The *Chakob* [rain gods] are big men. They eat breadstuffs weighing 48 kilos, called *xnohwahob*. For each sack of corn you harvest from your *milpa*, you must offer one *xnohwah* to the *Chakob*" (*milpero* Señor).

Each *xnohwah* thus symbolically weighs 48 kilos, just like a standard sack of corn. Although a *hmen* said the main prayers, Don Abundio, who is not a shaman, offered a separate prayer in which he reported the number of *xnohwahob* he was to offer.

6.3.1.4 Similarities between *U Hanli Kool* and *U Hanli Kab*

As performed by Don Hipólito, the ceremony for the cornfield (*U Hanli Kool* or *loh kool*) and that for the bees (*U Hanli Kab* or *loh kab*: Prologue & Section 5.4.7) had much in common. Firstly, there was the similarity of the solid, liquid and other offerings: in both rituals there were hosts, chicken, *xnohwah*, *xnabal* with seven chicken feet, *k'ol*, *saka'*, *balche'*, prayer and candles; yet, whereas the bees were represented in the *loh kab* by an offering of honey and coarsely ground corn, a rodent participated in the *loh kool* in the guise of corn-and-*pepita* bread. Secondly, the layout of offerings on the altar tables was similar, though not identical. On the altars of both ceremonies, the *saka'* was surrounded by food offerings; however, whereas in the

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[18]People who want to get drunk on *balche'* add a little *k'ob* (fermented corn kernels).

ceremony for the bees the food offerings were arranged in a curve circumscribing the altar table, in the ceremony for the cornfield they were placed in straight parallel rows. In all other respects, the altars were laid out in almost identical fashion. In both ceremonies, two calabashes (one of *saka'* and the other containing the 13-hole *xnohwah*, *k'ol* and some chicken) were hung from the arches above the altar at the point called *chumuk k'aan* (centre sky). Don Hipólito pointed to a corresponding point on the table, the *chumuk lu'um* (centre earth). There, directly beneath the *chumuk k'aan*, he had placed the host offering wrapped in an embroidered cloth, beside the *xnabal* offering with seven chicken feet. The table and arches were covered with *habim* leaves and the *xnohwahob* marked with a cross were placed at the corners of the table. There were further parallels in Don Hipólito's gestures: on both occasions, he sprinkled *saka'* and *balche'* in identical manner, and presented the hosts and *xnabal* in a different way to the other solid food offerings by raising them to *Yumbil Dios* in the sky. As the shaman later explained, the same major deities are invoked in both ceremonies: the thirteen food and liquid offerings on the table are for the spirits of the forest (*Yumtzilob*); other important guests are the *Chakob*, stationed at the four corners of the altar and the centre point, especially their chief *Kun K'u*, who brings the good 'cold' rain to water the corn plants and the flowers that give pollen and honey. Finally, both ceremonies should be performed annually out of gratitude for a harvest: the number of *mecates* planted or corn sacs harvested are reported to the gods in the *U Hanli Kool*, whereas the number of beehives are reported in the *U Hanli Kab*. If the ceremonies are neglected, the gods may punish the owner of the *milpa* or beehives by making him ill. Except for some necessary minor differences, then, Don Hipólito performed his *U Hanli Kool* ceremony in the same way as his *U Hanli Kab*. The other shamans of the village agree with Don Hipólito that the two rituals are, to all intents and purposes, identical.

6.3.1.5 Types of ceremonial practices

The numerous similarities between the ceremony for the cornfield (*loh kool*) and that for the bees (*loh kab*) become fully apparent when the offerings, gestures and underlying concepts are compared with those of the other *lohob*. In the ceremonies for the village (*loh kah*), homestead (*loh solar*) and bee-house (*loh nailkab*), no hosts are baked, and neither *xnohwahob* nor arches are built over the altar. On several occasions in 1996, I witnessed the ceremonial installation of crosses at the entrances to a village (see Section 8.2.2.3). In those ceremonies, Don Hipólito simply piled up unmarked breadstuffs in 13 stacks, each 13 high. Don Rocío told me that, when he performs a *loh* for the homestead, he only offers *saka'*, *xnabal* and *k'ol* at the centre of the house. In his dreams as an apprentice shaman, the *Chakob* revealed to him four different altar layouts for the *loh kool*, the *loh tsom* (ceremony for the hunt), the *loh k'ex* (ceremony for an important change of fortunes; for example, an illness) and the *loh solar*. Don Crescencio informed me that, when he performs a ceremony for the homestead or village (*loh solar* or *loh kab*), he explicitly emphasizes the perimeter by walking around it with burning incense or chilies to expel evil spirits from the area. In that sense, he distinguishes these ceremonies from those for the cornfield and for the bees. Although all kinds of rituals may be performed when some illness strikes, the Maya clearly distinguish the *loh kool* and *loh kab*, in their purpose, from all other rituals: annual yields are presented with thanks in the ceremonies for the cornfield and the bees, whereas the others are clearly protection rituals. Don Medardo stressed this difference by saying that the *loh kool* and *loh kab* should be performed regularly, while the *lohob* for homestead and village are only necessary when deities are deemed responsible for some illness. Of course, these *lohob* must also be performed whenever a new homestead or village is to be inaugurated. The idea behind the *lohob* for the cornfield and for the bees is probably closer to the purpose of the *loh* for the hunt, since hunters are often said to perform that ceremony to give thanks for wild animals they have shot. No hunting ceremony was performed during my stay in the villages, so I am unable to draw detailed parallels here. However, several shamans say that the offerings of the *U Hanli Tsom* are not identical to those of the *U Hanli Kool* or *U Hanli Kab*, that plain breadstuffs replace the inscribed *xnohwahob* and honeyed hosts of the latter two. The logical conclusion, then, is that the *U Hanli Kab* and *U Hanli Kool* have the greatest number of similarities.

6.3.2 Apiculture

According to Maya custom, all the animals in the homestead except the native stingles bees are taken care of by the women, while the cows and the non-native stinging honeybees (*Apis mellifera*, locally known as *Americano kab*) are tended beyond village boundaries by the men. With the appearance on the scene of Africanized strains of the honeybee (known as *Africano kab*), the risk of angry swarms of bees attacking people and livestock has increased markedly (Section 2.4), so it is now imperative to locate apiaries outside villages. For the sake of convenience, they are usually kept in the *milpa*. Keeping Africanized bees in the back yard, close to the home, is particularly dangerous: if the pigs and dogs that roam around freely there accidentally push over a hive, the whole colony may be incited to attack; even certain noises and odours from the home can rouse them. *Ejido* law therefore requires that apiculturalists locate their hives beyond the village boundaries. This rule is often ignored, though, and 'killer bees' once stung a horse to death in Tepich. When the non-indigenous honeybees became Africanized, several beekeepers abandoned apiculture because they found their colonies too aggressive. Apiculture is not normally discussed at *ejido* level; however, the apiculturalists in Tepich have a delegate who sometimes calls a meeting with a specific aim, for example to elicit government aid, or to discuss problems and regulations.

Most Maya apiculturalists have only a few hives, whereas the largest apiary in Tepich had 48 hives in 1996 (for size distribution, see Section 9, Table 9.1) and the maximum in Señor was 80 in 1994. The numbers of hives tend to mirror fluctuations in the price of Yucatan honey on the world market.[19] Apiary size dictates management strategies: apiculturalists with no more than four hives tend to keep them in the homestead, despite the risks; those with five to thirty hives keep them out in the *ejido* all year; for those with more then thirty colonies, however, it becomes profitable to move the hives around to keep them within foraging distance of the seasonally changing floral resources. In Tepich, for example, there are three apiculturalists who 'migrate' their hives between four seasonal locations in the course of the year. In December, they move their hives to Tizimin near the northern Yucatan coast for the blooming of the *Tajonal* (*Viguiera dentata*). From there, the hives are moved west to the neighbourhood of Mérida for the flowering of the *Ts'its'il che'* (*Gymnopodium floribundum*). As the blooming of this flower progresses from the Gulf of Mexico coast to the Caribbean coast, the apiculturalists keep their hives in the *ejido* of Tepich in April, moving them further east to the area of Tulum on the Caribbean in May.

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[19]Take Don Lorenzo, for example, who had an apiary of sixty hives in 1993; yet when honey prices dropped that year to 0.80 pesos a kilo (0.25 US dollars), he more or less abandoned the activity. In 1994, the honey price recovered to 1.70 pesos a kilo (0.56 US dollars), but he did not think it would be profitable to go back into apiculture. By 1995, he had only 14 hives left. In 1996, however, when the Mexican government devalued the peso and demand for Yucatan honey increased, apiculture again became profitable: that year, prices increased to about 12 pesos a kilo (around 1.80 US dollars). Don Lorenzo started to increase the number of his colonies again and by April 1996 he owned 29 hives of *A. mellifera*. At the time of writing, he is planning to expand his apiary to sixty hives, provided that the honey price does not plummet again. He once kept an apiary of 100 hives, but as he can make just as much honey with 60 hives of Africanized bees, he has decided that this is a satisfactory maximum.

Migrating the apiaries in this way boosts honey production and decreases the costs of feeding the bees artificially, but involves high transport costs (typically 75 US dollars per transport by trailer in 1996). When nectar flow is copious, in March, April and May, apiculturalists have to travel to their hives once a week to collect honey. Migration of hives is therefore limited to those Maya who have access to a car or van. According to the apiculturalists in Tepich, migration is only profitable if one owns thirty or more hives and the international honey price is favourable. For beekeepers with only ten hives who have no intention of increasing the size of their apiaries, the increased honey production per hive resulting from migration does not compensate the higher production costs. Other periodic expenses are incurred for equipment such as protective clothing, smoke generators and comb extractors, for materials to construct hives and frames, which have to be renewed from time to time, for the wax which is necessary for comb foundation, and for preparations used to treat the hives.[20] To keep costs down, beekeepers often share their equipment and, if possible, their means of transport. A good price for honey can only be obtained if transport is available: car- or van- owners drive around looking for the best price in the area. Sometimes, a car is rented to take the honey into town. Alternatively, the honey may be sold to an intermediary in Tepich who pays one peso less per kilo then his counterparts in town.[21] In a good year, apiculturalists can make a fair profit, but keeping *A. mellifera* is no guarantee of economic success.[22]

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[20]In 1996, the Varroa mite, a very serious pest of honeybees, was not yet a problem in Tepich.

[21]In Valladolid there are several intermediaries and a liquor plant to which beekeepers can sell their honey. Most people in Señor sell to the governmental *Instituto Nacional Indigenista* in Carrillo Puerto, which generally pays less per kilogram of honey than the intermediaries in Valladolid.

[22]Merrill-Sands showed that, of the ten wealthiest households in Chan Kom, six had gone into apiculture at an early stage. People who later followed suit did improve their economic situation somewhat, yet apiculture did not make them rich (1984: 232-234). In Tepich, the apiculturalists with the largest apiaries own a car, a status symbol available to only a few households in the village. Because honey prices were low in the years prior to 1996, the village's leading apiculturalists had not been making big profits. Since they took steps in 1996 to increase the number of hives in their apiaries, they were unable to extract as much honey as they would otherwise have done, (because multiplying colonies reduces productivity temporarily) and I am therefore unable to estimate how much of their income was from keeping *A. mellifera*. In general, cash influx from *milpa* cultivation is low and apiculture still proves to be an important means of supplementing one's income. In 1995, when honey was selling at around seven pesos a kilogram, the profit made by small apiculturalists with around 10 hives represented approximately 40% of their total cash income. Although apiculture can certainly increase the cash influx to a household (see also: Dixon 1988; Merrill-Sands 1984; Calkins 1974), keeping *A. mellifera* is no guarantee of economic success because it is prone to honey-price fluctuations on the world market and because beekeepers can lose large numbers of colonies when diseases and hurricanes strike (see also: Re-Cruz 1996; Merrill-Sands: 1984).

6.3.3 Collecting chicle and logging in the male labour domain: *k'aax*

Forest (known as *k'aax* in Maya and *monte* in Spanish) is any land which has never been cultivated (virgin forest) or which has lain fallow for some years following cultivation. As I explained in Section 6.3, the Maya distinguish several developmental stages of *k'aax*, the sole criterion being how long the wild vegetation has been growing since the last human intervention. Although the Maya recognize certain deities who protect trees, they perform no rituals specifically for the *k'aax*. Indeed, they regard the forest as a dangerous place where wild animals and potentially hostile spirits roam at will. The Maya enter the forest not only to cultivate their *milpas*, but also to hunt animals and to collect various natural products including *chicle*, the white latex of the tree *Manilkara zapota*, which grows dispersed throughout the forest. Such tasks are the undisputed preserve of the men.

Until several years ago, from July to November in the rainy season, many *ejidatarios* living in Xmaben and some in Tepich would collect *chicle*. To tap off the latex, the *chiclero* carves two diagonal grooves in the trunk, forming a chevron. Directly under the apex of the chevron he attaches a bag to collect the dripping latex, which is then boiled in a cauldron and poured into moulds, where it sets into blocks, the form in which it is sold. Having tapped the trees at the forest margins, the *chicleros* must penetrate ever deeper into the forest domain of snakes, jaguars, diseases and spirits. Don Jacinto, a *chiclero* living in Señor, told me of *Juan del Monte*, an invisible *chiclero* spirit who lurks in the forest and entices the unwary latex collector with false promises of excellent yields for little work, only to claim the life of the unfortunate victim seven years later. Not surprisingly, most *chicleros* seek strength in numbers and pass forest nights in groups to reduce the perceived risk. Enjoying the companionship and conversation, they exchange stories, many of a kind that do less than nothing to allay their fears. When the *chicle* trade was still lucrative, some groups would camp out in the forest for weeks on end, living on whatever natural food they could gather and supplies brought from the homestead. If a group stayed in the forest for an even longer period, villagers would shuttle extra food to them in their camp. Many *chicleros*, however, speak of how they went hungry until they were fortunate enough to find a bees' or wasps' nest. Honey can assuage hunger for hours. Usually, *chicleros* completely destroy the nests of forest bees and even eat the larvae, but sometimes they leave part of the nest intact to guarantee a supply of honey if and when they return the next year. Nowadays, though, very few men go into the forest to collect *chicle*. With the increasing deforestation in and around the *ejido* of Tepich, *Zapote chicle* has become quite a scarce commodity there, although the latex-producing trees can still be found in the *ejido* of Xmaben. When synthetic *chicle*-substitutes came onto the market, demand for the natural product declined dramatically. The *chicleros* of Xmaben used to have a collective health insurance, but the scheme was abandoned in 1989 because the bottom had dropped out of the market. There are still a few residents of the *ejido* of Xmaben who collect *chicle*, but in Tepich the practice seems to have dwindled into insignificance.

In the *ejido* of Xmaben, selective logging is practised and wood for railroad ties (railway sleepers) is extracted from the forest. Both activities are restricted to the dry season, when the vegetation in the *milpas* has been slashed and is drying out. Railroad-tie production is open to all *ejidatarios* and requires little more in the way of equipment than a good saw. Once cut, the heavy logs (90 to 100 kg) need to be dragged to the nearest road for motorized transport to the point of sale, so most trees are felled within about one kilometre of the road. Some of the trees are important sources of food for bees, for example *Chechem* (*Metopium brownei*), *Habim* (*Piscidia piscipula*) and *Yaax nik* (*Vitex gaumeri*). Unlike the railroad-tie production, selective logging is organized by a committee at *ejido* level, which hires *ejidatarios* to do the actual cutting of the logs. The work requires chain-saws, sleds and heavy trucks. The whole community benefits from the logging, because its members are guaranteed a percentage of the profit. In theory, the *ejido* as a whole is allowed to cut a quota of logs calculated on the basis of the number of trees still standing in the forest. The impact of railroad-tie production and selective logging in the *ejido* has yet to be studied, but it certainly goes beyond the actual cutting of trees (Murphy 1990: 112-124). Since logging is practised in *k'aanal k'aax* (high forest), and only well-developed trees are felled, the impact on wild stingless bees is not restricted to a decline in their food sources. As trees mature, hollows tend to develop in their limbs, so selective felling may cause an important decline in nesting sites available to colonies of stingless bees in the forest.

Furthermore, wood and other natural products are taken from the forest for domestic use: wood for building and for fueling the kitchen fire; palm fronds for roofing and for cooking food (e.g. ritual breadstuffs such as *xnohwahob,* and *tamales*); medicinal plants and seedlings for the homestead plots; *Habim* leaves for altar-dressing; *Chakah* leaves for beekeeping; bees' and wasps' nests; etc. Although women occasionally gather firewood, with or without their husbands, activities in the forest are regarded as a male preserve. Men also hunt in the forest, either alone or in groups.[23] Some spend the night in their *milpas*, lying in their hammocks with a rifle, waiting for animals to come. Deer, for example, often come to *milpas* to graze. Clearly, the forest is the labour domain of the men: it is where they hack out and cultivate their *milpas*, hunt animals, cut wood and extract all kinds of animal and vegetable products. The only real difference between the *milpa* and the *k'aax* is that certain rituals and agricultural techniques are practised in the former, but not in the latter. As soon as the *milpa* is abandoned, the wild forest starts reclaiming it. The process is rapid: within a few decades of being left fallow, the disused plot is hardly discernible from the surrounding vegetation.

6.3.4 Other types of male labour

As we have seen, the female labour domain extends beyond the homestead. It is also true that the male labour domain is not limited to the activities described above. Some men, mostly the more affluent members of the community, breed cattle on ranches located outside the village (Re Cruz, 116: Table 6.1). Men also sell produce grown in their *parcelas* and *milpas* to intermediaries in the towns. Men administer the *ejido*. Some men (and women) move to the city or another *ejido* temporarily to work for wages. A few of them stay away for years and only return because they would otherwise lose their rights as *ejidatarios*. These activities, however, have little to do with the keeping of stingless bees and are therefore beyond the scope of this dissertation.

6.4 Conclusions

The more labour-intensive activities in the annual cycle of meliponiculture, i.e. the harvesting from colonies and their multiplication by splitting (if necessary), coincide with the period during which the slashed vegetation in the *milpas* is left to dry, i.e. March, April and May. For apiculturalists too, regular visits to the hives mostly fall

[23]Hanks sees an interesting analogy between people hunting in groups and ants swarming. In addition, the Maya describe rage in an individual as *p'uúhul u sìinik* (literally:'his ants are stirred up'). Hanks concludes: "The analogy between the body with its nerves and pulse and the earth with its living inhabitants is patent here" (Hanks 1990: note pp. 528-529).

within that period. In other words, beekeeping activities come to the fore when there is a lull in *milpa* cultivation. Although the first corn cobs appear in the *milpas* as early as in October, after which the *milperos* start harvesting piecemeal, most of the corn is left to dry until March or April, when it is taken to the homestead. Corn harvesting therefore overlaps with the removal of honey from the beehives. In this sense, the two activities are parallel. Other parallels between meliponiculture and agriculture are evident in ritual practice. The 'thanksgiving' ceremony for the bees, the *U Hanli Kab*, shows many similarities to the ceremony for the cornfield, the *U Hanli Kool*. A key similarity is that both ceremonies are directed at *Kun K'u*, chief of the rain gods, whose power is to provide or withhold the rain that is vital to the pollen- and honey-bearing flowers and the corn plants. These two ceremonies are distinct from all others in that they are harvest rituals in which the yield of the cultivated hives and plots is symbolically conveyed to the gods. While some Maya ensure that the tally of hives kept or sacks of corn harvested corresponds to the actual number of offered *xnohwahob* (breadstuffs with a symbolic weight of 48 kilos), in Don Hipólito's minor versions of the two ceremonies, the correspondence was only evident in his prayers. During the *U Hanli Kab*, he reported the number of *Xunan kab* hives kept; during the *U Hanli Kool*, he reported the number of *mecates* cultivated. Certain offerings in the *U Hanli Kab* and *U Hanli Kool* are identical and quite distinct from those made in other forms of ceremony: specifically, the *xnohwahob*, hosts, *xnabal*, 'bees' or 'rodents', and the offerings hanging from the arches over the altar, none of which are found in other ceremonies. On the other hand, incense, candles, *balche'* (mead), *k'ol* and chicken often play a role in other ceremonial practices as well. For the *U Hanli Kab* and *U Hanli Kool*, the *xnohwahob* and hosts are decorated with numerical patterns of dots or holes, crosses and an arc. Two calabashes, one with the 13-hole *xnohwah*, the other containing *k'ol*, are suspended above the altar and constitute the sky offering. Don Hipólito indicated that the positions of offerings on the altar corresponds to certain deities: the offerings at the four corners and centre of the altar are for the *Chakob* and their chief, *Kun K'u*; the interposed *saka'* and *k'ol* offerings are for the *Yumtzilob*, the forest spirits. In his account, Don Hipólito indicated that small differences in how the offerings were arranged on the altars (i.e. in straight lines or in a curve) were not very significant. He also pointed out that the *milperos* particularly value *Xunan kab* honey as an ingredient of the hosts for the final *milpa* offerings. In Section 8, I return to this issue of symbolic references in the *xnohwahob*, hosts and other important offerings. For the time being, we can confidently conclude that Maya shamans draw a strong parallel between the *U Hanli Kab* and the *U Hanli Kool*. The obvious question that arises (and to which I also return in Section 8) is this: why do the shamans draw such parallels?

The organization of land into the forest domain (*k'aax*) and the urban domain (*kab*) corresponds to the organization of labour into, respectively, male and female domains. Above all, women take care of children, plants and the domesticated animals (*alak'*) in the area designated for that purpose: the homestead (*solar*), the boundaries of which are precisely defined and demarcated by ritual. Men, in contrast, are responsible for hunting wild animals (*ba'alche'*) in the ritually uncircumscribed forest domain, where they also hack out a plot (*milpa*) for cultivation, mainly of corn, beans and squashes. The boundaries of this plot are ceremonially defined and guardian spirits are installed at the corner points. After cultivation, the plot is given up to the forest. The distinction between *k'aax* and *milpa* is therefore temporary and is evident only in agricultural and ceremonial practices. There are, of course, other activities which seem to be less governed by gender-rules; for example, the cultivation of *parcelas* and, to a lesser degree, apiculture. Both activities are recent innovations with a more commercial thrust and do not require ritual demarcation. Although both men and women play a role in rituals, here the gender-defined domains are kept strictly separate.

The male and female labour domains correspond to the places occupied by different classes of stingless bees in Maya society. The forest bees (*kaaxi kab*) are classified as male (except for one species: *Xnuuk*, 'Old lady' or 'Grandma') and, like human males, their realm is the forest. The main species classified as female, *Xunan kab*, is kept in the homestead, which is inextricably linked to female labour. The 'male', forest bees are not incorporated in ceremonial practice, whereas this is considered essential for the 'female' bees. More generally, a similar distinction can be seen in the fact that there are no specific ceremonies for the forest area (corresponding to the male, undomesticated), whereas ceremony clearly defines the village and homestead areas (corresponding to the female, domesticated). It is interesting to note that, even when forest bees and *Xunan kab* are 'cultivated' in the same homestead, they are usually kept physically separated. However, the forest bees are not set apart in what might logically seem to be the appropriate place for them, i.e. the "area of extensive use" (Herrera Castro's term), where uncultivated plants grow as if in the wild. The important point here is that the entire *solar*, including the area of extensive use, is bounded off by ritual and therefore forms a unit: any further separation of the bees is apparently unnecessarily. The pattern that emerges is one of protective delineation by means of ritual. The boundaries thus constructed correspond to gender divisions, which are of particular importance in the organization of day-to-day labour. When an activity or product passes the demarcation line between the untamed forest and the protected homestead, it generally passes from the male to the female labour domain. It is therefore all the more striking that women neither breed nor tend the stingless bees kept in the female labour domain, even though all other animals in that domain are their responsibility. I address this apparent anomaly in Section 7.

7 Fertility: *Xunan kab* honey and corn

In Section 4, we learned that Almighty God has uniquely entrusted the 'Lady bee', *Xunan kab* (*Melipona beecheii*), to human care. That is why the Maya regard themselves as the protectors of this species of bee, whereas other animal species are though of as living under the guardianship of non-humans: i.e. protector deities or collective animal spirits, the *ah kanulob*. In Sections 5 and 6, it became apparent that the men take care of meliponine bees in the homestead, even though this area is designated as the labour domain of women. My aim in this section is to discuss whether this aspect of Maya social organisation is or is not the contradiction that it appears to be. The Maya appropriate parts of the animal domain by establishing homologous relations between their society and their environment. Furthermore, in their ritual and agricultural practices they create scale models of the world in which they live. This modelling may be rooted in their own family life. In exchange for services rendered by the gods and animal spirits, for example the provision of rain or permission to hunt wild animals, the Maya feel obliged to make ritual offerings. In Section 4, however, one important issue that remained unresolved was why the *ah kanulob*, the collective animal spirits, should be willing to share their own flesh and blood with the Maya. In this section, I attempt to demonstrate that, in return, the people make ritual offerings of life-giving or life-sustaining substances which are of symbolic equivalence to those which were received: corn for flesh; honey for blood. In this way, the Maya participate in the overall flow of vital substances between the natural, everyday world and the realm of the supernatural (cf. Ingold 1986). This provides a link to the important subject of fertility and reproduction.

In Maya society, which is patriarchal in organization, the oldest male member of the family exercises supreme authority over the household (see Section 7.1). The Lady bee's place in the household is determined on the basis of her attributed gender (see Section 7.2). Women need *Xunan kab* honey because it is a potent agent of female fertility. As this honey is so important to the women, and as the bees that produce it are located in their labour domain, why do women not tend and breed *Xunan kab* themselves? The Maya - not only the men - believe that women in certain states have so much *k'inam* (a kind of energy) that they would harm the bees and themselves if they engaged in beekeeping (see Section 7.3). It appears, however, that *k'inam* is not the only reason why it is taboo for women to keep bees. I argue that the gender attributed to *Xunan kab* and the special value attached to her honey are more important reasons for the taboo. *Xunan kab* honey plays a key role in Maya sexuality and procreation (see Sections 7.4, 7.6 and 7.7), yet its full significance and value only becomes apparent in connection with broader Maya concepts related to fertility: specifically, the symbolic value of corn and the role of the earth and the moon in cyclical human fertility (see Section 7.5). The Maya symbolically link the earth's fertilization, the agent of which is the corn kernel, to the fertilization of women by semen. Apart from insemination, men evidently do not play any role in the development of pregnancy. On an abstract level, the fertility of the land is comparable to female fertility. In Maya society, which is patriarchal and strongly oriented towards producing children as heirs, men have responsibility for the fertility of the land. Do they not also seek influence over the fertility of women? This leads to another important question: could it be that men, by controlling the production of *Xunan kab* honey, also gain some degree of control over female fertility?[1] Extramarital sexual relations are strictly taboo for Maya women. Men who indulge in sexual intercourse outside the marriage bed may be criticized, though, in practice, people often turn a blind eye. In Maya society, however, there is a curious character who poses a threat to female monogamy: the *arux*, a dwarf companion of the *milpero* and seducer of his wife. As I show in Section 7.8, the only means by which the *milpero* can avert this danger is *Xunan kab* honey. On a higher level, in the form of *Xunan kab* honey and corn, men exchange vital substances with gods and thus play a role in maintaining fertility beyond the household (see Section 7.9). *Xunan kab* - Lady bee - is needed by women

[1]South America provides an example of how men appropriate part of the female domain by means of stingless bees. In Colombia, the most powerful shamans of the Barsana use a bees' nest in a calabash - an attribute that only they can possess - to gain control over a force that normally pertains to the female domain. The wax nest-vessel, cupped in the hemispherical end of the calabash, is associated with the genitals of the creatress *Romi Kumu*, by whom it was created simultaneously with the universe. The wax vessel itself is compared to the womb, the flight- hole to the vulva, and the molten wax that flows when the vessel is burned to menstruation. *Romi Kumu* offered the ancestors wax from this vessel, yet they refused it. Instead, snakes and other animals ate of it and obtained the power to change their skin, which is associated with rejuvenation. Women are believed to be rejuvenated by menstruation - a process akin to the shedding of skin. *Romi Kumu* and the wax vessel are associated with the Pleiades and the sun, both of which are responsible for the regular alternation of dry and rainy seasons, and of day and night. Rain is associated with blood and the rainy season is conceived of as the menstrual period of the sky of *Romi Kumu*; seasonal periodicity is thus associated with the physiological periodicity of women, the alternation of dry and rainy seasons being reflected in the phases of ovulation and menstruation. A symbol of conjunction, burning wax between the two seasons induces the rainy season and is the climax of the initation rites held in that period to transform children into adults (Stephen Hugh-Jones 1982, 1979; Christine Hugh-Jones 1977).

for the agent of fertility she produces and is kept in the female labour domain, yet men look after her. Is this paradoxical or is it consistent with the general organization of Maya society?

7.1 The patriarchal organization of society

Maya society is hierarchically organized along the male line. This is apparent in, for example: a) kinship terms; b) marriage practices and c) male authority over female family-members:

a) That kinship terms reflect the importance attached to gender and age is illustrated by the various terms for siblings. Elder male siblings are called *suku'n*, 'elder brother'. Male first cousins and sons of the godparents, if older than the subject, are also called *suku'n*. Elder female siblings are called *kíik*, 'elder sister'. This term is also used for female first cousins and for daughters of the godparents, if older than the subject. In contrast, one general term - *its'in* - applies to all younger siblings, first cousins and children of godparents, whether they be male or female.[2] According to Villa Rojas, much of the original system of kinship terms has lost its meaning because of the adoption of the Spanish system. Hence, children nowadays receive two surnames: the paternal surnames of both their father and mother.[3]

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[2]The following is a summary of Maya kinship terms in their commonest senses (based on Villa Rojas 1978: 245-249):

Na' (*madre*):	mother; mother's sister (*nohoch na'* if older than mother, but *ma-x-thup* if younger than mother)
Tata (*padre*):	father; grandfather; husband of mother's sister (*nohoch-tata* if sister is older than mother, *thup-tata* if sister is younger than mother); godfather
Pal:	son or daughter; any child of female subject's sister
Ko'olel:	grandmother
Abil:	grandson or granddaughter
Suku'n:	only if older than subject: brother; son of mother's or father's brother or sister; godparent's son
Kíik:	only if older than subject: sister; brother's wife; husband's sister; godparent's daughter
Its'in:	only if younger than subject: brother or sister; any child of mother's or father's brother or sister; any child of godparent
Tio:	father's brother; brother's son; son of father's brother
Tia:	father's sister; brother's daughter; wife of father's brother; wife of (husband's) brother's son
Sob:	mother's brother; any child of male subject's sister

[3]This practice is, of course, based on civil legislation of Spanish origin. In the 1930s, Redfield and Villa Rojas noted that, in many cases, children's surnames were not officially registered: i.e. neither by church nor state. If the father recognized the child as his, the father's paternal surname would be entered in the Civil

b) When a woman marries, she effectively leaves the parental family (Section 6.2). There are no particular rules governing marriage, except that one should not marry kin closer than first cousins: i.e. those identified by terms equivalent to 'brother' or 'sister' (Maya: *its'in*, *kíik*, *suku'n* - see Note 2 of this section), 'uncle' or 'aunt' (Spanish: *tio*, *tia* - see also Note 2). According to the available literature on this theme, parents have the final say in the selection of a spouse for their son or daughter. They arrange the marriage and negotiate the dowry (Elmendorf 1976; Villa Rojas 1978; Redfield & Villa Rojas 1934). Although these practices remain virtually unaltered, there are countless opportunities for young men and women to get to know each other, and parents often respect the choice of their son or daughter. Nonetheless, the verdict of the young woman's father is decisive: if he refuses to accept the male suitor, the marriage cannot go ahead. In that case, the young man can still choose to 'capture' (elope with) the daughter with her permission, whereupon the young couple start a household without parental consent. In addition, elder brothers may be asked for their opinion about the marriage of their sisters, though neither elder sisters nor younger siblings are ever consulted about the marriage of their brothers or sisters. When the father who is the patriarch or male head of the homestead dies, the eldest son assumes primary responsibility for all widowed or unmarried women living in the homestead. If a single woman is left without direct male relatives, custom dictates that the husband of her eldest sister should support her. As women leave the parental home and men, particularly when co-residing as brothers in one homestead, take responsibility for women of other families who marry into the extended family, marriage presupposes an exchange of women between families.

c) As a rule, men have more authority than women and all kinsfolk respect the elders of the family. Even though the head of the family is the oldest male, a paternal grandmother may have similar status if her husband has passed away. The oldest male supervises the younger males of the extended family in the homestead, while the oldest female supervises the younger females, including those who have married into the family. Generally, though, a woman is subject to the authority of a man, whether it be her husband, her father or, in some cases, her eldest brother.

Register. If the couple lived together as man and wife, others also called the child by the father's paternal surname. In addition, an illegitimate child was often recognized by others, who called the child by the paternal surnames of the natural father and mother (1934: 184). Landa simply commented that children were given both the father's and the mother's paternal surname ([1566] 1992: 81, 82).

However, if husband and wife are on good terms, most decisions are made by mutual consent. In fact, married women have far more freedom than unmarried women and can participate in many aspects of public life. Although sexuality is treated with a great deal of humour (Hanks 1990), it is a serious matter. This is particularly so for women, who, it is said, rarely commit adultery. A woman cited in Elmendorf's work illustrates this point, saying that the gravest sin for a woman is to "to go with another man". Elmendorf adds that "the only woman she knew who did this was the beekeeper"! (1976: 54)[4] Adultery by men is more easily accepted (cf. Elmendorf 1976: 67, 91). When marital problems arise, women can seek the support of (female) members of their own family, parents-in-law, godparents and friends or acquaintances. If the problem is maltreatment by the husband, the matter can be brought to the attention of the male authorities of the *ejido*. As within their families in the homesteads, men have authority in the political and civil administration of the *ejido*. Nevertheless, men and women are mutually dependent due to the gender-based division of labour in Maya society. As controllers of the female social domain, women are not without power.[5] As I show in the next sub-section, the 'female' bee *Xunan kab* is given a place in this partriarchal society on the basis of her attributed gender.

7.2 Gender-based beekeeping

Why do the Maya insist that women cannot tend *Xunan kab*, while these bees are *alak'* (i.e. domesticated and therefore, like children, in need of nurturing) and are kept in the female labour domain. What do the Maya themselves have to say on the subject? Here are explanations given by two men:

"No, women cannot work with *Xunan kab*, only men can. Only men handle the bees. Because these *Xunan kab* are women, after all; they may get jealous" (Don Pedro Tec, Chan Chen Comandante).

"*Xunan kab* is of another kind... She is more delicate... She is more like... It is more as if they [the

[4]This quote implies that the beekeeper in question was a woman. Either this is an error on Elmendorf's part (she visited the same village as Redfield, who explicitly describes beekeeping as a male activity), or this women deviated from the norm in two ways: by committing adultery and by keeping bees.

[5]Once husband and wife have separated, for example, the children usually stay with their mother. She can, of course, use this as a lever on her husband, especially if the break-up has been caused by his unfaithfulness or drunkenness.

bees] stay, well... to live with a man. A man takes care of them. The other bees [the forest bees] don't, they don't like to live with men" (Don Tirbacio, Tepich).

As was shown in Section 4, forest bees are regarded as male whereas *Xunan kab* is female. In both of these quotes, *Xunan kab* is referred to as if she were the beekeeper's woman. These bees are liable to get jealous of the beekeeper's wife and fly off into the forest. For this reason, women should not touch the hives. What strikes one most in the context of sexuality is that, in the Maya view, *Xunan kab* is as dependent upon the male beekeeper for her reproduction (Section 4.3.1) as is his wife. Furthermore, according to the story told by Don Pedro (in Section 4.3.1), if the 'male' bee *E'hol* attempts to seduce her, *Xunan kab* flees to the forest to escape from his indecent proposals. In other words, the relationship between *Xunan kab* and the beekeeper is comparable to the relationship between him and his wife. Interestingly, though, women tend to give another explanation for the fact that they do not keep bees:

"If we touched the bees or the hives, it would harm us, because *Ko'olel kab* is not used to being touched by women. Only men can do that. Once my sister came and harvested the honey. She fell ill because of a *chu'uk me' iik*, an evil wind" (Doña Maria, Tepich).

Whereas some men claim that if their wives were to tend the domesticated bees, 'the other woman *Xunan kab*' would get jealous and leave, some women say that they themselves would fall ill. The explanation of these men centres on protecting their precious and dwindling stocks of bees; the female explanation has more to do with self-protection. It appears that women do not even want to keep the bees, which implies that the taboo on their doing so has been very effective. Attitudes, however, have changed in the modern era:

"Previously, women weren't allowed anywhere near the hives of *Ko'olel kab* [i.e. *Xunan kab*]. It was said that the Lord of the Bees [i.e. chief rain-god *Kun K'u*] would not be at all pleased if the ladies came too close. Now, though, when I go to harvest honey, my wife helps me. She takes a bucket of water and washes all the bees that fall into the honey" (Don Desiderio, Yaxley).

Nowadays, then, not all Maya are steadfast in the belief that women may not take care of the domesticated stingless bees; yet, despite this apparent relaxation of the taboo, it is still almost unheard of for a woman to extract honey from hives of *Xunan kab*. Although women may assist during the harvest, it is always a man who opens the hives, removes the honey, cleanses the bee-logs with *Chakah* leaves and then closes and seals them again. This rule is observed even if the hives belong to a woman, as a few do. In Tepich, for example, one woman has inherited some logs of *Xunan kab* but never harvests the honey herself; instead, her brother comes to the homestead to do the job. *Xunan kab*, just like her human 'sisters', is always under the authority of a (senior) male family-member. This is also the case when all the hives that are owned by a number of brothers are kept in the homestead of one of them (Section 6.2.1). Furthermore, honey and other products of bees are always brought into the household by a man.[6] Once in the house, however, all bee-products are exclusively processed by women. This being the accepted custom, how should we interpret Doña Teresa's story, told during preparations for a bee-ceremony in Tepich (Prologue), of her harvesting honey when she was still young and unmarried? In telling the story, she made it perfectly clear that 'pure' women (virgins) would not normally be allowed to extract the honey, but, as there was no senior male in the homestead taking care of her and her sisters, she had no option. It is important to note that, even though all the men present burst out laughing, this probably concealed some consternation (see Section 7.7, final paragraph).

Doña Teresa's childhood act was an unusual example of someone crossing the well-defined gender lines of Maya society. Although most people would normally find such taboo-breaking shocking or even threatening, when presented in the form of a story it is more likely to amuse them and provoke discussion. On the one hand, there are men and women who resolutely argue that a woman must never approach the bee-house of *Xunan kab*, for this would inevitably result in the colony being lost or the woman falling ill. On the other hand, there are those who concede that a woman may sometimes perform auxiliary tasks during the harvest. They usually cite potentially harmful *k'inam* as the reason why she must not actually harvest products from the bees. The concept of *k'inam* is discussed in the following sub-section.

7.3 *K'inam* as possible grounds for gender-based beekeeping

Why is it not customary for women to take care of *Xunan kab*, even though they tend all other domesticated animals in the homestead? The Maya often explain that the bees would flee to the forest if they were exposed to the *k'inam* of a woman. So far in this

[6]In the colonial era some women inherited hives, though most were inherited by men (Roys 1939; see also Wagner 1993: 118-119). As far as can be ascertained, women did not harvest honey from the domesticated hives in those days either. Interestingly, women are also known to have inherited *milpas* (Roys 1939), though it also seems highly unlikely that they worked such cornfields themselves.

dissertation, the concept of *k'inam* has been discussed several times. In Section 5.7, I explained it as a kind of energy possessed and radiated by all animate and some inanimate objects. Living beings that radiate *k'inam* only weakly are most likely to fall ill if they come too close to a strong source of this energy. Although *k'inam* causes illness in this way and, indeed, in one sense can be literally translated as 'pain', there is nothing negative about the energy for the one who possesses it in large quantities. People with strong *k'inam*, for example shamans, are mentally and physically robust and have the power to cure others.[7] That the concept has an aspect of gender is illustrated by the belief that men generally have stronger *k'inam* than women. This imbalance should be respected in a marriage: if the roles are reversed and the wife's *k'inam* is stronger, the husband may become ill. As a rule, the older a person is, the more *k'inam* he or she possesses. The energy does not dissipate at the moment of death: on the contrary, the *k'inam* of the deceased is so strong that only elderly men can safely handle and bury corpses.[8]

The energy known as *k'inam* also influences the system based on the hot-cold (*chokoh-sis*) continuum in people and animals, which is referred to in the literature as 'humoral ideology'.[9] Plants, animals, people, rain, plots for cultivation, kinds of food and even actions are assigned a level of hotness or coldness, without this necessarily implying a measurable temperature difference. When *k'inam* is transferred to an object or being, its humoral warmth increases. If the *k'inam* becomes too strong in a person or animal, it 'overheats' and falls ill. The hot-cold equilibrium must then be restored - i.e. the overheating must be compensated - by eating foods, or doing activities, that are categorized as cold. When a person with too much *k'inam* touches a hive of *Xunan kab*, the energy radiated by his or her hands overheats the hive:

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[7]People with weak *k'inam* cannot function as healers because, rather than being immune to the pain or malignancy in others, they tend to absorb it.

[8]The shaman Don Rocío explained to me that the dead have endured great pains in their life and their bodies have therefore accumulated very strong *k'inam*, which they retain even after life ceases.

[9]Much has been written about humoral ideology, a principle widespread among the more traditional societies of the world. It relates to the relative warmth or coldness of living things and/or their relative dryness or moistness. Often, such humoral states are imperceptible to humans and cannot be detected even by the most sensitive measuring devices. In many cases, humoral ideology is associated with indigenous use of medicines, hence the term humoral medicine (see, for example: B. Tedlock 1987; Neuenswander 1977; Logan 1973; Currier 1966. For a social explanation, see Sault 1990). Barbara Tedlock argues that, contrary to the assumptions commonly made in the literature, such hot-cold and/or dry-moist categorization is mainly furnished as an ad-hoc explanation by lay people, whereas shamans attach greater value to herbal lore. Similarly, lay people in Tepich are more inclined to explain diseases in terms of hot or cold syndromes than shamans are. The latter usually consult their *sastun*, or divining crystal, to find the spiritual source of the condition (see Section 8.5). While Maya shamans are perfectly aware of the hot-cold syndrome as it applies to plants and other objects, their use of medicines is complex and not restricted to this principle alone.

"When they [the bees] become too hot, they leave. Someone with warm hands cannot harvest the honey of *Xunan kab*. This person cannot come close to the hive, for the bees will depart" (Don Eus, *hmen* and beekeeper, Pino Suarez).

"You have to harvest the hives well before *Hanal Pixan* [*el día de los difuntos*, 'the day of the deceased'] - some fifteen days before. From then on, you may not touch the hives because they say you have *k'inam*. They say your hands are *chokoh* [hot]" (Don Crescencio, *hmen* and beekeeper, Tepich).

Another beekeeper, Don Naceverio of Yaxley, told me that if you handle hives when you have too much *k'inam*, you will find ashes inside. As people always have a certain amount of *k'inam*, the beekeepers use cool (*sis*) *Chakah* leaves to neutralize the energy which passes from their hands to the bee-log (Section 5.7). However, even *Chakah* leaves may not be able to restore the balance to the hive if it has been exposed to a very strong source of this energy. Indeed, elderly people often claim that they lost logs of bees because, not long before handling them, they had laid out or carried a corpse while preparing for a funeral. This illustrates how strong the *k'inam* of the dead is. The fact that elderly people have strong *k'inam* does not mean that they themselves fall ill, yet their touching of a corpse heats them to such a degree that they cannot touch a hive for weeks. If they were to, the balance of the hive would be so seriously disturbed that *Chakah* leaves would be useless. *Chakah* leaves are also powerless to counteract the warmth produced in the hive by the *k'inam* of a woman. Even though *Xunan kab* honey, unlike almost all other kinds, is said to be 'warm' by nature, a woman's *k'inam* can upset its humoral balance and result in overheating. In the same way that fire reduces the vegetation in the *milpa* to ashes, *k'inam* turns the inside of the hive to ashes. However, whereas the ashes of vegetation render the land fertile (Section 6.3), the ashes in the bee-log are a sure sign that the domesticated stingless bees will soon flee to the forest or die.

Although *Xunan kab* is highly vulnerable to *k'inam*, this factor cannot fully explain why women are particularly unsuited to tending stingless bees. According to the Maya consulted for the purposes of this study, another reason for the taboo on women approaching the bee-house is that *Kun K'u* himself may be present and inflict illness on the woman through his extremely powerful divine *k'inam*. How do we account for the fact that a god drives off the ladies yet not the Lady bees? And does it not seem more logical that men should be unsuitable as beekeepers, for they are generally said to have more *k'inam* than women? It is important to note here that there are periods in a woman's life when her *k'inam* increases:

"Women cannot breed *Xunan kab* because they may have a lot of *k'inam*. Sometimes they are pregnant, and this kills the bees. So women cannot work with the bees. A pregnant woman has a lot of *k'inam*, which makes the bees weak and causes them to flee" (Don Crescencio, *hmen*, Tepich).

K'inam also increases in a woman when she is menstruating. As women are thus said to pose the greatest danger to *Xunan kab* during periods of pregnancy or menstruation, could it not be female fertility itself which constitutes the perceived threat to the Lady bee?

7.4 Fertility as possible grounds for gender-based beekeeping

As we have seen, men are believed to be better suited to keeping stingless bees, even though they generally have more *k'inam* than women. We must therefore look beyond the context of *k'inam* to find a satisfactory explanation for this aspect of the gender-based division of labour in Maya society. My aim in this sub-section is to show that issues related to fertility are important factors in this restriction of women. Among the Maya, as in most societies, procreation is only approved of within the institution of marriage. Most newly-weds hope to have children as soon as possible, and the first child is expected to be born within one or two years of the marriage. A very important event, this is usually the main incentive for the young couple to start an independent household. Much of this sub-section is based on the work of Manning (1993)[10], who shows that fertility defines three important phases of a woman's life: 1) the pre-menstrual or pre-fertile phase of girls; 2) the fertile phase of adult women, in which they menstruate regularly and are capable of procreation; and 3) the menopausal, post-menstrual or post-fertile phase. The onset of periodic menstruation defines the transition from the first to the second phase; a woman who has undergone this transition is considered to be adult and ripe for marriage. The etiquette of relations with males also changes with this transition (ibid.: 145; cf. Elmendorf 1976: 65). Menstruation and pregnancy both increase a woman's *k'inam* and, as a result, she also becomes warmer in the humoral sense. During the fertile phase of her life, a woman needs to protect her humoral balance: if she becomes too cold, infertility may result. (On the other hand, as we have already seen, she may pose a threat to her husband's

[10]Manning, who researched fertility concepts and the role of midwifes in Señor, relates this material to pre-Hispanic concepts as apparent in historical sources including the Dresden Codex.

well-being if she becomes too hot.) Therefore, certain taboos regulate her life during this crucial phase in which she is able to bear children. In this phase, for example, a woman continues to participate in household ceremonies (such as those held at times of childbirth or illness), yet her participation in public ceremonies (such as those related to agriculture) is restricted to the preparation of ceremonial foodstuffs. It has been shown that the adult woman refrains from participating in public ceremonies in order to protect her fertility (Manning 1993: 197). After the menopause, there is no need for seclusion, as the woman is no longer fertile and can therefore participate directly in religious practices outside the home:

> "Old age possesses experience, therefore wisdom [...]. The possession of wisdom means rising to the possession of supernatural power. [...] The old men and women are the only ones who may perform certain duties which are harmful because they destroy fertility. Many taboos cease to exist for those who have passed the age of procreation" (Guiteras Holmes 1961: 70-71, also cited by Manning 1993: 108).

Since menstruation and pregnancy are associated with increased *k'inam* (Manning 1993: 146; Hanks 1990: 112), a woman in either state can be harmful, not only to domesticated 'female' bees that require nurturing but to other dependants, especially babies and domestic animals. For this reason, a menstruating or pregnant woman must not be present at the birth of another woman's child. Women who are no longer restricted by their fertility therefore make the most useful midwifes. In addition, they are experienced mothers and, in most cases, grandmothers. The particular knowledge and experience possessed by midwifes complements that of the shamans: they are traditional religious specialists in the field of fertility and procreation (Manning 1993).

Don Crescencio spoke of the danger posed to *Xunan kab* by women with increased *k'inam* due to pregnancy, and we have learned that the menses are equally dangerous in this respect. That post-menopausal women are unfettered by matters of fertility is illustrated by the fact that it is more common for elderly women to be near the hives when the bees are being harvested than it is for young women. I even know of one instance in which an elderly woman actually harvested honey: Doña Ignacia of Tepich, who is about 60 years old, extracted honey from hives of *Xunan kab* because her husband had been called away from the homestead. Although elderly women have more *k'inam* than younger women, in principle they are no longer a danger to the bees because their fertile phase is over. As was noted in Section 4, it is striking that *Xnuuk*, 'Old Woman' or 'Grandma', is the only female member of the class of forest bees, all but one of which produce cold honey. It seems that by virtue of her age, this bee has lost an essential aspect of her female gender - her fertility, her humorol warmth. Therefore, in contrast to the only other female bee, *Xunan kab*, *Xnuuk* produces cold honey. There is a parallel here to the fact that post-menopausal women can perform tasks that are not normally allotted to women who still are capable of procreation. Similarly, it is not a problem for Xnuuk to live among the male bees in the untamed forest.

In conclusion, *k'inam* does not seem to be the driving factor in the taboo on women breeding bees: the fact that women pose a particular danger to the bees when menstruating or pregnant indicates that fertility-related concepts play the leading role here. It is true that *k'inam* increases during menstruation and pregnancy, but there are other instances in which (human) beings with strong *k'inam* come very close to *Xunan kab* without any apparent harm to the bees. In the following sub-section, therefore, the focus shifts to fertility.

7.5 Maya fertility concepts: corn, the earth and the moon

In this sub-section, I argue that the reason why women do not breed the domesticated stingless bees has to do with the female gender attributed to *Xunan kab*, the place the bees occupy in Maya society partly as a result of that gender, and to more general Maya concepts related to fertility. As we have seen, fertility needs protecting and therefore circumscribes the role a woman can play in ceremonial practice. However, as I aim to show here, the issue of fertility is not restricted to the female domain of human reproduction: it is intimately intertwined with other aspects of day-to-day life and is also linked to fundamental cosmological notions. At a later stage (in Sections 7.6 and 7.7), I attempt to show that men directly influence female fertility by means of the *Xunan kab* honey they produce, and that the value of such honey lies in its being a key element of general Maya fertility concepts. For this reason, it is first necessary to examine in brief three other key elements that, for the Maya, are associated with fertility: corn, the earth and the moon.

The Yucatecan Maya are not the only ethnic group who view fertility as linked to cosmological phenomena. Although an extensive overview of similar concepts in other societies is beyond the scope of this dissertation, a little relevant background will help to put the Yucatecan Maya view into perspective. The majority of the concepts described below are Mayan in the broader sense (i.e. they have been noted among groups other than the Yucatecan Maya). In many languages, the sun and the moon are denoted by the same word or root: for example, the moon may be referred to as the 'cold sun'. It may be inferred from such use of language that the speakers recognize both the sun and the moon as producers of light, but only the sun as a producer of heat. As diurnal and nocturnal celestial bodies, the sun and the moon are often regarded as a complementary pair. Generally speaking, in the more traditional societies of Latin America, these heavenly bodies are of unstable sex (Lévi-Strauss 1976: 211-221). In Mayan communities, the sun is usually regarded as male, 'Our Father' and Christ; the moon as female, 'Our Mother' and the Virgin Mary (Vogt 1976: 16; Gossen 1974: 21; Guiteras Holmes 1961: 152). As Mother and Father, furthermore, the moon and the sun are intimately associated with the creation of beings on earth. For example, the Chamula Maya believe that Father Sun gave humankind the very substance of his body: corn, which is the staple food of the Chamula and other Mayan groups. Mother Moon, in contrast, provided the milk of her breasts: the potato, which is a far less important foodstuff. Although the sun was born of the moon and was initially outshone by her, he soon rose again in greater splendour to surpass even his creatress. These concepts are inextricably intertwined with the social and ceremonial organization of the Chamula. Gossen states that the moon provided the 'breakfast of the sun' and that:

> "her relationship to her son is like that of the female principle to the male principle in Chamula life: submission within a larger sphere of economic interdependence" (Gossen 1974: 40).

Characteristic of the moon is its waxing and waning. Among Mayan groups in general, the moon is associated with the fertility of women, animals and the land; its phases often being related to their cycles of fertility: especially the menstrual cycle of women. The Tzotzil, in particular, regard the 'dark phase' of the moon as the absence of the 'Holy Mother' and associate it with danger, the infertility of plants, and death. When the moon waxes to maturity, fertility on earth increases to a maximum and this is the time to plant various crops. Waning, the moon is shrouded in darkness again and this marks the time for clearing and burning fields (Guiteras Holmes 1961: 35-37). To the Chortí, the waxing and waning of the female moon and the daily and annual cycles of the male sun evoke the stages of human life, from childhood to old age. The new and waxing moon corresponds to the newborn and childhood; the full moon to adulthood.

Once past her prime, however, the moon wanes, as people do when they grow old and wither. When the rainy season draws to a close, heralding the time for harvesting, the old moon dries up and shrivels. The sun progresses through his own life cycles every day and every year: noon and the longer days of the year correspond to his adulthood (Girard 1969: 264-266).

Among Mayan groups, the earth and women are closely associated because of their capacity for procreation. The umbilical cord symbolizes the relationship of nurture, the newborn's dependence upon its mother. After a birth, the umbilical cord is often buried in the earth (Guiteras Holmes 1961: 203,217). The K'iché Maya woman Rigoberta Menchú depicts woman as mother of her children and the earth as mother of all children (Burgos-Debrey 1993: 104). On one occasion she made the following comment:

"We believe that we belong to Mother Earth and that the earth is sacred. [...] the earth is our mother because we eat maize that comes from the earth, and Mother Earth accompanies our every step. She is our shadow, our *nawaal*, our personality, our double, our twin soul that will always belong to nature. [...] There is a reason for burying the umbilical cord. It is as if my cord were my sole link with the energy and life force of Mother Earth" (Menchú 1998: 75).

Corn, grown in the earth and the staple food of the Mayan communities, is the raw material of which the gods made people (Popol Vuh: Tedlock 1985: 163). Not surprisingly, therefore, a strong link is drawn between corn and concepts of fertility. Since the Creator Sun cut the primordial ear of corn from his own groin, the Chamula metaphorically link corn to heat; and as corn-gruel and semen therefore originate in the same part of the anatomy, men use the same word for both (Gossen 1974: 229). Semen, conceived of as hot, is the male contribution to conception (Guiteras Holmes 1961: 102) and among Mayan groups in Chiapas and Guatemala it is also associated with corn-gruel (Freidel *et al.*: 1993: 181). In addition, Rigoberta Menchú speaks of the birth of children as if they were grown from corn (Burgos-Debrey 1993: 33). After childbirth, the Tzotzil Maya sprinkle blood from the umbilical cord over corn stalks that have been planted in a special field. As the corn grows in this field, it symbolizes the developing life of the child (Guiteras Holmes 1960).

To sum up: the male sun produces heat on earth and the female moon, being closely associated with water, is responsible for moistening the earth. Warmth and moisture are indispensable for fertility: without these two elements on earth, corn could not grow and the people would not have their most basic source of energy. So the earth produces energy and this energy sustains life. fluid in the form of gruel and solid in the form of dough, corn itself is a life-sustaining substance - the very stuff of life- from which people were created at the dawn of time. With these basic elements of Mayan thinking on fertility, the particular Yucatecan Maya view of fertility and procreation can be put into perspective.

7.5.1 Corn

Fertility is pivotal to cycles of human reproduction and agriculture. As corn is the staple food of the Maya, it is most appropriate that their gods made the first people of corn in the Popol Vuh creation story (Tedlock 1985: 163). In latter-day creation stories told by people in Tepich, Almighty God accidentally created different races of people while sculpting them from corn-dough and baking them over the fire. He inadvertently burned the first sculpture and thus created black people. On His second attempt, He was over-cautious and took the sculpture from the fire too soon, creating white people. The third time, He had enough experience to get it just right and created the Maya. In another version of this story, told by Don Beto, the people are moulded from earth (*luum*), though still with stomachs of corn. Corn itself is considered to be alive: during one family lunch, I noted that a woman hired to help with domestic chores reprimanded a child for trying to heat up a tortilla that had been toasted half an hour earlier. She explained to me that it would be cruel to put the tortilla over the fire while the original toasting was still fresh in its memory! If the tortilla were to be left for the evening meal, however, it would forget.

There is also a more specific link between corn and people, for the Yucatecan Maya compare children to corn kernels (Manning 1993: 177; Burns 1983: 8). In the Maya Zone of Quintana Roo, the beginning of the lives of humans, plants and animals is often referred to as *la semilla* ('the seed', *hi'nah*; Cordemex Maya dictionary). Not only is corn alive, but it imparts life to people. A warm foodstuff, it depends for its growth upon rainwater (which is governed by the moon, as previously described; and Section 7.5.3) and heat (which is provided by the sun). Men sow corn and tend the growing plants (Section 6.3). By thus producing corn, men participate in the overall process of maintaining human fertility. Although women customarily do not participate in the growing of corn, they join the men in harvesting it when it is ripe. Once the harvested corn has passed from the male domain which is the field to the female domain which is the kitchen, it is transformed into food by women. Burns (1983: 9) noted that, in this transition, the name of corn changes from *ix'im* to *santo gracia* (divine grace).

While such concepts are universal among Mayan groups, the Yucatecan Maya make a special distinction as to the humoral state of corn. Whereas all Mayan groups regard corn as a hot (*chokoh*) foodstuff, only the Yucatecans consider corn-gruel to be cold (*sis*). The only difference between gruel and other edible forms of corn is water, which must therefore be the factor of coldness. In every ceremony I have witnessed, corn is offered both in cold fluid (i.e. *saka'*) and hot solid form (i.e. *xnohwahob* or other breadstuffs), the latter often sprinkled with 'warm' mead (*balche'*). In ceremonial practice, corn in its cold fluid form is associated with women whereas the warm *balche'* is associated with men. For example, midwifes need *saka'* every year to perform the ceremony that enables them to continue practising their profession for another year, while shamans use *balche'* for the same purpose (see Section 8.5).

To summarize: corn, the basic foodstuff of the Maya, is not only 'hot' and 'alive' but is regarded as a life-giving and -sustaining substance. The first people were created from corn; their very flesh was sculpted of it. In solid or liquid form, corn is an indispensable offering in religious ceremonies. By offering it, the Maya exchange the most fundamental stuff of life with their gods.

7.5.2 The earth

Doña Pilar and her mother-in-law indicated to me that they draw an homologous link between woman and the earth with respect to life-giving acts by man. In their view, when a man 'plants his seed' in a woman to produce children, this is like his sowing the *milpa* to produce corn and beans. The homology consists in both woman and earth being impregnated by man.[11] Perhaps Redfield and Villa Rojas had something similar in mind when they wrote the following:

"It is generally understood that in the sexual act the man plants in the woman the seed of the future offspring, but of the development of the embryo next to nothing is known" (1934: 209).

Doña Pilar lived in Tabasco State for several years, teaching at a primary school. There she noticed that it was customary for a married man to wear a black scarf at certain times. She was told that this was supposed to enhance the intelligence of the child

[11]At this point in the text it would have been appropriate to include translated extracts of the statements made by Doña Pilar and her mother-in-law. Unfortunately, however, the interview with them was neither recorded on tape nor transcribed verbatim.

developing in his wife's womb. Unlike their counterparts in Tabasco State, Yucatecan men have no specific way of influencing foetal development after impregnating their wives, though they do of course cultivate 'warm' foodstuffs such as corn and *Xunan kab* honey. Thus they have a dual role in procreation: sowing the earth with the seeds of corn, their women with the seeds of children. In this and other ways, a conceptual link between corn and children is manifest. After his child is born, the husband burns the placenta (*k'anche'*, literally 'its seat'), which was coupled with the baby and returns it to the earth. If the baby is a girl, the placenta is burned and buried at the three-stone fireplace. If the baby is a boy, the placenta is burned and buried outside in the homestead, and sometimes a few corn kernels are sown on the spot. The ashes must be buried deep in the ground, otherwise the child will grow up to be a cowardly, anxious weakling (Manning 1993: 130, 150). As women - particularly in their capacity to bear children - are compared to the earth, I believe it would be fully in keeping with Maya concepts to equate the fertility process of a woman to that of the land in a *milpa*. Taking the various values ascribed to corn and honey (see also Section 8), the following equations seem reasonable:

CORNFIELD - WOMAN

field lying fallow - pre-menstrual phase
↓
slash-and-burn - menstruation
↓
sowing with corn kernels - impregnating with semen
↓
offering honey - administering honey
↓
harvesting - childbirth
↓
planting for 2nd & 3rd year - additional fertile cycles of adult woman
↓
field lying fallow - menopause

The pattern that emerges indicates a close similarity between the successive plantings of a cornfield in its 2- or 3-year productive phase, before it is left to lie fallow again, (Section 6.3) and the reproductive cycles of a woman in her fertile phase between childhood and menopause. After a period of productivity, both cornfield and woman become barren. The entire process is repeated when a new *milpa* is slashed and burned out of the forest or when a woman of the next generation enters the fertile phase of her life.

7.5.3 The moon and its destruction

In Tepich, on the night of May 24th 1994, the moon was suddenly engulfed in darkness. As people became aware of the lunar eclipse, guns were fired and pots and pans beaten together. Having never seen an eclipse before, I was keener to observe the heavenly spectacle than the reaction of the villagers. However, the grandmother of the family I was staying with strongly expressed her disapproval of my attitude. I was taken aback and remained puzzled until I had learnt more about the moon.

Why did the villagers react to the eclipse by trying to create a cacophony?[12] Why is a lunar eclipse cause for concern? My aim in this sub-section is to answer these questions by referring to the moon's influence on life and fertility on earth. As we have seen, among Mayan groups in general, the earth is linked to motherhood and fertility, while the moon plays a special role in concepts of fertility. Manning showed that women in their capacity as midwifes are related to the moon (1993: 177-179). In addition, the Maya believe that there is a connection between the female cycle of menstruation and the lunar cycle (ibid.: 145). Women are assumed to be fertile at full moon and in their menses at the new moon. Furthermore, the moon is thought to be in the same phase at the conception and the delivery of a child (ibid.: 128). The people of Tepich also have these ideas. According to Doña Pilar, the female menstrual cycle and pregnancy are governed by the lunar cycle: the former is directly related to the phases of the moon, while pregnancy develops over ten lunar cycles from the moment of conception to the moment of delivery. Children conceived at full moon are supposed to have strong *k'inam* and no physical or mental weaknesses. Manning's informants (1993: 128) told her that most of the children born on the day before and the day after full moon (known as *kum u*) are boys, while most of the children born at new moon are likely to

[12]The idea that an eclipse is perilous and the evil must be averted by making as much noise as possible is widespread, not only in Latin America but in many parts of the world (Lévi-Strauss 1992: 298-299; Closs 1989; Guiteras Holmes 1961: 152, 194).

be girls. In addition, the link between the lunar and the menstrual cycles is reflected in the utterance '*ú*' which denotes 'moon' and 'menstruation' (Cordemex Maya dictionary). In Tepich, the moon is also called *Mama Luna* or *Ko'olel Luna*.[13] As with the stingless bees, *ko'olel* indicates a female characteristic ('woman', 'mistress': Cordemex Maya dictionary). My interpreter Jacinta Pool May translated *ko'olel* into Spanish as *abuela* ('grandmother'; cf. Villa Rojas 1978: 246), whereas Doña Pilar translated it as *tia abuela* (literally: 'aunt-grandmother', i.e. great aunt). By referring to the moon as 'Grandmother', the Maya give expression to a broader notion that grandmothers (in the role of midwifes) and the moon both influence human fertility and procreation on earth.

The moon's influence on fertility is not restricted to humans: it also governs the development of bee and wasp larvae (Section 5.5.4.1) and agricultural processes. Corn cobs should be bent down on the stalks at full moon to promote drying:

"The moon is also important during the rainy season. When the moon is full, I mean when it has come to maturity, it gives force. Then you bend down the corn cobs quickly, for the full moon will dry them rapidly. But if you bend down the corn cobs when the moon is small, they will stay [moist and] soft and become infested with insects" (Don Pepe, Kimbila).

The fact that corn cobs are bent down at full moon illustrates that this lunar phase produces dryness on earth. In this context, 'full moon' refers not only to the actual day when the full face of the moon is visible, but to the preceding two to four days as well. During this period, the crops grow with the force of the mature moon. It is not advisable to sow corn after the day on which the moon has shown its full face, because the corn plants will take very long to produce ripe cobs or the amount they produce will be far less then when planted just before full moon.[14] In general terms, the moon

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[13]Manning (1993) confirms that the moon may be linked to woman in her role as mother and grandmother. Although it is tempting to assume that the lunar phases are related to phases of human life (as is documented, for example, among the Chortí Maya: Girard 1969), there is no direct evidence that the Yucatecan Maya have any such concept. Manning remarks further that the parallel between the lunar cycle (approx. 29 days) and the familie fertility cycle (approx. 28 days) has led other authors to postulate that the waxing moon may represent the ovulating phase and the waning moon the menstruating phase in the female cycle (ibid.: 28; and Note 1 of this section).

[14]Tomatoes, coconut palms, bananas and other fruit and vegetables should also be planted before full moon. Crops that are not for immediate consumption, such as corn or pineapples, should be harvested at full moon so that they can be conserved for as long as possible. For edible roots and tubers such as potatoes, there are contradictory ideas: some people say that such plants should be sown at the same lunar phase as other vegetables; others argue that the time of planting is not very important. As is the case with insect larvae and human children, plants which are grown for their fruit or are eaten as vegetables are thought to be more

governs fertility on earth. An eclipse disturbs this process because the moon is believed to be under attack:

"*Xulab* [an ant species] reaches the moon and attacks it. *Xulab* starts eating it up. So the people grab pots and rifles or anything else suitable and start making lots of noise until *Xulab* releases the moon, otherwise it would be killed. When there is a solar eclipse, it is *Xulab* again [...]. An eclipse is a very dangerous time because the world might end if we were unable to rescue the moon or the sun. There was an eclipse in July 1993. It grew dark even though the sky was clear. Smoke came from the sky, [which is] very dangerous because it can turn you blind. Anyway, you have to make noise so that *Xulab* will release the moon. An eclipse can finish off the whole world. The animals come into the village - the peccary, deer and big cats - and demand to know why we people are killing them. They come to the villages to eat the people. It is their revenge. Also the plates, cups, pans and chairs ... everything starts moving about, even the wardrobes and tables. Everything we use comes to life ... until *Xulab* releases the moon" (Don Pablo, Tusik).

It is also said that the household articles which come to life turn against their owners and try to kill them. Instead of *Xulab* (Devil), some people say that *Chak Wayah Kab* (Beehive-Destroying Red Ant) eats the moon.[15] The Maya recognize that both are carnivorous ant species. It is interesting that ants are blamed for this destruction, for they are regarded as consumers of living things in other contexts as well. Leaf-cutting ants regularly invade cornfields and destroy young corn plants:

"The ant *Say* or *Mulsay* [a leaf-cutting species] lives in red earth. These are the ants that cut leaves. They are evil because they invade the *milpa* and cut off the leaves of the corn plants before they are fully developed. They take the leaves underground and slow down the growth of the corn. We kill them with poison" (Don Pablo, Tusik).

Say are very active in cornfields during the rainy season. The carnivorous ant species (*Xulab* and *Chak Wayah Kab*) are also enemies of bees, for they can destroy entire

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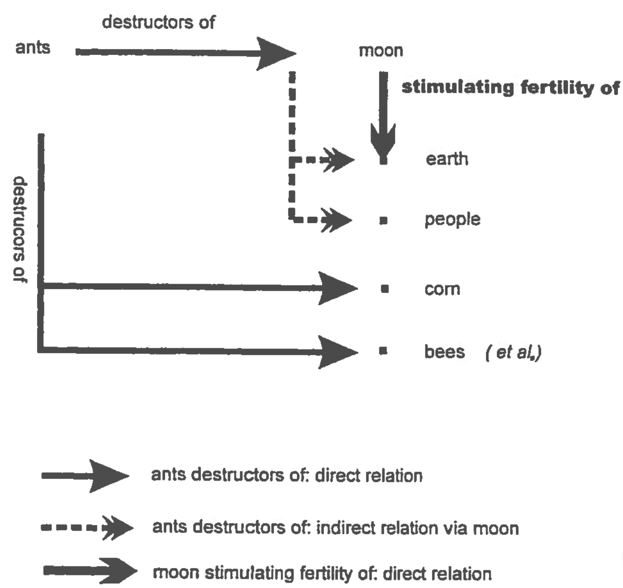
vigorous when their 'conception' (planting) and/or 'delivery' (harvesting) occur at full moon.

[15]Ants play a similar role in colonial codices. In the Codex Pérez (based on material collected by Don Juan Pio Pérez, who lived from 1798 to 1859), in the foretelling of auspicious or ill-omened days, ants are associated with misfortunes and plagues which strike humans and bees (Craine & Reindorp 1979: 71, 108, 110, 113, 122, 170). According to the predictions cited in Landa's 'Relaciones de Yucatan' ([1566] 1992), in the year known as *Cauac*, ants will eat people's food and some will starve. In the *Chilam Balam de Chumayel*, the ants *Xulab* and *Chak Wayah Kab* are associated with misery and vexation (Roys 1967: 152, 153). Moreover, the sting of *Xulab* causes a lunar eclipse (original work: Sanchez de Anguilar 1639, cited by Roys 1967: note 152). In 20th-century ethnographic fieldwork, ants have been associated with foreigners (Redfield & Villa Rojas 1934: 13), with eclipses (ibid.: 206), with illness - for they consume people's food - (ibid.: 244) and with the devil and snakes (Villa Rojas 1978: 229; Thompson 1927-32: 68-69, 109, 115; and Section 4.3]. Ants also hide corn from other animal species and people (ibid.: 136) or steal corn tortillas from people (ibid.: 163-164). In colonial codices and 20th-century ethnographic fieldwork, ants have been associated with bad fortune for humans and bees.

colonies (Section 5.6.1). Although the destruction of the earth as a result of lunar eclipses can be prevented, they are said to cause disease and death among the womenfolk. In contrast, solar eclipses, which are also conceived of as the work of attacking ants and as a threat to the world, cause disease and death and disease among men (cf. Guiteras Holmes 1961: 152, 194).

Diagram 7.1 summarizes the elements which play roles in stimulating or destroying fertility:

Diagram 7.1: The influence of ants and the moon on fertility.



The moon stimulates the fertility of corn plants, people, bees and, more generally, life on earth. Corn and, as explained later, honey are life-sustaining substances. Ants destroy fertility in several ways. During an eclipse, they devour the moon: i.e. the governor of all fertility cycles on earth and therefore the element responsible for the maintenance of fertility. Were the moon to die, then the fertility of people and other species on earth could no longer be guaranteed. It is also believed that if the ants were allowed to devour the entire moon, the world would come to an end as a direct result. In addition, leaf-cutting ants devour corn plants growing in the field. Thus they destroy the fundamental life-sustaining substance and one of the two important products (corn and honey) which people use to pay their dues to the gods. Furthermore, carnivorous ant species devour bees (the producers of honey, a life-sustaining fluid) and even consume the honey itself.

To summarize: some cosmological notions are gender-based. The moon's and woman's well-being are directly related, as are the sun's and men's well-being. The moon is linked to concepts of female fertility, though the sun's role in this respect is unclear. Fertility and reproduction require both female and male participation. Women must be warm (in the humoral sense) in order to be able to conceive. Perhaps the sun is responsible for producing such a warm condition in females. I return to this issue in the next sub-section and further in Section 8.3.2.

7.5.4 Humoral concepts, gender and astronomical phenomena

The links between women and the earth or moon and between men and the sun seem to be confirmed by humoral concepts and the gender-based division of labour:

"When a man is heathily engaged in work, he is said to be *čokow* 'hot', that is forceful, potent, and invigorated by the heat of the sun. The sun hardens a man's body as he works, making him *maásisóoh* 'hard'. A woman when healthy is relatively cooler, and indeed, the description *čokow* usually implies sexual promiscuity when applied to females [...]. When pregnant or menstruating, women are relatively 'hotter' and are said to be *k'ohá'an* 'sick'. Women work in the shade and are typified as *suave* 'soft', *'o'olkil* 'baby soft, *kukutil* 'attractively chubby', and *k'aab (il)* 'juicy'. Elderly women are said to *tiíhil* 'to dry', or to be *tikin* 'dry'. When working in the orchards or extracting *sahkab'* 'calcified earth' from pits, men climb up trees and go underground, just as they walk *yàanal k'aáš*, 'under forest' when hunting or going to their *milpa*. Women apparently never climb trees, rarely enter *sahkab'* pits, and do not walk in the forest unaccompanied. These various associations can be summarized by saying that woman are linked to the earth's surface, which is, ideally, cool, moist, fecund, the ground in which plants grow. This might also explain the well-known fact that Maya women are much more prone to walk barefoot than men, and that the k''oob'en 'kitchen', a basically female space, is almost never given a concrete floor or a tile floor even in modernizing households. Maya women stay on the ground" (Hanks 1990: 111-112).[16]

Hanks' description relates men and women by virtue of their labour domain to the hot-cold and dry-moist continua. In Tepich, the idea that the elderly are dryer than

[16]Gossen makes a similar statement about the Chamula: "Men in this patrifocal society always sit on tiny chairs, which raise them above the cold, feminine ground and complement their masculine heat. Women, in contrast, customarily sit on the ground and always go barefooted, which symbolically gives them direct contact with the cold" (1974: 37).

younger people is not restricted to women but applies to men as well. As a body ages, the blood is thought to run dry:

"When a person dies, he is short of blood and breath. If your blood is drying up and your breathing is becoming shallow as well, you will die soon. First the blood starts to dry, then your flesh dries too, and finally there is no more breath. You cannot breath any longer and you dry out. It is like a tree. When a tree is healthy it is robust, but with the passage of time, as a result of an illness or some other cause, the tree falls ill too. First it loses all its leaves, then the branches dry out, and finally the disease reaches the trunk and the whole tree dies. It is the same process as in people" (Don Medardo, *hmen*, Tepich).

The people of Tepich commonly refer to the sun as *Yum K'in* or *Ah K'in* (Lord Sun), while they call the moon *Mama Luna* or *Ko'olel Luna* (Grandmother Moon) to emphasize her female characteristics. *Hmenob* (shamans) may also be referred to as *Ah K'in*. The sun produces warmth of its own accord, whereas the moon and the earth cannot. Without warmth, women cannot get pregnant and the earth cannot produce corn. Moisture is also of fundamental importance to fertility and is governed by the moon: women and the earth are most moist when the moon is in its dark phase; they are driest when the moon is full. The male and female components which are warmth and moisture respectively (possibly combining to produce vapour) need to be present in the right proportions for a fertile condition. Dryness (as in old people and trees) is symptomatic of infertility and approaching death. At and around full moon, warmth and moisture seem to be in proportions which are ideal for 'maleness' to dominate (i.e. *k'inam* and dryness are maximum), which explains why most children born in this lunar phase are male. Conversely, 'femaleness' seems to dominate during the dark lunar phase, when moisture increases and female children are more likely to be born. In other words, men and women are related to astronomical phenomena - the sun and the earth or moon respectively - not only in an abstract sense but very concretely: their relative warmth and moisture, which are directly associated with gender, derive from their link with the sun and the moon.

7.6 *Xunan kab* honey as an agent of female fertility

There are two probable reasons why Maya women do not breed the stingless bee species *Xunan kab*: either to protect their own fertility or to protect the bees from the increased *k'inam* which occurs in fertile females and can easily disturb the humoral balance of the hive. Women are like the earth in that they depend upon the moon for their fertility. Women produce children, the earth produces corn; in this sense, children and corn are comparable. Similarly, *Xunan kab* depend upon the moon for the fertility to produce honey. Do these domesticated bees also have some influence on human fertility? The answer is that they clearly do, as I demonstrate in this sub-section.

When asked why they breed *Xunan kab*, many traditional beekeepers reply that women need the honey of these stingless bees to get pregnant:

"I believe *Xunan kab* honey is very holy. That's why it's also very fine honey. The honey is especially useful for women who are about to give birth. They take the honey with a herb called *Pixoi* [*Guazuma ulmifolia*]. You have to grind the herb, add it to the honey and heat the mixture for a while. Then the baby will be born within half an hour. That's why this honey is very holy" (Don Pascual, Señor).

Although this beekeeper only mentions childbirth, *Xunan kab* honey is said to have beneficial effects in all phases of the human reproductive cycle. It is administered to women as an aid to conception and problem-free childbirth, and is given to both mother and child after delivery as an aid to recovery. *Xunan kab* honey may be taken by healthy women to prime the body for conception, though it is particularly indicated when their are problems relating to fertility. For example, if a woman consumes too much food and drink of the 'cold' category, she herself becomes too cold to conceive. The humoral balance of her body can be restored by taking 'warm' *Xunan kab* honey. Regular menstruation is the most obvious sign of female fertility. If a woman does not menstruate regularly during the fertile phase of her life and fails to get pregnant, the cycle must be re-activated. Some women just take water with *Xunan kab* honey for this purpose, while others mix the honey with the herb *Chaw Che'* (*Croton glabellus*: Sosa *et al.* 1985). Since both the honey and this herb are humorally warm, the mixture helps the female body to return to a healthy equilibrium. The same ingredients are used to cure a condition known as *ciro*, which is characterized by pain in the uterus quite unlike regular menstrual pain. Another condition, called *pasmo*, results in sterility:

"When a woman loses blood after giving birth, this is not due to menstruation. In some women, the bleeding continues for eight to ten days; in others, it may take up to thirty days to stop. If it does not stop, they say *'sis u kuch'* [your burden is cold]. For example, if you eat pork fat, you spoil your *perferio* [post-partum haemorrhage] You don't get rid of it all, and you develop an illness called *pasmo*: you cannot get pregnant or deliver again. You have to cure it with warm things, with honey from *Ko'olel kab* [i.e. *Xunan kab*] because this has the power to heat. To cure *pasmo*, you bury some leaves of *Ki* [*Agave* sp.: Sosa *et al.* 1985] under glowing cinders. Later, you make some juice from the leaves and mix it with *Ko'olel kab* honey. It works this way because it is *chokoh*, it has curative powers" (Doña Maria, midwife, Tepich).

Maya midwifes say that warm honey mixed with *Chaw Che'* is a very potent fertility drug: if a healthy woman takes the mixture twice, she is certain to get pregnant. Two Tepich women even assured me that if a woman were just to take *Xunan kab* honey twice, without *Chaw Che'*, she would have her baby within nine months. When I told them that women living on the Nicoya peninsula of Costa Rica take this honey every day for 40 days after childbirth, they burst out laughing and warned me that one should be careful because the honey is very hot [*chokoh*]: in other words, you can over-stimulate fertility! A woman can also take warm honey during pregnancy to ensure a good supply of mother's milk once the baby has been born.

Xunan kab honey is even more important in childbirth, which can be difficult and dangerous for mother and baby. If complications are foreseen, the birth will usually take place in hospital. If everything appears normal, however, the midwife and the husband will assist during delivery. The husband:

"must stand at the head of the hammock while the delivery takes place. With his hands over the sides, he must clasp them under his wife's head at the nape of her neck so as to form a brace against which she can push during labour. If the birth is delayed, the husband passes under the hammock nine times and raises his wife each time with his back. As [...] the nurse with the Carnegie Expedition observed, the father always remains in the room until the baby is born, 'because he was the one who gave the woman the child' " (Elmendorf 1976; cf. Redfield & Villa Rojas 1934: 362).

Most Maya midwifes take government-funded courses in the city.[17] In addition to the techniques learnt on such courses, many use traditional lore. Midwifes generally charge a small fee and, according to one of them, Doña Tina, expect to be given a bottle of Xtabentun honey-liquor[18] for their services. Babies are often born at night, when evil winds or spirits roam freely, and the honey liquor is believed to protect the midwife from their influence. She also uses the liquor to wash her hands, and may take a few sips to chase away sleep while waiting for the child to be born. Nowadays, though,

[17]For more detailed descriptions of midwifes' tasks, see: Manning 1993; Elmendorf 1976; Redfield & Villa Rojas 1934.

[18]This alcoholic drink (named after the flowering plant *Xtabentun*, which supplies copious nectar) is produced at a processing plant in Valladolid. Before apiculture became widespread on the Yucatan peninsula, the liquor was made with the honey of stingless bees. Nowadays, though, *A. mellifera* honey is used.

most people seem to have forgotten about this custom, and Doña Tina usually delivers a child without a fortifying drink.

The husband has to provide the *Xunan kab* honey that is needed at the time of birth. If he has none himself, he may obtain some from a brother or other relative who keeps bees. If no one in his family has any of the honey, he must try to find some in a forest nest, though wild *Xunan kab* honey has become very scarce in recent years. For this reason, the honey is hardly ever on sale. If someone needs it urgently, though, a beekeeper will generally charge very little or even give it away.[19] However, as *Xunan kab* honey is such a rare and precious commodity nowadays and there is no real substitute for it, except perhaps the 'borrowed honey' of the unproductive forest bee *P'uup'* (Section 4.3.3), most women have their babies without taking honey. When the 'warm' honey is available, the midwife can also use it to predict how the delivery will be:

"*Xunan kab* honey is hot [...] we take a small quantity of it and burn it under the hammock with a little rosemary [...]. The smoke shows how the delivery will go. If it spreads slowly under the hammock, the baby will be born quickly; but if the smoke rises, the mother will suffer a lot ... perhaps the baby will even die. For me, anyway, it is a sign of what will happen. Immediately after the baby is born, I take a herb called *ak'a xuul* [unidentified]. I grind it up and mix it with *Xunan kab* honey to put in the navel when it is bleeding. The woman in labour drinks a calabash of honey tea three times. If the delivery is difficult, I burn honey with rosemary twice. Then I take the calabash of honey tea and rub it over the woman's belly nine times. This eases the birth. There isn't always *Xunan kab* honey nowadays, so sometimes I have to use *Americano kab* honey, but it just isn't the same: *Xunan kab* honey is much better" (Doña Felipe, midwife, Señor).

Another midwife claims that if the smoke spreads slowly, the child will grow fast and that if it rises quickly, the child will grow slowly. There is general consensus with Doña Felipe that the honey of *Americano kab* is not appropriate in such situations. In contrast to most other midwifes, however, Doña Felipe says she sometimes uses a kind of honey classified as cold as a substitute for warm *Xunan kab* honey. Most people

[19]There is no taboo on the selling of *Xunan kab* honey. In Yucatan State, the 1994 local market price was 20 to 30 pesos (6.60 to 10.00 US dollars) a litre. People in Tepich charge only about 4 to 8 pesos for the honey because it is usually bought and sold only between relatives and friends, whom it would be wrong to charge too much. One man at Carrillo Puerto market offers *Xunan kab* honey at 8 pesos the half-litre, though for most of the year he has none in stock because he only has one supplier. Once, a beekeeper with one of the largest meliponaries on the Flor de Mayo ranch wanted to sell part of his honey harvest and took it to the Xtabentun liquor plant in Valladolid, where they paid him the same price as for *A. mellifera* honey. Rather than spending a lot of time and energy trying to get a higher price somewhere else, he accepted the deal, even though it is generally agreed that honey of *Xunan kab* is far more valuable than that of *A. mellifera*.

would rather use no honey at all if the warm variety is not available, for cold foods lead to sterility and may make for a difficult delivery. Female fertility is thus reduced by cold honeys: i.e. that of *Americano kab* and those of all the forest bees except *P'uup'*, who is believed to borrow honey from *Xunan kab* (Section 4.3.3). The woman in labour may drink *Xunan kab* honey in hot water to speed up the delivery. If the birth does not proceed smoothly, the honey is taken again, with or without the herb *Pixoi* (*Guazuma ulmifolia*):

"If the baby takes a long time to be born, this honey is very good. Sometimes the contractions can go on for two to three days. So you use this honey and the baby will be born very soon afterwards, because this honey is very hot" (Doña Felipe, midwife, Señor).

Another method of easing a difficult delivery is to massage the woman in labour with warm water and *Xunan kab* honey. Finally, the mother can take *Xunan kab* honey - normally for one week after childbirth or until the honey is finished - to ensure a speedy recovery.

Honey is also used for the new-born baby. *Ts'o'ok kab* (finishing honey) refers to a traditional method of applying honey to the umbilical cord until it dries and detaches, though, nowadays, other methods are used which do not require honey. The baby may be fed with *Xunan kab* honey in the interval between its birth and the mother's first lactation. Some Maya claim that they can influence the child's future features and 'sex-appeal', once again by means of the honey produced by the favourite stingless bees:

"A few days before the woman is to give birth, the husband searches for *Xunan kab* honey in the forest, or he gets it from another beekeeper who keeps *Xunan kab*. [...] The woman can take the honey every day for as long as she is still pregnant, so that the baby will be born with green eyes and a light skin. *Está comprobado*! [It's proven!]" (Don Pepe Yaxley).

Green eyes and a light skin are regarded as desirable features, for they are characteristic of *Xunan kab* herself. Some women even claim that eating one of these bees has the same effect! Others put a few drops of *Xunan kab* honey in the baby's eyes. This apparently guarantees that the boy or girl, when it reaches the age of fifteen, will be irresistible to the opposite sex and will be able to chose from a long line of potential suitors. One story, known to many people, tells of how a woman ordered her lover to murder her husband in the forest. As proof of death, she demanded that the lover bring her the eyes of her husband. The two men were friends, however, so the lover decided that he would only pluck out the husband's eyes without killing him, and then leave him in the forest. As a ploy, he invited the husband to go searching for wild honey in the forest with him and then put his plan into action. However, it completely backfired because the chief of the rain gods, *Kun K'u*, gave the husband the eyes of *Xunan kab*. His wife abandoned her lover and returned to her husband. Apparently, the eyes or honey of *Xunan kab* make a person far more attractive to the opposite sex.

Until about thirty years ago, honey was part of the dowry or bride-price paid by a boy's parents to his future parents-in-law. Don Pepe of Yaxley told me that, on each of the first six visits for the purpose of negotiation, the boy's parents generally had to present a bottle of *Xunan kab* honey, plus *aguardiente* (liquor), soft drinks and cacao. Meanwhile, they tried to obtain the required articles for the rest of the dowry, such as *huipiles* (embroidered cloth), shoes, jewelry and household utensils. The marriage would be arranged on the seventh visit. In addition to the dowry, the bridegroom's family had to provide a total of five crates of soft drinks, *aguardiente*, twenty cacao tortillas, thirty loaves of bread and seven bottles of *Xunan kab* honey for the wedding party. A drink was made of the honey and cacao. Don Yermo recalled that, when he was young, his parents negotiated for his marriage to the daughter of one of the wealthiest families in the village. In a disapproving tone of voice, even after all those years, he told me that the potential in-laws demanded thirteen bottles of *Xunan kab* honey for the wedding. Believing that to be an excessive amount, he decided to break off the engagement. In general, if a man can obtain honey for his wife at the appropriate times, he is considered to be a good husband. Nowadays, while part of the dowry (including the jewelry and fabrics) is still demanded, honey is no longer in sufficient supply.

To summarize: women need *Xunan kab* honey to restore the humoral balance of their bodies so that they can conceive, or, if their bodies are already in equilibrium, so that they can get pregnant as quickly as possible. The honey helps the midwife to predict how the birth will proceed and, if problems arise while the mother-to-be is in labour, it can be used to ease and expedite the delivery. A honey mixture can be used, for example, to massage the woman's distended belly. After birth, the honey can be used to feed both baby and mother, the latter taking the honey to restore her body's balance. *Xunan kab* honey can also used to enhance the sexual attractiveness of young people of marriageable age, as is apparent not only in the way the honey is administered to young children but also in a popular folk story about an unfaithful wife. Even though *Xunan kab* honey is indispensable as a means of maintaining female fertility, men are in charge of its production, just as they are responsible for the production of corn. Therefore, a woman always obtains the honey from a man, usually the one to whom she is married, who is considered a good husband if he can acquire honey when it is most needed. This touches on an interesting theme: corn is always grown by a man, who, in some communities, ritually administers *Xunan kab* honey to the field before sowing the corn. Corn may be harvested by both husband and wife, but, as it is transferred from the field to the village, always passes from the male to the female domain. Symbolically, children move in the opposite sense, *Xunan kab* honey having boosted the fertility of a their mothers. She conceives and gives birth, the baby being 'brought into the world' by both husband and wife. Although the mother takes care of her child on a day-to-day basis, in effect babies move from the female to the male domain once they have been born. For, after all, Maya society is patrifocal, so the (grand-)father is the head of the household, which includes all the children. Custom demands that the patriarch has the final say in the marriage of his (grand-)children. Children produced by a recently married couple are incorporated into the extended family via the male line (Section 7.1). In other words: although labour is strictly divided on the basis of gender, in practice it is a system of exchange - of interconnected and communicating vessels - which cannot function without the full participation of both men and women. As previously indicated, honey produced by men is required by women for reproduction. This observation is further emphasized by the use and symbolic value of *Xunan kab* honey as described in the following sub-section.

7.7 The male fertilizing aspects of *Xunan kab* honey

We have seen that *Xunan kab* honey has an essential role to play in human procreation and would continue to do so if it had not become so scarce. Here, I try to show that this honey is a potent fertilizing agent comparable to the male principle. Below, the shaman Don Medardo gives an account which sheds much light on this issue. Most people in Tepich and other communities of the Maya Zone believe that Adam and Eve were the progenitors of humankind. Apparently, however, this was not the original intention:

"God had planned it all differently. Adam and Eve weren't supposed to be our father and mother; everybody was to be born of a flower. It was the Antichrist who challenged Adam and Eve. He made Eve eat an apple and Adam eat a banana. At first they didn't want to, but they were seduced ... and they ate the fruits. After that, the body of the woman acquired female sexual organs and the body of the man acquired male sexual organs. They didn't have these before they ate the fruits, it only happened because they sinned. For all the people were supposed to be born of a flower. It was the work of the Antichrist, not of God. He saw that they had sinned, so now people have to get married. [Question: How exactly were people supposed to be born of a flower?] Well, as the flower produced honey [i.e. nectar] in its centre, according to the stories people tell, when the honey started to drip from the flower, that's when it would start to ... every drop of honey that fell on the ground would develop into a new-born person. That was the way God had planned it, but it didn't happen that way" (Don Medardo, *hmen*, Tepich).

This story provides some valuable insights. Firstly, honey itself has the power to fertilize, to bring forth life. Indeed, the women of Tepich told me that if you take *Xunan kab* honey twice, you get pregnant. Secondly, in the earth, each drop of honey would develop into a human being, the earth functioning as the womb. We have already seen that the Maya link the earth to the fertility of women and corn kernels to children. Does this extend to the hive and honey, to give the linked sets 'corn-children-honey' and 'earth-woman-hive'? Some Maya words used in the context of traditional beekeeping would seem to support this hypothesis, particularly the utterances *ilmah* and *hobon*. According to the Cordemex Maya dictionary, *ilmah* means "to harvest honey", "to menstruate", "semen" and "to consult the *sastun*". The link between honey and semen now seems perfectly intelligible, as both are thought to be able to impregnate women, to make them pregnant, and both are apparently life-sustaining fluids. The Yucatecan Maya are explicit in likening children to corn kernels, other Mayan groups liken corn-gruel to semen (as explained in Section 7.5). Among the Yucatecan Maya, corn is regarded as hot, whereas corn-gruel - which is corn with only water added - is thought of as cold. In contrast, *Xunan kab* honey is hot and remains in this humoral state even when water and an extract of the bark of the *balche'* tree is added to make mead. If there were a homology between the hive and the womb, than this could explain the relation between the harvesting of honey and the flow of menstrual blood. As we have seen in previous sections, the word for hive (bee-log) is *hobon*. According to Hanks, this utterance also means "woman's belly" (1990: 112). When I asked Doña Pilar if *hobon* had this meaning for her too, she could not exactly confirm it, but suggested that people who use the word in both senses might be indicating that the bee-log and 'woman's belly' are both 'hollow'. Apart from the fact that women use *Xunan kab* honey to promote or regularize menstruation to ensure that they can conceive, for the time being no relation can be established between honey and menstruation. I return to this issue and to the understanding of the *sastun* in Sections 8.4 and 8.5. Hanks makes a very interesting contribution to the subject of fertility and sexual reproduction when he comments that speakers of Maya are renowned for their verbal humour. He gives some examples of suggestive double meanings of words often used in a playful context:

"Such play turns partly on the existence of a set of words and phrases that male speakers know have potentially double meanings, including *bisik* 'to take (be sexually penetrated)', *kučik* 'to carry (be sexually penetrated)', *kúuč* 'load, genitals', *si'* 'firewood (erect penis)', *kàab* 'honey (semen)', *kèeso* 'cheese (female genitalia)', *čiwóol* 'tarantula (vagina)'. When these terms, and many more, occur in speech, speakers have the option of turning them towards their secondary meanings or taking them at 'face' or 'literal' value" (Hanks 1990: 121-2).

In playful speech, the word for honey thus also means semen. As *Xunan kab* honey is so essential to female fertility that some women claim you can actually get pregnant simply by consuming it, and as people - at least in one story - are imagined to have been born of drops of honey that soaked into the earth, it would be fair to say that the double meaning of the word *kab* goes far beyond a ribald joke. Being 'hot' and comparable to semen, *Xunan kab* honey has a male aspect related to fertility. This could certainly explain why Doña Teresa's story of her harvesting honey when still unmarried caused such hilarity amng the listeners. It is not fitting for women to obtain honey directly, circumventing male authority. This issue also relates to the important question of whether men, in cultivating *Xunan kab* honey, gain control over female fertility. In the next sub-section, the answer to that question comes in the surprisingly small form of a rather dubious character: the *arux*.

7.8 The *arux*: man's companion and competitor

In many parts of the Yucatan peninsula, the ruins of pre-Columbian Maya architecture are concealed by dense vegetation. The contemporary Maya believe that these small hills overgrown with trees and plants are the dwelling places of *aruxob*, potentially nasty and sometimes naughty dwarves. Some say that the *aruxob* have now died out; others claim that you can still come across one in the form of a little clay figure, which can be brought back to life. Some people dread an encounter with a dwarf. When asked if they know an *arux*, some Maya are liable to become extremely ill at ease. Nonetheless, the dwarves may also bring good fortune.

You can only bring an *arux* to life on a Friday, by means of nine special prayers and *saka'* (corn-gruel, also known as *santo uk'ul*). The revived *arux* is like a tiny man, dressed as a Maya and wearing a hat; he carries a rifle and is accompanied by a little dog. At night, he watches over your *milpa* and will kill any intruder who tries to steal your crops, using power to invoke a disease-laden wind. The dwarf may even help the owner to obtain a good harvest: if rain does not fall when it is needed, the *arux* captures the rain god *Chak* and teases him until he starts weeping onto the *milpa* or promises to send rain. If your corn or watermelons are not growing very well, the *arux* may steal the best from your neighbour's *milpa* and plant them in yours. If a deer enters your *milpa* and a hunter tries to shoot it, the *arux* makes sure that he gets no venison, just feathers. *Aruxob* are the subject of many stories. Their tricks are the subject of much joking among the Maya, though the laughter usually conceals an element of real fear, for these dwarves are not always charming little creatures. They tend to be very demanding in exchange for the marvellous services rendered. Before the man who has benefited from the intervention of the *arux* can eat, he must always offer the best part of his meal to the dwarf, who never accepts second best. The arux is also very jealous and tries to kill babies, probably because they receive so much attention. He demands plenty of attention, too. He can easy become spoiled and greedy, and if you fail to fulfil his every wish, he may play a nasty trick on you or give you a high fever. When such things start happening, you know that the time has come to get rid of the troublesome *arux*. There is only one way to do this: you have to kill him. The following example of *arux* behaviour is particularly interesting in the light of the special significance that the Maya accord to honey.

While the lady of the household is taking a bath, an *arux* may creep up on her and attempt to seduce her. Pointing at different parts of her anatomy, he asks: "What is this called?", to which the woman responds, for example: "Why, these are my eyebrows!" And so the naughty little dwarf goes on, pointing at other parts of the lady's body and growing ever less discrete. Finally, the *arux* comes to her genitals and, if he manages to touch her vagina, impregnates her. According to a man of Yaxley, one of the unmarried women of the village bore thirteen children to an *arux* who had impregnated her in a single encounter. Yet women may use female magic to kill an *arux*. If the woman boldly responds to the ultimate question with: "This is my vagina!", the *arux* explodes into a thousand pieces, dying before he gets the chance to impregnate the woman.

Men, in contrast, have no magical power to kill an *arux*. If a man wants to kill one of these dwarves he needs honey - the honey of *Xunan kab*. The man prepares *santo uk'ul* (corn- gruel) sweetened with the honey. On a Friday, he serves this drink to the *arux*. As soon as the dwarf tastes the honey, he explodes exactly as he does when the bathing woman says her 'magic word'.

One of my informants in Señor, who had moved to that part of the Maya Zone from Yucatan State, stated that he had no desire to keep a colony of *E'hol* because, according to him, an *arux* protects this species of forest bee (Section 5.2). The idea of *aruxob* protecting forest bees is more widespread in Yucatan State that elsewhere (Zwaal 1993). People in Quintana Roo State think it unlikely that *aruxob* would protect bees, since their honey acts on the dwarves like deadly venom. There is more to this issue than meets the eye, though. From the stories about the *aruxob*, it is evident that only the warm and fecund honey of *Xunan kab* can kill them, while the cold honey of the forest bees has no effect on them. Moreover, men do not kill the dwarves with honey alone, but add it to corn-gruel (*saka'* or *santo uk'ul*). In making this brew, they combine male and female vital substances. Apparently, women can directly wield the ultimate symbol of their sexuality, the vagina, as a weapon against the nasty dwarf; men have recourse to a substitute which is no less sexually potent: semen - in this case, a fluid mixture of corn and *Xunan kab* honey. The important point here is that whereas water turns corn 'cold', the combination of water and honey (such as in mead) is *chokoh*, 'hot'.

7.9 The flow of vital substances to maintain fertility

We have seen in various contexts that corn and *Xunan kab* honey, the latter in the form of *balche'* (mead), are indispensable ingredients in ritual practices. What role do they play in rituals and why are life-sustaining powers attributed to them? It has been established and is widely known that the pre-Hispanic Maya would shed blood during certain rituals and often sacrificed humans to their gods. So far in this section, corn has been linked to human flesh (for, at the dawn of life, people were moulded from corn) and to semen (corn kernels and semen as 'seeds'). Furthermore, corn is the staple food of the Maya, so it clearly has life-sustaining power. We have also seen that an equally important life-sustaining substance - *Xunan kab* honey - is associated with semen; in Section 8, its association with blood becomes apparent. Is it therefore not plausible that the Maya have come to regard corn and honey as ritual substitutes for human flesh and blood? I believe that this is consistent with the facts and now present my arguments.

One question that remained unanswered in Section 4 was why the collective animal spirits, the *ah kanulob*, should be willing to share their own flesh and blood with the

Maya. What do they get in return for this service? If the substances that the Maya ritually offer to such spirits and to protector deities are indeed regarded as equivalent to human flesh and blood, then the exchange between the human world and the realm of the supernatural is in equilibrium. This would appear to solve the mystery. Evidently, the *ah kanulob* are willing to provide the life-sustaining flesh and blood of the animals they possess, in return for surrogate human flesh and blood in the form of the corn and honey offered by the Maya. As I argued in Section 4, the Maya must hunt animals in order to survive, but consider that this disturbs the natural equilibrium. They clearly believe that they can restore the balance by offering corn and honey to the animal spirits and protector deities. Humans are the only beings upon the earth who establish such a relationship with the supernatural: after all, only they can cultivate corn and *Xunan kab* honey. Animal species that hunt others also upset the natural equilibrium; they, however, have no produce to offer to the collective spirits of their prey. Once a year, though, the flight of the Feathered Snake *Kukulkan* conveniently restores the earthly balance by transforming hunter into hunted and vice versa. Humans are unique in another sense: they are the only earthly beings whom Almighty God has appointed as protectors of an animal species - *Xunan kab*. In her need for protection, at one level, *Xunan kab* is compared to the beekeeper's wife and, at another level, to human children, who require nurturing too. Only *Xunan kab* honey, like real blood and semen, is moist and warm: all other kinds of honey are moist yet cold. In this sense, the honey of the domesticated stingless bee is an indispensable life-giving essence. This may also explain why, when a Maya hunter does not made the required offering of corn and honey in return for the kill, its *ah kanul* can become so wrathful that he will even take the life of the hunter, who has deprived him of the (surrogate) vital substances needed to maintain the two-way flow which constitutes the natural equilibrium. The punishment fits the crime, for the errant hunter must now pay in real flesh and blood - his own! The flow of vital substances may not be interrupted. In my opinion, then, it is right to regard offerings of corn and honey as substitutes for human flesh and blood.

Ingold (1986) once again provides an interesting insight - this time into the need for an exchange of vital substances that goes beyond the fact that both people and animals have to eat, and therefore kill other species. He argues that animal spirits depend upon humans to kill animals so that new life can be born and the herds sustained through sexual reproduction. This is apparent among Cree hunters, for example, who draw the following parallel:

"[...] whilst the master is formidably powerful and masculine, the reindeer themselves are often seen as weak, vulnerable and feminine. The male hunter, approaching a reindeer with intent to kill, imagines himself on another level to be seduced by a beautiful girl, and the kill itself represents the consummation of sexual intercourse [...]. In this imagery, the essential connection between killing and reproduction is once more apparent, for like intercourse its consequence is the conception of new life rather than its destruction" (Ingold 1986: 251).

Siberian Chukchi reindeer owners (ibid.: 262) make similar connections. Such perceptions are rather like the imagined relationship between the Maya beekeeper and his female *Xunan kab*. The beekeeper needs *Xunan kab* honey to maintain fertility within his family as well as to make the required offerings to certain spirits and deities. Only when the gods have been paid their dues by means of ritual do they provide an abundance of vital substances in return, in the form of corn or honey harvests, or the flesh and blood of animals. In other words, it seems that the Maya hold views on the essential flow of vital substances which are similar to those of other shamanistic societies. In this context, the following comments by Farriss are deeply significant:

"As can be expected of an agricultural people inhabiting a tropical forest environment where biological recycling is especially rapid and obvious, the Maya ecological model was an organic circular one, in which all creation was seen as mutually dependent, feeding on itself in endless cycles of decay and renewal. In a region where the life-renewing rains are so uncertain, it is also not surprising that this cyclical rhythm was not to be taken for granted and that man as part of the system was expected to do his share to keep it going. The Maya conceived of survival as a collective enterprise in which man, nature and the gods are all linked through mutually sustaining bonds of reciprocity, ritually forged through sacrifice and communion" (Farriss 1984: 6).

7.10 Conclusions

K'inam (energy) appears to be a concept in which various notions converge but which, in itself, cannot account for the fact that it is taboo for women to breed bees. From the various explanations of *k'inam* that have been presented in this section it can be concluded, on the one hand, that there is normal (i.e. not excessive) *k'inam,* which naturally increases as one gets older and is possessed in greater quantities by men than women. Although this form or level of energy may upset the humoral balance of living creatures, under certain circumstances, the hot and dry symptoms can be counteracted with cool and moist *Chakah* leaves. On the other hand, *k'inam* may become excessive: i.e. when it is associated with pain and illness, pregnancy or menstruation. This form or level of energy is dangerous to bees (and young children), for it heats them up to an extent that cannot be counterbalanced by *Chakah* leaves. Women, it would seem, make bad beekeepers because of the humoral 'symptoms' of their fertility. It should be noted, however, that women take care of other homestead animals even though these are just as vulnerable to excessive female *k'inam* resulting from pregnancy and menstruation as the domesticated stingless bee. As there are some important similarities between the beekeeper's wife and *Xunan kab*, principally that both depend upon the male beekeeper for their fertility and hence reproduction, it would appear that it is this factor, not *k'*inam, which explains why women do not breed bees.

To the Maya, the acts of a man planting corn in the earth and his 'planting' children in a his wife's womb are equivalent. Children are linked to corn kernels and the earth's fertility is linked to woman's capacity to bear children. After sowing corn kernels in the earth, the man tends the growing corn plants. However, after his wife conceives, the husband does not play an obvious role in the baby's development in the womb. However, as I have tried to show in this section, the man does indirectly influence how his wife's pregnancy progresses, for, according to the rules laid down by the cultural system, it is his responsibility to produce and supply *Xunan kab* honey. Women use *Xunan kab* honey to facilitate conception and to ensure that pregnancy develops smoothly and culminates in a relatively easy delivery. Furthermore, *Xunan kab* honey, or the (eyes of the) bees themselves, can be used to make an individual more appealing to the opposite sex. In a manner of speaking, *Xunan kab* honey itself has sexual potency. As women can become pregnant through the agency of this honey, its potency must be male and therefore equivalent to the potency of semen. This could explain the belief that, if Adam and Eve had not sinned against God, children would have been born out of drops of honey and would have developed in the collective womb which is the earth. Instead, individual women give birth to children now and may be assisted in this with warm *Xunan kab* honey. In contrast, the honeys of forest bees and *Americano kab* are cold and their consumption can only lead to infertility. The taboo that prevents women from harvesting the honey of *Xunan kab* themselves (or even more strictly, from even approaching the hives), puts the production and harvesting of honey fairly and squarely in the masculine domain. Men supply the life-giving substance, whether it be semen or honey. A woman can only obtain the good warm honey from a man, even in the exceptional case that she herself owns logs of *Xunan kab*. Sex out of wedlock, particularly when the wife strays, must be controlled because it seriously threatens the patriarchal social order. The dwarf figure, *arux*, seems to be a cultural outlet for this danger. Although a companion of the *milpero*, the *arux* may seduce his wife. The *milpero* can avert this danger only by administering *Xunan* *kab* honey to the *arux*. The cold honey of forest bees, which has no power to boost female fertility, has no effect on the dwarf. By handling and administering *Xunan kab* honey, therefore, men transcend the male domain and exercise control over fertility in the female domain. Since they are also in charge of the production of corn, which is symbolically equivalent to the production of children, this is fully in harmony with the Maya division of labour. In the context of fertility, it is now understandable that, in the *ejido* of Xmaben, *milperos* ritually administer *Xunan kab* honey to the cornfield in the form of *kaliz* (Section 6.3.1.1). As *Xunan kab* is domesticated (*alak'*) and 'female', the species must be kept in the homestead as a member of the family in accordance with the patrilocal and patrilinear rules of society, just like the other female family-members. The bee-house may contain the *hobonob* of one man or, by social extension, of a number of male kinsmen living in different homesteads (Section 6.2). Although this practice stresses the supremacy of the senior male role in Maya society, it is important to note that the male and female domains of Maya society are mutually dependent and that, in the process of maturing, both corn and children are (symbolically) transferred from one domain to the other in opposite directions. Moreover, procreation requires the full co-operation of both husband and wife!

Gender in Maya society is connected to cosmological phenomena. In the context of fertility, Maya women are related to the earth and the moon. The earth is moist, and only women who have not yet 'dried up' (which is the case with elderly women) can bear children. Procreation and fertility thus depend upon fluids. The moon increases the fertility of humans, bees and corn alike. Corn cobs should be bent down to dry when the moon is full, which illustrates that this lunar phase is associated with a certain dryness on earth. In contrast, the new moon is said to evoke menstruation. Procreation also depends upon warmth. Cold women cannot bear children, just as cold ground cannot produce corn. For such purposes, warmth is required: the warmth of *Xunan kab* honey in the former case; the warmth of the sun in the latter. The full moon also plays an essential role here. The humoral concepts of warmth and dryness appear to be directly related to *k'inam*, for this energy increases towards full moon (and is possessed in larger quantities by males) and decreases with the new moon (and is possessed in smaller quantities by females). The combination of moisture and warmth suggests a sort of evaporation or cooking process.

By means of honey and corn, men achieve the very important task of exchanging vital substances with the realm of the supernatural. Men, rather than offering their own flesh and blood, which is precisely what the *ah kanulob* are willing to exchange, offer homologous substitutes: corn and honey. On her part, *Xunan kab* needs the beekeeper for her reproduction and, on a higher level, needs the beekeeper as middleman to pay her dues to the gods, in particular the chief of the rain gods, *Kun K'u*, and Almighty God Himself. This payment is in exchange for the good rain that makes flowers, and for God's protection and blessing. In fact, these are the same deities to which men address the tally of their *milpa* harvest and give thanks for blessings. As the Maya themselves are the human protectors of *Xunan kab*, there is no need for any being to exchange on their behalf with an *ah kanul*. On their part, the beekeeper and his bees may be blessed with generous yields of, respectively, honey and corn - and, through the agency of these valuable commodities, the survival of the species in the form of children. Humans thus participate in the overall cycle of fertility and renewal.

Although this section has provided the answer to the question of why women cannot breed *Xunan kab*, other interesting questions have arisen. Why does only *Xunan kab* produce warm honey and not the other bees known to the Maya? How should we understand the fact that a female bee, rather than the male forest bees, produces a male life-giving substance? What is the relation between the shamanistic divining crystal - the *sastun* - and honey? Does the set of equivalences represented by 'honey-semen' and 'corn-children' also imply an equivalence between honey and corn? I turn to these important questions in the next section.

8 *Yook'ol kab*: 'Upon the earth'

The Maya word for 'bee', *kab*, has meanings that are obviously related to bees and beekeeping (e.g. 'honey', 'hive') and others that, at first glance, appear not to be (e.g. 'earth', 'village', 'world'). One of my aims in this section is to show that all these disparate meanings of *kab* are, in the mind of the contemporary Maya, in some way related to the subject of bees. This linking of concepts implies, more precisely, that the semantic field of the utterance *kab* comprises sets of structurally equivalent terms. Most importantly, this equivalence of terms has a bearing on the day-to-day practice of, and ritual discourse pertaining to, beekeeping.

T 526: *kab*

In the pre-Hispanic hieroglyphic texts of the Maya, the glyph T526 denotes *kab* in the senses of 'earth', 'bee' and ' honey' (Kurbjuhn 1989). The contemporary Maya in Quintana Roo still use the word in these three senses, but also to signify 'hive', 'village', 'world' and even 'coloured ground'. A contemporary Maya ethnographer, Tec Poot, has concluded that although *kab* signifies three distinct and mundane objects 'earth', 'bee' and 'honey', in another reality these coalesce into a compound object 'earth-bee-honey' (1980: 4). In his argument, he cites a 'bee page' in the pre-Hispanic Madrid Codex (as translated by Cordan, 1966), the Popul Vuh (Mediz Bolio 1970) and contemporary ethnographic data from Yucatan. Although recent breakthroughs in deciphering Maya hieroglyphs have proved Cordan's translation of the 'bee page' to be erroneous, Tec Poot's conclusion is valid. In this section, I wish to reinforce his idea of compound objects with additional arguments based on ethnographic fieldwork. More particularly, I maintain that, while the Maya do indeed think in terms of compounds such as 'earth-hive', there are also related sets of equivalents which appear to be, but are not necessarily, linguistically cognate. I aim to demonstrate that the homology between 'earth' and 'hive' (or 'bee-log') is parallel to that between 'people' and 'bees'. Thus, the semantic field of an utterance may be multi-layered or stratified; the various senses, however disparate, being unified by a structural principle. Depending upon the intent and the context, people can convey a concept which is simple or multivocal, worldly or spiritual.

Yucatecan Maya utterances are not the only examples of stratified semantic fields and multivocality. To account for and to explain such semantic structures, Geertz (1975) advocates what he calls 'thick description', illustrating his point with the example of a rapid winking of the eyelid. This signal may be either intentional or involuntary and can be interpreted in different ways, depending upon the intention of the signaller and the context. The challenge facing the ethnographer is to surmise the intention and hence the meaning, by comparing different kinds of data at 'microscopic' level. Other authors have indicated that the Yucatecan Maya are not the only Maya group to employ stratified semantic fields (Freidel *et al.* 1993; Hanks 1990). The Tedlocks show that meanings of utterances in the Popol Vuh are subject to what they call 'intertextuality'.[1] They claim, for example, that a passage about the measuring of the sky-earth at the time of its creation alludes to the demarcation of a *milpa* (cornfield) or a *solar* (homestead) and, metaphorically, to the practice of traditional weaving on a backstrap loom. They also point out that weaving is analogous to the growth of forest vegetation, for, in one episode of the Popol Vuh, the animals command the trees and bushes to weave themselves together and reclaim the *milpa*. In so doing, the animals use two words: *che'*, which denotes the sturdy trunks and branches of trees, as well as the vertical pegs which support and space the warp threads in weaving; and *c'a'm*, which denotes the more flexible twigs and vines, as well as the ropes of the loom. They also point out that the present-day K'iché Maya construct stratified semantic fields in music-making, storytelling, prayer, dream interpretation, divination, weaving, building and horticulture (Tedlock & Tedlock 1985). John Sosa argues that the reason why the Yucatecan Maya use the word *che'* for 'cross' as well as for 'tree' and 'wood' is not because they have a limited vocabulary, but because a cross is generally made of wood and may be regarded as being equivalent to a tree. Indeed,

[1]See: 'Intertextuality', Worton, Michael & Judith Still (ed.) 1990.

the sign of the cross has become so inextricably bound up with the image of Jesus Christ (see Section 8.2.2.1) that the Maya believe a tree cut at Easter will bleed (Sosa 1985: 241-242, 261). There could hardly be a more graphic illustration of stratified semantic fields in action. 'Thick description' is therefore essential if multivocal and stratified meanings of symbols and utterances are to be revealed and correctly interpreted.

Stating that *kab* is a multivocal and stratified utterance has no relevance to this dissertation unless a link can be drawn to beekeeping practice and its ideational context. This section therefore addresses such links. In Section 8.2, I discuss the inscriptions on the bee-log, *hobon*: the square, four points or circle carved around the nest-entrance, and the cross above it. I also refer briefly to some pre-Hispanic and colonial concepts that are pertinent to an analysis of their meaning. Three decades ago, important discoveries were made in the field of deciphering the Maya hieroglyphic writing system (Coe 1992) and, as texts found at archaeological sites, in codices and on pottery became clearer, scholars gained direct access to the ancient cosmology. Now, therefore, some basic comparative assumptions can be made about the classical Maya conceptualization of certain elementary cosmic structures, such as the earth, and the cross or First Tree of the World. However, I do not wish to comment on the issue of cultural continuity between the classical and modern eras, for this necessitates a discussion that is beyond the scope of this dissertation.[2] What I am primarily concerned with here is the following: given that the conceptualization of the bee-log and the day-to-day reality of the earth are unified in the mind of the Maya, how does the compound 'bee-earth' relate to the world they inhabit? And what consequences does this relation have for beekeeping practice? In order to be able to address these questions, I first briefly examine the Yucatecan Maya view of the cosmos, in Section 8.1. Sosa studied cosmological concepts in Yalcoba, a village near Valladolid. The concepts he describes seem to correspond closely to the ideas of the Tepich shamans. In Sections 8.3 and 8.6, I discuss the relation between the bees' world and the human world. As I hope will become clear, the homology between bees and humans gives rise to an important paradox concerning beekeeping: while the Maya cherish their bees and see the welfare of the colonies as intertwined with their own existence and subsistence, in practice this very concept impedes their efforts to help the bees and may even be the reason why meliponiculture is slowly but surely disappearing.

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[2]For a discussion of this subject, see: Freidel *et al.* 1993; Lovell 1988; Farriss, 1984; Miller & Farriss 1979.

8.1 Cosmological notions

The Maya conceive of the surface of the earth upon which they live, and about which the sun, moon, planets and stars move, as a flat square called *yook'ol kab* (Hanks 1990: 306; Sosa 1989: 132; Redfield & Villa Rojas 1934). As in many other Central and South American indigenous societies, cosmology, or "the cultural specific theory of the universe" (Sosa 1989: 130), plays a key role in their time-reckoning, spacial orientation, regulation of agricultural and ritual practice, and beekeeping. In equatorial skies, the heavenly bodies describe parallel east-west arcs that are almost perpendicular to the horizon. The Maya, like many other traditional peoples of the tropics, use the horizon as a cursor to monitor celestial motions and to mark the passage of time (Magaña 1988: 255; Aveni 1981). Their horizontal reference points are the solstices, the northern- and southernmost rising and setting positions of the sun, which they call 'the corners of the world' (see Figure 8.1). The four sides of the plane quadrilateral defined by joining these four points are known as east (*lak'in*), west (*chik'in*), north (*xaman*) and south (*nohol*). These directions are not, therefore, cardinal points as we think of them. The corners of the Maya world are referred to as south-east, north-west, etc. (Sosa 1985). The earth is regarded as a flat square with seven sky layers above, a water layer below and, beneath that, a fire layer (*metnal*). The universe is depicted as an inflated globe (Hanks 1990: 305-306). There are holes at the mid-points of the east and west sides of the earth-square. From beneath the earth, the sun emerges at dawn through the eastern hole. It ascends through the seven sky layers until it reaches the zenith, at noon, where there is a third hole also called 'east'. This is the starting point or 'seat' of the sun,[3] which is identified with God (*Yumbil Dios* or *Hahal Dios*, meaning 'Almighty God'; Hanks 1990: 304; Sosa 1989: 132). In the 1930s, it was noted that, in accordance with this concept, each new day begins at noon (Redfield & Villa Rojas 1934: 184). From the starting point at the zenith, the sun descends to the western hole of the earth-square. At dusk, the sun disappears into this hole and continues its passage under the observer's feet to the nadir (Sosa 1989, 1985), which is also regarded as 'west'. 'East' and 'west' (*lak'in* and *chik'in*) therefore have their vertical corollaries 'up' and 'down', while retaining their horizontal values as sides of the earth-square. From the nadir

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[3]Classical Maya conceptions of north and south are disputed in Freidel *et al.* 1993. Freidel originally asserts that north and south were viewed as 'up' and 'down' and associated with the zenith and nadir respectively. Schele, citing other researchers, maintains that they were horizontal directions. In a note, Freidel concludes that north was up, but not the zenith point, while south was down, but not the nadir (75, 76, 421Note 29).

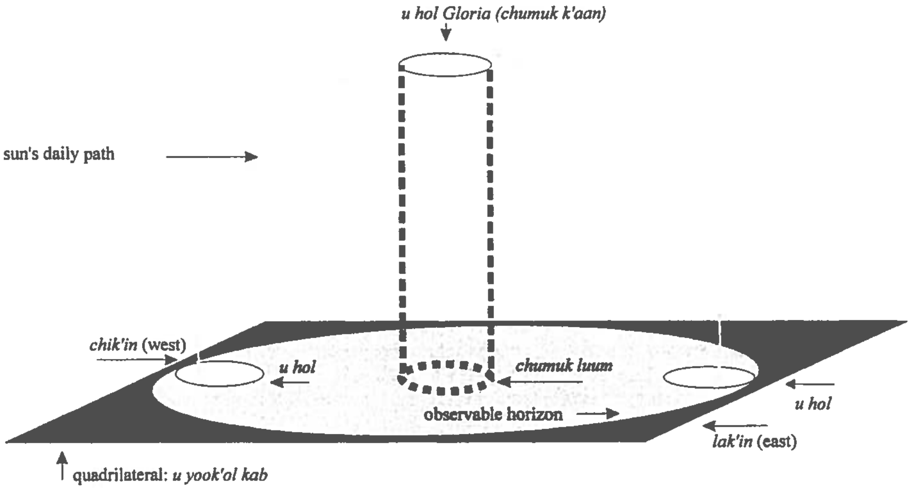

Figure 8.1: The sun's conduit around the earth (based on Sosa 1989: Figure 9.10).

('west'), the sun continues along its eastward path, reappearing above the earth's surface at dawn. When the sun is in its seat at the zenith, the moon is thought to be in its own seat at the nadir. According to one of Hank's informants, it is there that the female spirit known as "woman's light of the night" resides (1990: 305). The new moon is conceived of as residing at the nadir ('west'); the full moon at the zenith ('east'). At night, the moon and the stars travel above the earth's surface from the eastern to the western horizon, while in the day-time they pass below the surface. Upon the earth, all cosmic motions are from east to west; beneath the earth, they are in the opposite direction.

Solar positions play a major role in the organization of many aspects of social life and economic activity; they also govern ritual practice by shamans and by *milperos* in the cornfields, as a 'thick description' by Sosa (1985) demonstrates. As solar positions are fundamental to all ceremonies, I return to them at a later stage in this section. As I stated in Section 5.3.1, *Kun K'u*, the chief of the rain gods (*Chakob*), provides the rain that makes the flowers grow for *Xunan kab* and the corn grow for people. Sosa remarks that *Kun K'u* resides on the eastern horizon and starts thundering on the 13th of June, at which time of the year the Pleiades (Tsab) rise before the sun and are thus visible in the dawn sky (1985: 454; cf. Don Beto's contradictory account, Section 6.1 in which he states that *Kun K'u* thunders in the west to herald the start of the rainy season in June: see also Note 28 of this section). However, Sosa found that the present-day Yucatecan Maya do not attach much importance to the stars and constellations (ibid.: 431). This contrasts with the conceptualization of the cosmos in several contemporary South American indigenous societies, in which constellations are central to a set of space-time systems that govern society and the agricultural cycle (Magaña & Jara Magaña 1982, 1983; Hugh-Jones, S. 1982, 1979, 1977; Hugh-Jones, C. 1979, 1977; Reichel-Dolmatoff 1978). There are several indications that the Yucatecan Maya formerly linked the Pleiades to the cycle of agriculture. In June, the Pleiades rise just before the sun and then disappear from the sky in the light of dawn.[4] This marks the start of the rainy season and the time to sow the cornfields. We learn from Freidel *et al.* (1993: 92, 96) that the Pleiades are associated with a handful of corn kernels.[5] The background of South American cosmological systems and information gleaned from

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[4]On the 1st of June, the Pleiades rise at about 04.30 and set at about 17.40 in Yucatan.

[5]Interestingly, among the Arawak of the Guyanas, the Pleiades are associated with the staple food *Casava farine* (Jara Gómez: 'Arawak constellations, a bibliography survey' in her forthcoming publication 'Songs from the Sky: Indigenous Astronomical and Cosmological Traditions of the World').

the pre-Columbian past[6] implies that, for the Maya, the Pleiades once played an important role in the organization of agricultural life. Among the contemporary Yucatecan Maya, however, the sun is the key player in the organization of day-to-day life and ritual practice. Having explained some of the basic concepts underlying the Maya view of the cosmos, I now turn to the question of how Maya cosmology relates to beekeeping and the ceremonies for the bees, examining first the inscriptions on the bee-log. In the course of this section, I describe other elements of the Maya cosmos as the need arises.

8.2 The inscriptions on the *bobon*

Five hundred years ago, as the Spanish conquest of Mesoamerica progressed, Spanish friars backed by the military power of the *conquistadores* burned all but a few of the Maya's hieroglyphic books and destroyed religious idols. This was the region's *auto da fe*. With the decline of the Maya elite and the gradual elimination of the priestly caste, the ability to read Maya hieroglyphs was lost (Coe 1992).[7] Hieroglyphic writing having been abandoned so long ago, it is striking that the older *hobonob* in particular are decorated with pictograms. I intend to show that at least one of the figures commonly inscribed on bee-logs conveys a meaning beyond its practical function. First, though, I describe the inscriptions.

The older *hobonob* found in the Maya Zone often have a square figure carved around a central hole (see Photo 5), which functions as sole entrance to the nest and is guarded by the soldier bee, or *cintenela*. On some bee-logs, a circle is carved instead of a square. The same two inscriptions are also found in Yucatan State; there, however, some beekeepers paint a white circle of lime around the nest-entrance. This is not customary in the Maya Zone. In both areas, nearly all the bee-logs are also marked with a perpendicular cross, which is centred above, and joined at its base to, the square or circle (see Photo 9). Some logs have a cross as the only adornment. Others bear a cross

[6]See Note 11 of this section (on the subject of creation)

[7]The Maya texts that have survived in documents and as inscriptions found on archaeological sites would have been composed and read by professional scribes. The common people were probably illiterate, yet this does not necessarily imply that they could not understand some of the more elementary pictograms. Similarly, in modern society, people who have not learned to read or write can nevertheless interpret pictograms such as traffic signs.

and four small square points carved at the corners of an imaginary square. In that case, the cross is not based upon the top line of the imaginary square but rises from the entrance hole at the centre (see Photo 9). Apart from any deeper meaning, the cross certainly has a practical function: it helps the beekeeper to avoid placing the *hobon* upside-down, which would cause the brood to drown in the larval nutriment Section 5.8.3). Of course, the square and circle cannot have this function because they are symmetrical. All the inscriptions described here are most commonly found on bee-logs that have been inherited. Since some of these *hobonob* are at least a hundred years old, the meanings of the inscriptions may date back to the 19th century or even earlier. Often, however, it seems that the original meanings have not survived with the inscriptions.

8.2.1 The square or the circle

Most Maya do not seem to know what the square figure means. They just say that it is one of the customs inherited from their grandparents, or indicate that it has lost its meaning by calling it "a luxury". However, one of my informants in the village of Tepich did not need to think twice about the inscription before explaining:

"They make this square because they say it is the universe. It is called *yiik'le kab* or *yook'ol kab*, which means 'the earth'" (Don Beto, Tepich).

Given this statement, it seems remarkable that Hanks (1990: 86) translates *yiik'el* as "bees (of a hive), ants (swarming in the earth)"; however, as I showed in Section 4, the term *yiik'le* refers to the class of social insects.[8] Don Beto's explanation is ambiguous: does the inscription symbolize the universe or the earth? Don Medardo of Tepich interprets the square as "upon the earth, the earth upon which we live". Hanks give a more precise explanation of *yook'ol kab*:

"Above the earth is the region called *yoók'ol kàab'*, 'above earth'. In everyday Maya, speakers refer to the world we inhabit, including the earth and visible sky, as the 'above earth'. D.C. [a shaman] took exception to this usage, pointing out that properly speaking we live *ǐčil yoók'ol kàab'* 'inside above the earth', which he takes to include the surface of the earth and the sky below the seven [...] great cloud layers [...]. This is the domain of the baálam *ǐík' ó'ob*, 'jaguar

[8]The words *yiik'le* and *yiik'el* are used interchangeably without any difference in meaning.

spirits', and other earth guardians who assist farmers and protect their cornfields" (Hanks 1990: 306).

The summer and winter solstices define the square surface of the earth, as I explained in Section 8.1. The square figure on the bee-log represents the traditional Maya image of the flat earth sandwiched between the sky and the nether regions of the universe, and the sky. Among the Maya, there are different ways of describing the detailed structure of the universe. While all agree that there are several *yaal* ('layers'), different numbers are stated. Whereas the layman Don Abundio claims that the universe has thirteen *yaal*, the shaman Don Hipólito speaks of seven. Then again, Don Medardo maintains that there are only three: a layer known as *metnal* beneath the earth's surface itself and a single sky layer above.[9]

The square form of the earth's surface is repeated in the structure of the universe:

"In the sky, there is that thing which supports the sky above the earth. It is like a table with four corners and it is like a house with four poles. In this way, the sky is held above the earth; this is the way God has made it. The sky is made of a single *yaal* ['layer'], but we cannot see that very well. There above, they say, it is exactly the same as how we live down here; there above is everything we have here" (Don Medardo, *hmen*, Tepich).

According to this view, four poles support the sky above the earth, and both the sky and the earth are square. This seems to explain the ambiguity of Don Beto's statement that the square on the bee-log symbolizes *yook'ol kab* ('upon the earth') as well as the universe. On the one hand, the earth's surface is a distinct part of the universe; on the other hand, its square form is repeated in the layer(s) of the sky.

For the Maya, then, the square figure is a key element in the structure of the cosmos. So far, though, I have neglected the pivotal element of that structure: the centre point. Marking off four corners in relation to a centre point is a common practice among the contemporary Maya, as it was among their ancestors. In pre-conquest hieroglyphic writing, the verb *tzuk*[10] denotes this action. *Tzuk* also refers to the primordial act of creation whereby First Father raised the World Tree (*Wakah Chan*, 'Raised Up Sky') at the centre of the universe to lift the sky up above the earth

[9]The disparity may be resolved as follows: The concept of 7 sky layers is of Toltec origin, whereas the 13-layer concept is Maya. In addition, the distinction between 13 or 3 layers seems to be only virtual: actually two explanations of a single model of the universe as a square-based pyramid with 3 layers. Those who refer to the number 3 only count the layers, while those who refer to the number 13 count the corners or sides of each layer plus a centre point: $3 \times 4 + 1 = 13$ (Prof. R.A.M. van Zantwijk, personal communication).

[10]This is the spelling according to Freidel *et al.*, the Cordemex Maya dictionary gives the spelling *tsuk*.

(Freidel *et al.* 1993: 140).[11] The centre is essential to this conception and, according to some, is a fifth cardinal point (Hanks 1990: 300; Aveni 1981: 167). The contemporary Yucatecan Maya call the centre of a given area *chumuk*; it seems that the verb *tzuk* has fallen into disuse. Nowadays, though, the Maya still accord special significance to the centre when they ceremonially mark out a *milpa* for cultivation in the forest, establish and inaugurate a plot for a house or homestead, demarcate a village, or when they construct an altar (cf. Freidel *et al* 1993: 50; Hanks 1990: 128-131; Vogt 1976: 58-59). Determining and emphasizing the centre of an area by ritual brings it out of the wild and into the protected domain. It transforms forest into cultivated fields, uninhabited areas into homesteads or villages. According to Freidel "it is the same work as that the gods undertook at the beginning of everything" (Freidel *et al.* 1993: 130).

Shamans assume that there are four crosses at the corners of the earth and one at the centre. Those crosses are accorded great holiness and importance, especially the one in the centre of the earth, which is called *u Gloria*, 'its Glory'. Hence, the surface of the earth can only be depicted by a quincunx design. This is precisely what is seen when the square inscription on the bee-log is substituted by four small square points at the corners of an imaginary square. The bees' ingress- and egress- hole at the centre of

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[11]Combining episodes of the Popol Vuh with events recorded on pre-conquest buildings, decorated pottery and inscribed bones, and correlating these with sky maps for the year 690 AD, Freidel *et al.* (1993) argue that, for the Classical Maya, creation was re-enacted annually in the skies of 13-14 August and 4-5 February. During the night of 13-14 August (at latitude 15 degrees north), the Milky Way (*sac be*, 'white road'; *xibal be*, 'road of awe') swept around in the sky. The Classical Maya saw it transform from the Crocodile Tree (after dusk: 'upright' or north-south alignment) into the Canoe (before dawn: 'recumbent' or east-west alignment). The Canoe, carrying First Father and His Paddlers across the sky, sank. First Father fell to the place of creation at *Ak* (the Turtle - a symbol of rebirth - in Orion), specifically to the Three Hearthstones of Creation (the stars Alnitak, Rigel and Saiph), which the contemporary Maya associate with the three stones of the kitchen fire. Under water, First Father was resurrected from the Turtle Shell (Orion). He bore a sack of corn kernels (the Pleiades) and a quatrefoil on his shoulder. He then rose from the Cross (formed by the ecliptic - the path of the sun, moon and planets - intersecting the Milky Way) and became the Maize Tree. His umbilical cord extended out along the ecliptic: the path that was to be trodden by his sons (the planet Venus and the sun) and his wife (First Mother, the moon). Just before dawn on 14 August, the Three Hearthstones of Creation and the Pleiades approached the zenith; at noon, the sun took up position exactly overhead. On the night of 4-5 February (reciprocal and opposite sky maps to that of 13-14 August), First Father entered the sky and landed in the Tree. After nightfall, the Three Hearthstones (Orion), from their position at the zenith, took the Pleiades, the handful of corn kernels, to be planted in the earth (as they set on the western horizon). At 02.00 hours on 5 February 690 AD, the Milky Way lay on the eastern horizon and there was an utterly dark patch of sky overhead. This position of the Milky Way was known as *Ek Way*; the 'Black Dreamplace' or 'Black Transformer' was the portal through which beings emerged from Otherworld. Then the Milky Way rose from the eastern horizon until it arched overhead from north to south. By thus erecting the *axis mundi*, First Father raised the sky above the earth. He made his house in the north and unfolded the four-cornered earth. The *axis mundi*, in the form of a tree, stretched from north to south, with its crown in the north. By erecting the *axis mundi*, First Father imparted circular motion to the planets and stars, enabling the Maya to calculate time (Freidel *et al.* 1993).

the square is an integral part of the figure, just as the centre is the inseparable fifth point of the earth's surface. This imagery may be emphasized by the position of the cross: as previously described, it is normally erected from the mid-point of the square's top, but rises directly from the nest-entrance if the square is represented by four corner-points (see Photo 9 and 10). This figure corresponds to the traditional Maya conceptualization of the square earth with a cross or tree rising from the centre. The quincunx pattern of the earth's surface is thus reproduced in the rectangular inscription on the *hobon* of the bees; the four corners and the centre point, like the earth's surface, being called *yook'ol kab.*[12]

In this context, it is interesting to note that Don Hipólito told me that the square figure on bee-logs is the *k'anche*, 'the bench of the cross', though I initially attached little importance to this seemingly meaningless statement, which was reiterated much later by Don Nicolas. I discuss the matter in Section 8.2.3, for the deeper meaning only becomes apparent in another context. I now turn to the other figure inscribed on bee-logs: the circle.

The circle is less commonly seen on bee-logs and its meaning is far less clear: some Maya maintain that it helps the bees to construct their typical stellate figure at the nest-entrance so that they can recognize the door to their home; others regard it as purely decorative. Hanks and Sosa discuss the symbolism of the circle, the shaman in the work of the former depicting the universe as a globe which defines the limits of reality. In his practice of medicine, he constructs a circular area within a quadrilateral one by laying out herbs in the shape of a cross superimposed on a circle to depict a person, *máak* (Hanks 1990: 305, 333). In Sosa's work (1989: 140), the observed horizon forms a circle (Section 8.1). Judging by the literature alone, the circle could refer to the limits of the universe or to the limit of vision, or be an iconic representation of a person. In this context, it is interesting to note that, in the 19th century, Huber (1836) described a Mexican bee-log from Tepic (the village of Tepic Nayarit?) which was decorated with the design of a human head at the nest-entrance. However, as the present-day beekeepers have given me no indications of the circle's meaning that even remotely correspond to explanations in the literature, I have insufficient evidence to draw any conclusion more meaningful than the statement that people nowadays see

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[12]In a few instances, the figure around the nest-entrance of a bee-log has been observed to consist of a square with several lines or layers inscribed above it. Such a figure resembles a square-based pyramid such as that at Chichén Itzá, which Wilhelmy has interpreted as a petrified cosmogram of the universe (1981: 315, and see Note 9 of this section).

the circle purely as decoration.

8.2.2 The sign of the cross

In discussing the meaning of the square, I identified the cross as that which was erected at the centre of the earth, or as the tree at the centre of the universe as depicted in pre-Hispanic Maya cosmology (Freidel *et al.* 1993). However, it would be quite wrong to assume that the meaning of the cross remained the same during centuries of foreign domination. Following the Spanish conquest of the Yucatan peninsula, the sign of the cross acquired many new historical and religious associations, implanted Christian concepts gradually fusing with the original Maya meaning to result in a new notion, which is briefly described in the next sub-section. Today, crosses play a key role in Maya ritual practice, as I have observed in Tepich. The importance of the cross is manifold in beekeeping. Firstly, it is encountered in several forms in the ceremony for the bees and, secondly, it is part of the symbolism of the bee-log, whereby beekeeping is connected with cosmological notions. As I wish to establish the link between the bee-earth and the human earth, I must first describe in some detail what the sign of the cross means to the people of Tepich.

8.2.2.1 The cross: a brief historical perspective

The Maya of the pre-conquest era, initiates and common peasants alike, would have been perfectly familiar with the sign of cross. As testified by the surviving codices and inscriptions found on archaeological sites, the cross is the *axis mundi*, erected at the centre of the world, which runs through all the different layers of the universe, the *Yaax Che'* or First Tree of the World. Playing a key role in the creation of the world, the cross is a symbol of rebirth and creation (see Notes 11 and 14 of this section). A pre-Columbian incense pot depicts a bee-deity[13] with a cross beneath his hands, in

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[13]The incense pot is exhibited at the Museum of Anthropology and History in Mérida, Mexico. The descending god, flanked by two logs of stingless bees, holds a brood nest in his hands. The museum's accompanying text identifies the god as *Ah Muzenkab*, the contemporary protector deity of the stingless bees in Yucatan State. Although the image is indisputably of a bee-deity, there is no direct evidence that it should be associated with *Ah Muzenkab*. This name has been erroneously given to another image of a descending god: that found at of Tulum. Roys saw characteristics of a bee in the Tulum figure, published a reproduction of the god in his book and called it "*Ah Muzenkab*, the Maya bee-god". He based his identification on a

which he holds a brood nest. As the brood chambers are the essential element in the nurture of larvae and their metamorphosis into adult bees, this cross may also be interpreted as a symbol of rebirth.[14]

What new meanings did the cross take on once the Spanish had occupied Yucatan? During the actual conquest, Spanish clergy imposed the Christian dogma of the cross as a symbol of crucifixion and salvation (Callaway 1990), yet the Maya were able to absorb all this into their own religion without totally abandoning its principles and ritual practices. Thereafter, as Farriss points out, it is likely that the Maya vision of the cross and the image of Christ Crucified gradually fused until the cross became identified with God himself (1984: 315). From Callaway we learn that the cross in colonial Yucatan was personified as *Ca Yum Santa Cruz* ('Our Lord - Holy Cross'), as *Yax Cheel Cab* (i.e. *Yaax che' kab*, 'First Tree of Earth') and as a water deity who was invoked if the rains failed. There is evidence that, in Yucatan and beyond, remnants of an association between the cross and the fertile earth still survive (Callaway 1990). During the Caste War of the mid-18th century (Section 2.6.2.2), Maya rebels rallied to the oracle of the 'Speaking Cross' and its human agent Jacinto Canek. This illustrates how the Maya, far from simply copying Christian conceptions of the cross, imaginatively drew ideological and symbolic support from Christianity to oppose Spanish rule (Freidel *et al.* 1993: 39, 405n; Farriss 1984: 315; Sullivan 1991).

The crosses used during rituals in the Maya Zone today could easily be mistaken for those ocurring in a purely Christian context. The letters 'INRI' may even painted on the former, though most Maya are unaware of the significance of this Latin abbreviation. The cross, referred to as *le santo* ('that saint'), is regarded as a living entity

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resemblance he saw to the bee-figure in the Codex Madrid and to the diving god at Coba, as well as on a letter from Redfield informing him that the *Ah Muzenkabob* were bee-deities that dwelt in Coba (Roys 1967: 63, and see Section 8.2.3: extract from Redfield & Villa Rojas 1934). Roys having published his conclusion, other authors also assumed that the descending god was *Ah Muzenkab* and that other descending gods were bee-deities (Thompson 1934: 215n). However, it has been convincingly demonstrated that these were other deities, either corn-gods (Miller & Taube 1993) or gods that come to earth to receive offerings (cf. Wagner 1993: 59).

[14]One bee is reared in each brood cell, the Maya word for which is *uay*. Stephen and Stuart associate a glyph that occurs in classical Maya texts with this word and state that it may also refer to form-changers or to spirit companions. Among the contemporary Maya of Yucatan, *uay* commonly refers to form-changers and sorcerers (Don Beto, cf. Miller & Taube 1993) and to the brood cells in which larvae transform into adult bees. In addition to the possibility that the cross symbolizes creation and birth, it may be reasonable to hypothesize that, at the same time, the cross of the bee-deity refers to the *axis mundi* (the Milky Way in the *ek way* position - the Cordemex Maya dictionary gives the spelling *uay* - see Note 11 of this section). The contemporary Yucatecan Maya conceive of both the brood nest and the universe as structures having several layers, one upon the other, called *u yaal*. Some Maya assume that the universe and the brood nest have an equal number of layers.

and is often clad in a *huipil*, a traditional embroidered dress. Although all the crosses I have seen are larger or smaller variants of the one shown in Photo 11, Sosa describes examples which are more tree-like, with the horizontal beam turned up a little at each end (1989: 137). Crosses are frequently painted green, further evidence that a gradual process of syncretism led to the contemporary imagery of the Maya cross: the First Tree fused with the body and crucifixion of Christ (as implied in the introductory paragraph of this section). Crosses are a very important element of ceremonial practice throughout the peninsula and were part of every ritual and village fiesta I observed there. As religion is an inseparable aspect of day-to-day Maya life, crosses have meanings in a wide variety of social contexts. What follows is a description of some of my encounters with crosses during my fieldwork in the village of Tepich.

8.2.2.2 Crosses in ceremonial practice

The three main manifestations of the cross in the ceremonial practice of the Yucatecan Maya are: firstly, the placing of a cross on the altar in all rituals; secondly, the invocation of crosses by prayer and, thirdly, the decoration of ritual breadstuffs with indented crosses in the *U Hanli Kool* and *U Hanli Kab* ceremonies.

The altar cross has a fixed position, halfway along that side of the table-top which is opposite the *hmen* as he stands to recite his prayers (always facing the cross).[15] Shrines built by lay people in the homestead also have a cross. Often, a cross is temporarily installed in a small outhouse which serves as a storehouse for the rest of the year and which is separate from, but close to, the main dwelling. Some people construct the household shrine inside their main dwelling. In all ceremonies, the cross is the vital medium through which God's presence becomes tangible:

> "Jesus was crucified; it was there on the cross that He shed His blood. So the cross must be present on the *mesa* [altar]. God exercises His influence by means of the cross so that no devils will pass over the *mesa*. The cross is the Catholic symbol for the *milpa*, so no devils will pass through the *milpa*" (Don Pascual, Señor).

The widespread belief is not that the cross symbolizes God; rather, that it ensures that God, Jesus or the Holy Trinity is actually present at the altar or in other important

[15] According to Hanks (1990), in different ceremonies, the side of the altar where the cross is placed may be associated with different cardinal directions.

places such as the cornfield or the bee-house. As a "Catholic symbol for the *milpa*", the cross evidently retains its original Maya function of protection (discussed in 8.2.2.3). Many people claim that the presence of the cross on the bee-log and in the bee-house assures the bees of God's protection as they journey to *Xmaben*. Don Beto claims that the bees are granted 'fertility' and 'honey' by virtue of the cross. To ensure God's presence, a cross is erected at all ceremonies, even when lay people recite their minor prayers after the honey harvest.

Shamans incorporate crosses in their spoken prayers. I regularly heard Don Hipólito invoking "My Beloved Father, Our Lord the Most Holy Cross" (*Santísima Cruz*) or *Juan de la Cruz* in one breath with the Holy Trinity, as well as "Lord Cross of the Green Stone, Seated at the Centre of the Earth" (*Yuum Cruztuun Verde, Xan Kulukba Ti' Tu Táanchumuk*). Furthermore, he assured me that, in the *U Hanli Kab* and *U Hanli Kool* ceremonies, he always says the Lord's Prayer five times for the crosses at the four corners and centre of the world. This aspect of his prayers is essentially a vocal reproduction of the cosmic quincunx structure, as *yook'ol kab*, which he underscores with gestures by sprinkling liquid offerings to the four corners and centre-point of the altar.

In the ceremonies for the bees and the cornfield, the ritual breadstuffs (*xnohwahob* and *hostias*) occupy fixed positions on the altar corresponding to the cosmic position of the deities to whom they are offered (a detailed account of the preparations for, and performance of, these ceremonies, is given in the Prologue and Sections 5.4.7.1, 5.4.7.2 and 6.3.1.2 to 6.3.1.4). Each *xnohwah* in the standard series is decorated with its own pre-determined number of small circular indentations or 'holes', *u holob*. The first has thirteen holes, the second has twelve, and so on, counting down to seven holes. On the 13-hole *xnohwah*, either the holes themselves form a cross and a superposed arc or these symbols are inscribed, or imprinted using a wooden stamp; the same is true of the 7-hole breadstuff, except that the arc is absent; all the others simply have the appropriate number of holes in no particular form. All the *hostias* bear a cross and arc, like the 13-hole *xnohwah*. One day, Don Hipólito having prepared these ritual breadstuffs, I asked him to explain the meaning of the designs and he responded:

"These *xnohwahob* have *yaal* ('layers'). We cannot make thick tortillas of several layers, so the *holob* (holes) in the *xnohwahob* are the layers. The sky is sevenfold; it covers the earth with seven cloud layers, and that's why the *xnohwahob* have holes" (Don Hipólito, *hmen*, Tepich).

Hence it appears that the holes symbolize access or passages to the various sky layers. Of particular importance are the lowest and highest numbers (7 and 13), both of which are associated with the cross. The hosts, each bearing the cross and arc (13), are placed at the centre of the altar table, which represents *chumuk luum* (centre of earth). Directly above this point, at the *chumuk k'aan* (centre of sky), hangs the 13-hole *xnohwah* bearing the same symbols. Two arches of forest vines run diagonally between the corners of the altar, which represent the solstice points (Section 8.1), and intersect above its centre. It is from this sky-intersection that the 13-hole *xnohwah* is hung.

Other shamans make similar patterns in the *xnohwahob*, though some personal preferences are apparent. When I asked Don Crescencio about the different designs, he commented:

"Don Rocío makes a *xnohwah* with thirteen holes that forms a cross and an arc [...]. The *xnohwah* with thirteen holes is the *nohoch wah* [major tortilla]; it is placed in the centre of the table. The *xnohwahob* that only bear the cross, those with the number seven, are placed at the corners of the table. Number thirteen must go in the centre, in the *Chumuk Gloria* [Centre of Glory] because it is for the Greatest, the God of Glory. However, they [deities] instructed me differently. I only make *xnohwahob* with thirteen, nine and seven holes. Thirteen goes in the middle, and the sevens go in the corners because they are a kind of authority, they guard, they are the *Balamob*. The *xnohwahob* with the number nine also go in the middle [on both sides of the centre point of the table] because they are for the *Yumtzilob*, who are merely helpers" (Don Crescencio, *hmen*, Tepich).

Although different shamans employ different decorations and layouts, they all arrange the breadstuffs so that the crosses of lowest order (7) are at the corners of the altar and those of highest order (13) are at the centre: this is the quintessential structure. Since the *xnohwahob* are offered in thanksgiving, ideally, the number of these breadstuffs presented at the altar should be equal to the number of bee-logs or corn-sacks harvested. Therefore, the greater the yield, the greater the number of 'surplus' breadstuffs required (i.e. in addition to those needed for the basic structure). Interestingly, the shaman who performed the *U Hanli Kool* ceremony I witnessed in Señor decorated his surplus *xnohwahob* with a five-hole or quincunx pattern. The four crosses at the corners of the altar represent the solstice points of the earth and the position of the *Balamob* (guardian spirits). The surface of the altar is like a scale model of the earth and is also known as *yook'ol kab* (Sosa 1985: 380). The highest-numbered cross at the earth-centre corresponds vertically to the sky-centre or zenith point, and is for the God of Glory. This is the 'east', the sun's starting point and seat of *Yumbil Dios* (Almighty God), who is one with the sun. The intersecting diagonal arches above the altar represent the sky, and the whole structure is therefore a scale model of the entire cosmos, its principal points emphasized by the designs on those *xnohwahob* that occupy fixed positions. When reciting his prayers, the shaman further emphasizes those essential points by sprinkling liquid offerings of *saka'* and *balche'* to the four corners and centre of the model earth as well as to the four corners and centre of the model sky.

Why are *xnohwahob* with cosmic designs used only in the *U Hanli Kool* and *U Hanli Kab* and not in ceremonies for the house and village, nor in the minor rituals performed in the cornfield? Some shamans simply state that, in their dreams, the *Chakob* (rain gods) have instructed them how to arrange the altar for each type of ceremony. Don Crescencio maintains that, in rituals for the house, village and *milpa* (which are for demarcation and protection, rather than thanksgiving and exchange) crosses must be erected at the principal points of the quincunx pattern and the *hmen* may physically accentuate the periphery of the plot of land by walking around it and taking liquid offerings (*saka'* and *balche'*) to the five points. Some shamans just determine the centre point and take up position there to recite their prayers. It seems that, in such protective ceremonies, the plane quadrilateral is not a model of the earth but is actually laid out on its surface where the shaman walks, so it is unnecessary to emphasize the principal points by means of special ritual breadstuffs.

8.2.2.3 Protective crosses

Ethnographers working in the first half of this century reported that Maya villages were protected by crosses, one standing at each of the four entrances (Redfield & Villa Rojas 1934: 111). While visiting Tepich and Señor in 1994, however, I found that this custom had fallen into disuse, for both villages had more than four entrances and there were no traces of protective crosses. Elderly residents of Tepich recalled their parents' telling them how, in the aftermath of the Caste War, their village had been completely abandoned. The crumbling church and houses must have been rapidly engulfed by the forest. Eventually, a few families resettled the site and hacked away the vegetation to build their dwellings around the ruined church. To ward off the dangerous spirits of the forest, collective rituals (*lohob*) were performed at the new village entrances, crosses were installed and invisible guardians invoked. Some say these were *Balamob*; others claim they were *Yumtzilob*, forest spirits. Don Beto told me that, once the guardians were in place, their eerie shrieking echoed around the village perimeter as they scared off the venomous snakes with which the area had become infested while uninhabited.

The spirits would shriek at each entrance, and were especially active when the rainy season was approaching. Every year following the resettlement, the people took part in rituals of supplication to the divine powers at the village crosses. With the village gradually expanding, snakes became less of a problem. Some years later, Don Beto could not say exactly how many, one of the village *hmenob* purchased an effigy of *San José*, who was promptly adopted as the patron saint of Tepich. Ever since, the villagers have honoured *San José* with an extensive annual fiesta in March. According to Don Beto, this new celebration soon supplanted the traditional annual ceremony of the crosses. Villagers are said to have been greatly surprised when, in 1996, on his own initiative, Don Hipólito ceremonially reinstalled seven crosses at the entrances to the village. These entrances, like the indentations on ceremonial breadstuffs, are known as *u holob* ('the holes', cf. Sosa 1985: 242; also called *cabo'ob*, 'ends'). Don Hipólito performed inauguration ceremonies for the new crosses,[16] assisted by a group of *ejidatarios* whom he reckoned among his loyal adherents.[17] Such rituals and offerings are elaborate and lengthy, yet with teams of helpers working hard to prepare the sites, Don Hipólito managed to inaugurate all seven crosses in three days. On the eve of each day, the shaman made the ritual *balche'* (mead). At daybreak, groups of women started preparing the ritual foodstuffs. The ceremonies ended with dinner at about three o'clock in the afternoon. On the Sunday after the seventh cross was installed, there was a final ceremony with offerings and a prayer before the altar at the heart of the village. Prior to the shaman's initiative, such grand rituals would only be performed if the *ejidatarios* were struck by an epidemic or some other collective misfortune: what had inspired the shaman to restore those old traditions? Had he been instructed to do so by the ancient deities? Some months later, he was to run for *delegado* in the *ejido* elections, so it cannot be ruled out that he was seeking political support of the more traditional *ejidatarios*.[18] Be that as it may, since early 1996, the village from Tepich has again enjoyed the protection of crosses. People returning from the *milpas* or the forest can

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[16]The ceremonies were funded by the government agency *Culturas Populares*, based in Felipe Carrillo Puerto.

[17]Although the communal land-use organizations known as *ejidos* originated in the colonial era, they have become as intimately involved in Maya ceremony as the image of Christ Crucified.

[18]In the previous election campaign, that of 1993, Don Hipólito had strongly supported the candidacy of the man who eventually became *delegado*, even though the latter had shown no interest in the post and had not even registered himself as a contender. It was Don Hipólito who put him forward and, in the end, the man won *in absentia*. Soon after the elections, however, the relationship soured because the *delegado* seemed to be turning a deaf ear to the shaman's advice. Since then, the shaman has vigorously opposed this official representative of the *ejido*, winning the greatest support from members of the community on whose behalf he performs rituals.

now rid themselves of disease-laden winds or spirits at one of the crosses, while the seven *Balamob* ensure that no snake or ill wind can violate the village. Protective crosses may also be erected at the corners of a newly established cornfield or homestead plot (Sections 6.2, 6.3.1.1 & 6.3.1.5). The fundamental purpose of such rituals is to install guardian spirits. Although these often take up their positions at crosses (Section 8.2.3), at the corners of the *milpa* and the *solar* they sometimes have to make do with no such device.

8.2.2.4 Crosses at the centre of a defined area

Crosses or trees are also placed at the centre of circumscribed areas; for example, the bullring in the fiesta of the patron saint. While it may be true that the adoption of *San José* in Tepich initially made the use of protective crosses redundant, their restoration certainly did not have the opposite effect, for the annual fiesta in his honour has grown into a flamboyant ten-day celebration. Each day of the fiesta is sponsored and managed by a group of volunteers. Special food has to be prepared; there are bullfights[19] to be organized for the daytime and live music after nightfall. For the fiesta I experienced in March 1996, the *delegado* and his immediate family took sole charge of the first day. During the previous week, the bull-ring had taken shape in the village's central plaza. The first task facing the family was to prepare a special meal for all the villagers, using enormous pans of chilies. The delegate hired bullfighters, musicians, a jury to select the beauty who would be crowned Tepich Fiesta Queen, another jury for the dance competition and professional Maya dancers for the grand opening. Posters appeared around the village, leaving no one in doubt that the *delegado* had arranged a lavish programme for the first day. Before that, however, Don Hipólito and his followers were to perform their own opening ceremony in accordance with traditional precepts, as they do every year. On the eve of the official opening, they cut down a young *Yaax Che'* (Ceiba) tree and, accompanied by musicians playing drum, flute and fiddle, they carried the tree to a house near the central plaza. That night, we danced the *Mayapax* into the small hours. At dawn, a young 'god' (one of the village boys) took his 'seat' in the *Yaax Che'*. In a procession formed by the consort of music, the women in their

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[19]The Spaniards brought cattle to the region and introduced bullfighting. In the literature, ceremonies for the protector deities of cows and bulls are described as being quite different to other Maya rituals. Evidently, such ceremonies were often regarded as inferior (Section 4.5).

festive *huipiles* and Don Hipólito at the head, the boy was transported to the centre of the bullring, where the tree in which he was sitting was set up (see Photo 12).[20] The fiesta had begun! From the tree, the 'god' scattered squash seeds while Don Hipólito distributed liquor to all those present. For the next ten days, the bullring with its *Yaax Che'* became the centre of Tepich and, as far as many of the villagers were concerned, the very centre of the earth.

In fact, the true or fixed centre of the earth is understood to be at a place called Xok'en (see Photo 11), about sixty kilometres from Tepich in Yucatan State (see map), where the centre cross of the world stands. According to the *hmen* Don Crescencio, the cross, which is painted green, is known as *Santísima Juan de la Cruz*, *Tres Personas Balamtun Rosa*, *Xmabentun de la Gracia*, *Tres Personas u Cruz Verde* ("Most Holy Juan of the Cross - i.e. Jesus Christ -, Trinity Jaguar-stone Rosa, Xmaben-stone of the Grace, Trinity of the Green Cross"). By these names, the cross simultaneously represents a quadruple deity and the Holy Trinity, or *Tres Personas*.[21] Don Crescencio accounts for this combination of quadruple and triple identities in a single cross as follows:

"Xok'en is the centre of the world because Jesus stood up when the cross was erected. That's why many people say it is the centre of the world. Outside the house of the cross, there's a road leading to Chun Pom, one to Tixcacal Guardia, another to Tulum and yet another to Chan Veracruz. These roads lead to all four places" (Don Crescencio).

These are the sacred places of the contemporary Maya.[22] Legend has it that the cross at Xok'en is deeply rooted in (properly speaking: 'one with') the earth. Once, some sceptics tried to uproot the cross but it began to bleed. Since then, the cross has been left in peace and a house has been built around it for protection. Particularly on *Viernes Santo* (Good Friday), people take flowers to the cross and burn candles in its honour. Throughout the year, people bring to the cross wax sculptures of body parts or photographs of the afflicted in supplication for a cure (in Maya: *k'ex*, a change of state or fortune).[23] Don Crescencio also told me that there used to be a holy book at

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[20]This practice is reminiscent of the creation myth, as explained by Freidel *et al.* 1993, in which First Father lands in a tree (see Note 11 of this section).

[21]When Spanish clergy first introduced the doctrine of the Holy Trinity to Yucatan, the Maya had little difficulty accepting it because they were already familiar with the idea of quadruple deities. The two beliefs appear to have fused smoothly into a compound concept.

[22]Some shamans in Tepich also refer to other sacred sites. For more information on shrine centres, see Sullivan (1991).

[23]In Esquipulas, Guatemala, people also bring wax sculptures and photographs to the crucified 'Black Jesus' to petition for healing. As previously explained, the cross in Yucatan embodies Christ Crucified, and this concept has also become essential to the earth-centre cross at Xok'en.

Xok'en, 'the Testament', but it was stolen. The book related how Almighty God had created the world, right there at Xok'en. To Don Crescencio, Xok'en means "the Day will come"; that is, the end of the world, when the people will again read the Testament.

8.2.2.5 Corresponding meanings of the cross in different contexts

The fundamental meanings that are fused in the symbol of the cross are manifest in different ways, depending on the context. The cross, often made of wood, is interchangeable with a tree. The symbol is associated with the centre of a pre-defined area in two senses: firstly, as a tree it becomes the centre of the village fiesta and, secondly, as a cross it is the centre of the world in Xok'en. This idea corresponds to the more general conceptualization or modelling of the cosmos, in which there are four crosses at the corners of the world and one in the middle. Although contemporary villages generally have more than four entrances and therefore require more than four protective crosses, the idea of a perimeter delineated by crosses and associated with a centre point is also evident in the layout of the village. The quincunx pattern, representing the cardinal points or directions of the cosmic structure, always appears when a scale model of the earth is established; for example, when the boundaries of a cornfield or homestead plot are drawn, when an altar is set up and when a bee-hive is inscribed. In the *U Hanli Kool* and *U Hanli Kab* ceremonies, the same pattern is manifest in the number and position of the ritual breadstuffs on the altar, corresponding to the relative cosmic positions of the deities. To the Yucatecan Maya, this ancient cosmological symbolism is in no sense incompatible with implanted notions of the crucifixion and the presence of God or the Holy Trinity. Without any difficulty, Christian values associated with the cross have become inextricably intertwined with the ancient Maya view of the universe.

The cross in beekeeping expresses manifold concepts. On the one hand, the cross inscribed on the bee-log has as its base the centre of a plane quadrilateral, *yook'ol kab*, similarly to the wooden cross which stands at the centre of the earth's surface, a square also known as *yook'ol kab*. On the other hand, the cross assures the bees of God's presence and protection. Significantly, the celestial field of flowers, *Xmaben*, to which only the native stingless bee *Xunan kab* has access, is located in *u Gloria*, somewhere at or near the centre of the universe and therefore above the cross at Xok'en. Only the bees know exactly where the field is. There is another remarkable aspect of the design on the bee-log which has yet to be discussed. It concerns the soldier bee in the nest-entrance, at the foot of the cross, in the very centre of *yook'ol kab*.

8.2.3 The Soldier Bee *Balam Kab*

The soldier bee that guards the entrance of the *Xunan kab* hive is called the *cintenela* ('sentinel'). Even those who only speak Maya use this Spanish name, instead of the original Maya name for this bee, *Balamil kab* or *Balam kab*[24] (Cordemex Maya dictionary; Castro Aguilar 1971: 11). To the Maya, this soldier bee functions in very much the same way as other guardians, including sentinels at a shrine centre and the invisible guardian spirits known as *Balamob*. The soldier bee stands guard in the nest-entrance (called *u hol*, 'its hole') at the foot of the cross and keeps out unwelcome insects. When ants try to invade the nest, the soldier bee and other members of an elite guard squad block the entrance hole with their bodies and fight to the death to defend their nest-mates. With similar devotion to duty, the *Balamob* stationed at the *u holob* (entrances) of the village or at the corners of the *milpa* and *solar* keep out all anti-social elements. The Maya greatly admire the soldier bees and compare them to their human counterparts: the sentinels in the doorways (*u holob*) of the shrine centre at Xcacal Guardia, who may deny visitors access to the place or whip them with a branch if they are not properly dressed. Beekeepers regard both the soldier bees and the shrine guardians as carefully selected members of their respective communities, who take turns to stand guard every two weeks.[25] *Balamob* are always associated with the earth; they protect a particular piece of land, whether it be a cultivated plot or a domestic area (Hanks 1990: 341) or, by homology, the 'earth' of the beehive. The position of the soldier bee further illustrates this argument.

The soldier bee is 'seated' at 'its hole' (*u hol*), the centre point of the quincunx design. I stated in Section 8.2.1 that the *hmenob* Don Hipólito and Don Nicolas referred to this figure as the *k'anche* or "bench (table) of the cross". Crosses, benches and *Balamob* are closely related:

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[24]In Tepich and the *ejido* of Xmaben, people use *Balam kab* to refer to a local wasp species. In this context, *kab* can be translated as 'earth' because this ferocious stinging wasp dwells in the ground.

[25]Guardians appointed to the Xcacal Guardia shrine may invite people from the *ejidos* to join their ranks. As they prefer those who are seriously involved in Maya tradition, they usually select *hmenob* for the job.

"[...] it is almost inconceivable to have a cross without it being on a table of some kind. The exegetical explanation for this practice is that these crosses are the position of *Yum Balam*, the guardian deity" (Sosa 1985: 243).

Balamob are also closely associated with holes (*u holob*): they are said to dwell in underground caves and, at dusk, to exit through holes to take up their positions at crosses (Sosa 1985: 246-248). The entrances to the village and the bee-hive are conceived of and referred to as holes. In other words, the sentinel bee of the hive is located exactly where a *Balam* is expected to be. Holes have even more meanings, though: firstly, the Maya believe that, at night, a person's soul may leave his or her body through a nostril and pass through a nostril into another person, who will then start dreaming (ibid.: 276); secondly, in Maya cosmology, upward or downward access to the next layer of the universe is gained through the eastern and western holes, which is why the ritual breadstuffs are indented with 'holes' (the holes represent the layers); finally, the bee-log actually has three holes: one at each end (the significance of which I discuss in Section 8.3.2) and one halfway along at the foot of the cross, i.e. at the place of the *Balam*.[26] The ancient meaning of *Balam* is 'priest' or 'jaguar', and jaguars are said to lie in wait for their prey at the foot of a *che'* (meaning 'tree' or 'cross' - ibid.: 244; Cordemex Maya dictionary).

Interestingly, at the beginning of this century, some informants of Redfield and Villa Rojas seemed to combine these different conceptualizations of the *Balamob*:

"[The *x-mulzencabob*] dwell in a certain place at Coba, where there is much red earth and many nests of bees (such as wild bees make). This place is inaccessible and protected by a tiger-like animal with a long tongue, called *hak-madz*, who devours anyone who attempts to enter the place. It is the business of the *x-mulzencabob* to inform the *noh-yum-cab* [Great Lord Bee] of everything that happens in the apiary [i.e. meliponary]. Then come the bees known as *bolon-hobon* ['nine(?) hives']. Their task is to cure the bees who have been injured when honey is taken from the hives. If, on a Saturday, a bee is reported missing, one of these *bolon-hobon* goes out to search for the lost one, to cure or revive him. The next class is known as *balam-cabob*. They remain at the beehives and keep away the evil winds" (Redfield & Villa Rojas 1934: 117, their spellings of Maya in italics).

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[26]Sosa demonstrates that the analogy between *Balamob*, holes and crosses can be extended to yet another form of cross: the nests of the wasp species *Chelem*, which are hung at doorways or on the walls of houses to protect people against certain dangers. "Why in particular a wasp nest?" he asks himself. He finds the answer in the similarity between the *Chelem* nest and the dwelling place of the *Balamob*. The wasps' nest hangs from a tree and is perforated with round holes. The wasps only enter the nest through the bottom hole, yet leave it through the many side-holes. As *Balamob* leave their caves to take position at the village entrances (*u holob kah*), Sosa concludes that there is a structural parallel in the inward- and outward-bound movements of *Balamob* and *Chelem* (Sosa 1985: 245-247).

Redfield and Villa Rojas also recognize that the *Balamob* are guardian deities who protect the hive (ibid.: 116). Furthermore, in a footnote, they add that a layman calls the soldier bee *Balam k'anche* rather than *Balam kab*. Taken together, all this evidence sheds light on the structural equivalences between the various roles of *Balamob*. They ward off different kinds of evil on earths of different scale, including the 'earth' of the bees (the nest or hive). They are associated with *k'anche* ('the bench of the cross') and are themselves protected by a kind of jaguar. Moreover, since *kab* (hive) also means 'earth' and bees are 'seated' in the *u hol* ('nest-entrance'), all the various kinds of *Balamob* dwell in some kind of earth.

To conclude, then, the ancient name of the soldier bee in the nest-entrance, *Balam*, denotes its function as guardian of the beehive, corresponding to the function of the *Balam* spirit or deity, which guards a defined area of the earth. In the Maya perception, the role of the soldier bee has not changed over the centuries and can therefore still be considered equivalent to the role of its spirit counterpart. All *Balamob*, of whatever kind, live in holes. In the modern era, the word *Balam* in reference to the soldier bee (and the guard of the shrine centre) has been supplanted by the Spanish *cintenela*, the nearest equivalent in one sense. Possibly, the word has survived in modern usage only in the sense of 'guardian spirit' because such spirits were invisible to the Spanish conquerors, who did their utmost to extinguish all visible form of Maya 'idolatry'.

8.2.4 The human earth and the bee-earth: an overview of equivalences

So far, I have established several links between the human earth and the bee-earth. Firstly, both are within the semantic field of the utterance *kab*. Secondly, the square figure connected to the cross on the bee-log signifies *yook'ol kab*, 'upon the earth'. This central cross rises from the nest-entrance, which forms the centre of the square figure. The use of a square figure with centre point to represent the surface of the earth or a smaller domain such as the bee-log parallels the construction of a temporary quincunx pattern when cornfields are cultivated or village fiestas celebrated. Thirdly, *Balamob* guard different kinds of earth on different scales (i.e. *milpa*, village, homestead). The soldier bees in nest-entrances were formerly called *Balamob* too. The concept of these soldier bees corresponds closely to that of other *Balamob*, who guard a rectangular plot, enter and leave the earth through holes and take up positions at crosses or trees. Finally, in ceremonial practice, the altar itself is a scale model of the earth's surface. The two arcs that are built above the altar in the bee and cornfield ceremonies represent the sky, their intersection forming its centre point. This pattern is reinforced by the designs on, and location of, the ritual breadstuffs placed on the altar. This is not the case in all other ceremonies (including those to obtain a cure or the protection of a cornfield, homestead or village), which do not require *xnohwahob*, for the physical plot itself is fundamental to the ceremony, there is no modelling.

In the Maya view, the beekeeper actually creates an 'earth' when he makes a new log for his bees, and realizing this sheds new light on the details of the practice. In Section 5.1, I described how the beekeeper wedges the log upright between three stones and scorches its core with a live coal to facilitate removal of the wood with a hammer and gouge. Once this task is accomplished, the beekeeper makes the hole that will function as nest-entrance and inscribes around it a square figure, *yook'ol kab*, with a cross on top. Once the hive is populated by bees, the act of creating a new bee-earth has been fulfilled. This closely resembles the divine act of making and populating the world as related in the creation myth of the Classical Maya, in which First Father is brought to the 'three hearthstones' of the constellation Orion (i.e. Alnitak, Rigel and Saiph: Freidel *et al.* 1993: 79). The contemporary Maya associate these stars, which form an equilateral triangle, with the three stones between which the kitchen fire burns. The K'iché Maya see the group of stars and nebulae at the centre of the triangle (Orion's Sword) as the smoke of the fire. Interestingly, the Aztecs used to associate the three stars at the apex of the triangle (Orion's Belt, including Alnitak) with a drill of fire that created new fires. In the Maya creation myth, First Father raises the cross (*axis mundi*) and establishes the earth by unfolding *yook'ol kab* before populating it with the people he creates (Freidel *et al.* 1993, Note 11). By creating a new bee-earth and populating it with *Xunan kab*, the beekeeper recapitulates the divine act of creating the human earth. As the difference between people and gods is a question of power rather than morality (Köhler 1988: 149), the Maya, by creating a bee-earth, establish their place between gods and bees in the hierarchy of beings.

8.3 Solar motion around different kinds of 'earth'

Having shown that the bee-log is conceived of as a kind of earth, I am now concerned with examining the consequences of such a notion. In Section 8.1, I described how the contemporary Maya interpret the motion of the sun along its diurnal and nocturnal paths. In Section 8.3.1, I briefly examine how solar motion governs ceremonial practice (for an exhaustive description, see Sosa 1985) and in Section 8.3.2, I discuss how this influences beekeeping.

8.3.1 Solar motion around the altar

The sun is associated with the presence of *Yumbil Dios*, or Almighty God, and Jesus Christ (Sosa 1985: 259-262, 412, 420) and therefore its motion implies theirs (cf. Vogt 1976; Gossen 1974; Guiteras Holmes 1961). The rising sun is equivalent to God ascending. At noon, the sun reaches the hole at the zenith, which is open at that time. The shamans in the village Yalcoba believe that God can receive offerings at the zenith, though not every day, for the sun is the source of *iikob* (winds) and these are not always favourable. The winds it releases through the hole on Tuesdays and Fridays are evil, whereas good winds carry God's blessing to earth on Saturdays and Sundays. For this reason, the shamans of Yalcoba argue, all ceremonies - except those for healing purposes - must be performed on Saturdays and Sundays. Because disease is often brought by wind, the *hmenob* make use of solar motion to cure the ill as dusk approaches, sweeping the responsible evil wind back to its source just as the sun is about to disappear through the hole in the west. As the hole at the zenith always releases winds when open, an opposite motion of equal strength is needed if offerings are to reach God on Saturdays and Sundays. The rising of smoke when incense is burned constitutes such an opposite and results in "the sky forcibly holding its breath" (ibid.: 348). The shamans of Yalcoba also make use of solar motion to bake ritual breadstuffs in the earth-oven (*pib*) at night, believing that the sun warms the underside of the earth. In their ritual discourse, Jesus Christ is identified with the host (which, according to Sosa, is equivalent with *xnohwah*). When a shaman removes the breadstuffs from the earth-oven at daybreak and puts them on the altar, he refers to them as "holy light" in his accompanying prayer (ibid.: 366). In this sense, dawn upon the earth is parallel to dawn upon the altar (Sosa 1985).

In Tepich, ceremonial practice is no less strictly governed by the motion of the sun and *Yumbil Dios*. There, the preparation of ritual foodstuffs starts on the eve of the ceremony, so that, at noon, everything is ready to be offered when God is in his seat at the zenith. As in Yalcoba, breadstuffs are cooked in the *pib* at nighttime (Section 6.3.1.3), though the shamans of Tepich clearly distinguish host from *xnohwah*. Threefold offerings of *hostias*, containing *Xunan kab* honey and symbolizing the body of Christ, are made to the Holy Trinity. The hosts are placed at the centre of the table and then raised up in offering to the sky. All the *hmenob* of Tepich agree that evil winds affect the earth on Tuesdays and Fridays, whereas God accepts offerings at noon on the other days of the week. Incense (i.e. tree-resin, *pom*; or bee-resin, *chal*, produced by *Xunan kab*) is indispensable if offerings are to reach God in the sky. This explains why his offerings are suspended from the centre point of the sky-model above the altar, while lesser deities must consume their offerings on the table.

8.3.2 Solar motion around the bee-earth

Given that the Maya regard the bee-earth (*kab*) and the human earth (*kab*) as equivalent structures, how does solar motion influence the keeping of bees in logs? In order to answer this question, it is necessary to consider the log populated by *Xunan kab* and the distinction beekeepers make between their domesticated *Xunan kab* and un-domesticated forest bees.

Hives of *Xunan kab* are placed horizontally in special bee-houses that run east-west. The openings at the ends of the bee-log, the 'holes' (*holob*) through which honey is extracted, therefore face the eastern and western sides of the earth, which is conceived of as a square, *yook'ol kab*. In other words, these two holes in the bee-earth correspond to those at the extremes of the much larger human earth through which the sun passes at dawn and dusk. These end-holes of the *hobon* are also appropriately positioned relative to the eastern and western sides of *yook'ol kab*, the square inscribed on the bee-log (see Figure 8.2). In addition, the entrance-hole at the centre of the smaller *yook'ol kab*, from which the inscribed cross rises, is associated with the hole at the sky-centre, for the cross points to the sun at its zenith.[27] In effect, the sun follows exactly the same course around the bee-log, the earth of *Xunan kab*, as it does around the earth of we humans. This is borne out by the fact that, when the shaman cited by Sosa took his ritual breadstuffs out of the earth-oven, he used a single verb (*puus*) and a corresponding gesture to indicate that he was extracting honey and host at the same time. The hive must be opened to extract honey, just as the earth-oven must be opened to extract the host; hence, the shaman implied that the bee-earth is equivalent to the human earth (Sosa 1985: 366-367).

Since the hives of the most commonly cultivated forest bees - *Xiik'*, *E'hol* and

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[27]The nest-entrance is at the foot of the cross (the place of *Balam*) rather than at its head, which actually corresponds more closely to the hole at the sky-centre. Even for the Maya, it is impossible to make all the imagery match the underlying concepts.

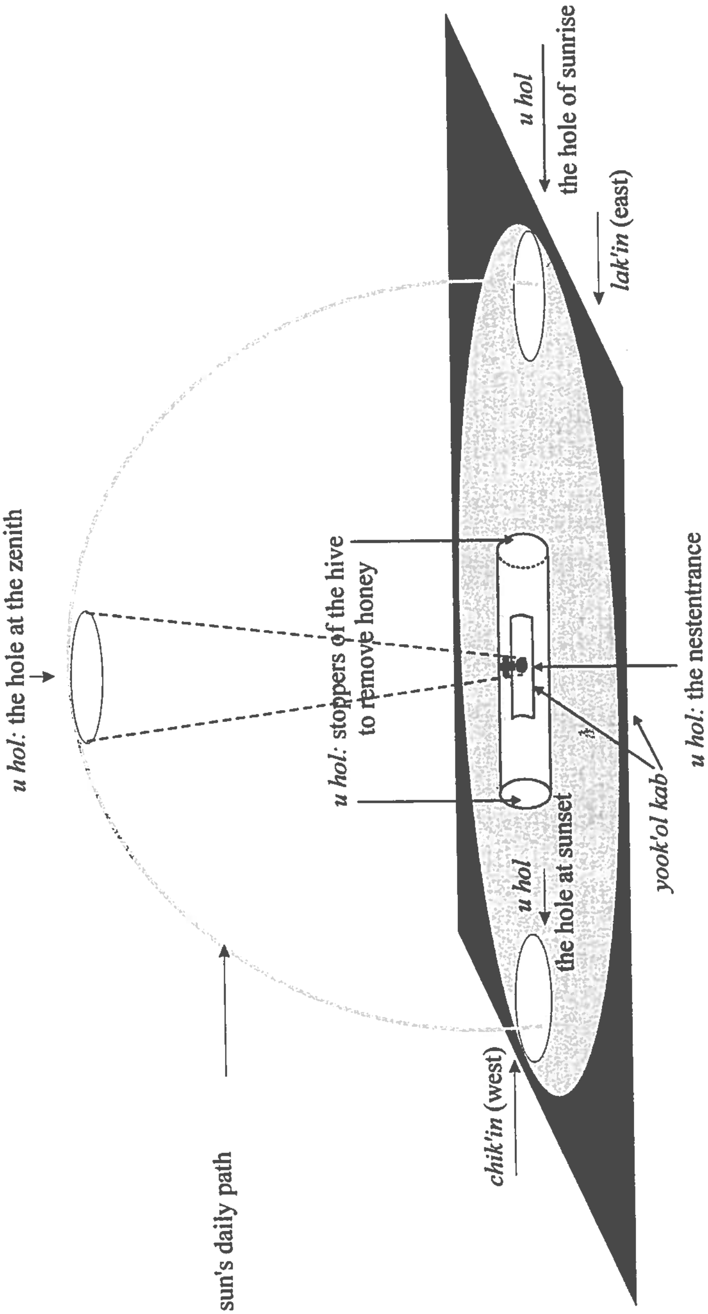

Figure 8.2: The positioning of the holes of the hive in relation to the holes of the earth.

Kansak - are generally kept upright, the sun does not follow the same path around these bee-logs as it does around the human earth. Furthermore, logs of forest bees never bear an inscription around the nest-entrance. These bees belong to the forest, which is regarded as 'cold' (*sis*), and, when cultivated in the homestead, they should always be kept at a distance from domesticated *Xunan kab*. This deliberate separation of the two kinds of bees has an interesting consequence, which also sheds light on the seemingly inexplicable paradox that emerged in the conclusions of Section 7. The paradox is that, even though women are generally considered to be humorally 'colder' than men, the 'female' bee *Xunan kab* produces 'warm' honey while the 'male' forest bees produce 'cold' honeys. In Section 7.5.4, I argued that the sun is the source of this relative heat in people. The sun is also the source of relative heat in honey. In the daytime, the sun's position with respect to the human earth is exactly the same as its position with respect to the smaller bee-earth of *Xunan kab*; therefore, in tracing its celestial arc, the sun heats the earth of humans and bees alike. In contrast, logs of forest bees are either placed upright or, more commonly, are not cultivated at all but left in the 'cool' forest (where, as some beekeepers argue, they build vertical nests in the trunks of trees). However, only horizontal logs can be heated by the sun, which explains why the 'female' bee *Xunan kab* produces 'warm' honey while 'male' forest bees produce 'cold' honeys. The relative heat of the honeys is not a direct result of gender; the warming sun is the main factor. Cosmic motions influence the bee-earth and the human earth equally, so honey should never be taken from hives on Tuesdays or Fridays, for that is when evil winds blow from the sky to the earth. If such a wind were to be caught in the hive, the bees would fall ill. Like all celestial beings, *Kun K'u*, the principal bee-deity formerly associated with the Pleiades (Section 8.1), describes an east-west arc over the bee-log. In the annual cycle, this means that, when he resides in the east (from March to early May), he sends light rain (*man ha' che'*) so that flowers will produce nectar for the bees, but when he moves to the west in June, his rains become much heavier.[28] Cosmic motions thus affect the earth of *Xunan kab* in the same way as they affect the human earth.

[28]There is an inconsistency here, for the movement of *Kun K'u* as described does not match the motion of the Pleiades: in June, they are visible in the east before dawn; in April, they are visible in the west after dusk. Perhaps Sosa (1985: 454) was mistaken in associating the Pleiades with *Kun K'u*.

8.4. The human body: another kind of earth

In Section 7.7, the earth was compared to the womb. At that point in the dissertation, however, the connection that Hanks had noted in Ozkutxkab between the two senses of *hobon* as "bee-log" and "woman's womb" remained unclear, and we could only assume that the link is still recognized by the Maya villagers. In the light of comparisons drawn in the present section, it seems possible that the linking factor consists in both bee-log and womb being conceived of as some kind of earth. In Section 7.7, Don Medardo related that if Adam and Eve had not sinned, people would still be born of the collective womb that is the earth. Apparently, there is a structural equivalence between the earth we all live upon, the bee-earth and the human body. Don Medardo explains it as follows:

"We are all earth (luum) because we come from the earth. The water in the earth is like the blood in your veins. Your soul is your wind. The earth is your companion, your mother (*u na' maak*), and the sun is your father (*u tata maak*). There are a few places with lakes and suchlike. It is said that water is the blood of the earth. When you want to make a well, you must dig a hole to reach the water inside the earth. Thus you reach the veins of the earth. It is like our body: the earth has a lot of veins where there is water, the blood of the earth. The *hobon* is also an earth and the honey is its water or blood" (Don Medardo, *hmen*, Tepich).

Since water mostly flows underground in Yucatan and comes to the surface via *cenotes*, or sink-wells, the comparison between the human body and the earth is consistent with the geographical environment. Other shamans confirm that the human body is a kind of earth and also call it *luum* (earth). According to Don Beto, God made people out of earth and their stomachs out of corn (Section 7.5.1). Shaman Don Kanuto says people must be made of earth because you always feel a little dirth on your body. Hanks comments:

"The body is made up of the same elements as is the rest of the material world: a person's *wiínklil* 'body' is his or her *lu'um* 'earth'. One's breath and animacy are one's *iík'* 'wind' - also related to *yiík'al* 'force, heat of a fire, momentum' and *yiik'el* 'bees' (of a hive), 'ants' (swarming in the earth). [...] Through the double action of heat and the movement caused by the body's wind, the water of one's earth is transformed into *k'iik'el* 'blood'" (Hanks 1990: 86-87).

The human body, like the earth, has heat, water and wind, as is evident in bodily processes such as sweating, fever and rage. In addition, a change in one of the various earths can affect the condition of any other. Don Medardo explains this too:

"If you leave your house and neglect it, if you no longer take care of your home, some years later it will remind you, it will punish you. Then you will feel that your whole body is irritated, that these *Pai*, these creatures, are biting you. They are the same *Pai* that live in the *hobon*. Sometimes they just come out of the earth. You did something wrong: you did not perform a *loh*, for instance, and you see the earth swarming with *Pai*" (Don Medardo, *hmen*, Tepich).

Villa Rojas wrote that people in Chan Kom consider the human body to be a replica of the cosmic structure, with a central point (the navel or belly button) and four 'directions' corresponding to the cardinal points (Villa Rojas 1979: 14). This concept is not confined to the Yucatecan Maya, for, as Vogt shows, the Zinacantecan Maya regard the centre of the earth as the "navel of the earth" (*mixik' balamil*):

"It seems to me that, in Zinacantecan Maya as well, *balamil* means centre of the world and that *mixik'* possible refers to the navel or to the world" (1976: 7, 13).

In general terms, the shamans of Tepich confirm that the body is a kind of earth, and this structural equivalence also holds true for the 'centre point' of the body. According to Don Kanuto, the centre of the earth corresponds to the centre of body, i.e. the navel, and to the centre of the bee-log. Similarly, Don Crescencio regards the cross at Xok'en, the centre of the world, as corresponding to the human navel, for he sees the centres of the sky, earth, body and hive as equivalents. Since the Maya recognize quadruple deities, the multi-dimensional 'earth' and 'earth-centre' do not present them with any difficulty. These earths can mutually influence each other: as Don Medardo's example of the neglected home illustrates, changes in the demarcated 'earth' of the homestead can affect the human body. This is also the case when a spirit enters the *solar* and one of the co-residents simultaneously falls ill. The victim can be cured by means of a ceremony in which guardian spirits are mobilized to capture the spirit and eject it from the domestic space (*hmen* Don Medardo, cf. Hanks 1990: 345-348). In healing practice, the altar can be used as a scale model of the earth to actually sweep spirits away (Sosa 1985: 348). Ants further illustrate the structural equivalence between the human body and the earth. If a child is too hot-tempered or an adult is regularly irritated, this is ascribed to the ants, *k'uul síinik*, which dwell in the earth. When the ants irritate the blood in a human body, a bruise appears on the victim's neck. The cure is to rub ants' eggs on the bruised spot.[29] In the mind of the Maya, the human body, the earth and the bee-hive form a set of homologous elements which correspond

[29]Similar notions of ants disturbing the human body and having to be driven out are described in the literature (Villa Rojas 1979: 3; Redfield & Villa Rojas 1934: 244).

to the elements blood, water and honey of another such set. Of great importance to Maya practice is the concept that any element of one set can affect the corresponding element of another set.

8.5 The *sastun*: dawn upon the shaman's earth

The key attribute which the shaman uses to communicate with the gods of Otherworld is his *sastun* (literally, 'light-rock': Hanks 1990: 247), a transparent crystal or glass which affords him insight into spiritual motion over the various kinds of earth. What is the power of the *sastun* and how does it work?

Properly speaking, the *sastun* itself is a kind of earth which, because it is transparent, renders events in other kinds of earth visible. The shaman keeps his crystal and other secret attributes wrapped in a cloth. During rituals, he places the cloth between the cross and the host offering on the altar. After his words of prayer have risen with the smoke of incense to the sky-centre, the shaman takes his crystal and holds it up to the light of a candle (see Photo #). By this act, dawn breaks on the transparent earth. In the light of the candle, the *sastun* becomes a diagnostic tool with which the shaman interprets reflections by referring to a broad system of knowledge. The gods send messages through the crystal (for example, those concerning any deficiency in, or omission of, a ceremony) by revealing the altar in the *sastun* or by illuminating roaming spirits and other causes of illness to the shaman. The shaman repeats this act of illumination (known as *ilmah*) several times, and may obtain different information each time. Fundamental to this system is the idea that a certain part of the crystal reveals information about other earths, such as the human body and the homestead. Some shamans roughly divide their *sastun* into a left- and a right-hand side, which correspond to death and healing respectively; others interpret the orientation of the reflection: horizontal, slanting "like a drunk", or vertical. Whereas the first two orientations indicate the possibility of a cure, the last means death. If the crystal remains blurred or misty, the illness has a purely physiological root.[30] The

[30]Although shamans told me a little about this practice, I still do not know exactly how the system works. Reichel-Dolmatoff has described how Tukanoan shamans use the hexagonal structure of the rock crystal and the colours of the prismatic spectrum, which are visible under certain light conditions, to interpret messages (1979: 129-150). In Maya symbolism, colours are associated with directions and deities, and I therefore suspect that the Maya shamans interpret the colours of the spectrum in combination with the part of the crystal in which they appear. Shamans also employ other techniques of divination: for example, throwing a handful of corn kernels to the floor to investigate the source of an illness. The grouping of the

flame of the candle thus serves as an artificial sun. From the candle itself runs *itz*, molten wax, which corresponds to the divine substance flowing from the sky.[31] The light of the candle reveals movements of the deities which are otherwise invisible to the naked human eye.

Hence the *sastun* is indispensable if the *hmen* is to communicate with the gods. If a Maya is destined to become a shaman, the *Chakob* (rain gods) will ensure that he finds a *sastun* somewhere on his path through life. However, a crystal thus encountered is still 'virgin' and will not work until it is brought to life. This is achieved during a special ritual by administering *balche'* (mead) to the crystal. Why does *balche'* have the power to give life to a stone? The key is that it contains life-blood in the form of *Xunan kab* honey. As became apparent in Section 8.4, shamans regard blood in the human body, water in the earth and honey in the hive as equivalents. Moreover, Don Medardo explained that as people grow older, their blood dries up and they finally die (Section 7.5.4). Similarly, without rain no corn will grow, no flower will produce nectar and, without honey, the bees in the hive will die out and people will cease to be fertile. The fermented *Xunan kab* honey in *balche'* is the life-giving fluid which makes all the difference between a 'dry' or dead *sastun* and a 'moist' or vivid one. Interestingly in this context, the shaman in Sosa's work says that *balche'* is the blood of God and the Virgin Mary (1985: 364). This aspect makes the fermented mead particularly holy, which is why it serves to consecrate the earth, the cross on which Jesus Christ bled and other important ritual attributes such as ceremonial breadstuffs.

Once his *sastun* has been brought to life, a shaman needs *balche'* every year to continue his work. This idea is in turn related to *helep*, 'transformation'. Every year, in the period from the 16th to the 20th of July, there is a major reshuffle in the world of the deities, the responsibilities of each particular deity being passed on to another.[32]

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kernels into even and odd numbers tells the shaman whether the question he posed mentally is relevant to the real cause of the problem. Other objects may be similarly used, including electric light bulbs and fungi that grow on eggs. During the process of divination, the shaman may be helped by certain signals or impulses he feels in his body.

[31]Among the contemporary Maya, *itz* not only denotes molten candle wax but also bodily excretions such as sweat, tears, milk and semen, as well as tree sap. In ancient times, people regarded *itz* as a supplement to, or even a substitute for, blood offerings. *Itzam*, "he who works with *itz*" (the cosmic sap of the World Tree) was the first shaman (Freidel *et al.* 1993: 210-213, 411-412).

[32]In the 19th century, Pio Pérez wrote that, for the Yucatecan Maya, the new *Haab* year (consisting of 360 days, plus a five-day period called *Wayeb Haab*) started on 16 July, the day on which the sun was said to return to the zenith above the peninsula on its way to the southern regions (i.e. those below latitude 20 degrees north). Pérez comments that this Maya calculation was only forty-eight hours in error (cited by Aveni 1981: 167). According to Bishop Landa, 16 July was the first day of the new year ([1566]1992: 112). The five nameless days of the period called *Wayeb* preceded the New Year, at which offerings were made.

Chakob or *Balamob* are functions rather than personalities, and the *hmenob* need their co-operation to be able to execute their duties:

"It is like a change of authorities. Yet the gods change every year; all the gods. On the 16th of July, they abandon their work until the 20th of July, when they start working again. In this period, I do my *k'ex* [ritual of change]. If you do not perform your *k'ex*, you cannot resume your work, you cannot cure anybody and you cannot perform any ceremony. We start working again on the 20th" (Don Medardo, *hmen*, Tepich).

During the *k'ex* (a ritual for an important change of state or fortune), the *hmenob* present themselves to the newly assigned divine authorities and ask for their help in shamanistic practice. In order to pay for the ritual, the shamans ask for a contribution from their clientele. Shamans do indeed have regular clients, which obviously makes their work easier, for they can keep a record of whether the people have performed their ceremonies or not. The customers can pay in cash or in kind (chickens, honey, corn, etc.). During the *k'ex* ceremony, the shaman consults his *sastun* to check whether he himself has paid all his debts dues and fulfilled all his obligations to the deities, before bathing his crystal in *balche'*. Up above, in the sky, sits *Ah Ka'an Tzib*, 'Lord Celestial Scribe', who keeps account of all the shamans who have asked permission to work for one more year. Replenished with lifeblood, the *sastun* is also ready to work for another solar cycle.

Midwifes, like shamans, perform their own *k'ex* in July. They also keep a *sastun*,[33] but bathe it in *saka'* (corn-gruel) rather than *balche'* to renew its power:

"Midwifes are women, so their change ritual is different to the *k'ex* of the *hmenob*. That's because the shamans talk and work with pure *Balamob*. The midwifes, though, talk with pure Virgins because they work mainly with women" (Don Medardo, *hmen*, Tepich).

Whereas Don Medardo directs his prayers to the *Balamob*, other shamans petition the *Chakob*. As *Balamob* and *Chakob* are 'pure men', shamans use the male life-sustaining fluid *balche'* (honey-blood) to give new power to their crystal. Evidently, *saka'* (cornflour mixed with water), which is considered 'cold', is a female life-sustaining liquid.

Shamans are thus dependent on *Xunan kab* honey to perform their duties.

People neither worked nor brushed their hair during this period, for they feared that, if they did, misfortune would befall them (ibid.: 130). Nowadays, in Tepich, women are not supposed to do embroidery in this five-day period, for this is the time when the shamans present themselves to the gods.

[33]I have been unable to establish with certainty whether all midwifes use such a crystal.

However, the bond between the bees and *hmenob* is much deeper than this, as the story of *Luum kab* (Earth bee) reveals. Note that the following is a highly condensed version of the story, which, in its original form, took about half an hour to tell:

"*Luum kab* was chosen by the *Chakob* to live among them and to learn their ways. But *Luum kab* was hard-headed and did much that went against the teachings of the *Chakob*. He made many mistakes which all but proved fatal to him and others. As time went on, though, he finally acquired some knowledge. Meanwhile, his grandmother was performing a ceremony to discover what had become of *Luum kab*, for he had disappeared without warning, leaving grandma alone in her sorrow. The *Chakob* heard her pleading and let *Luum kab* choose whether he should return to Earth or remain with them. But *Luum kab* had lived among the *Chakob* for such a long time that he felt no desire to return; he had even married one of their womenfolk. So his son was sent to earth in his stead and began to act as an intermediary between people and the gods. The son of *Luum kab* thus became the first shaman on Earth" (Don Hipólito, *hmen*, Tepich).

Contemporary shamans are instructed by the *Chakob* in their dreams and by experienced shamans during special rituals. The knowledge of the first shaman was handed down from generation to generation. As a result, all contemporary shamans are intellectually descended from the demi-god son of *Luum kab*. In two ways, then, shamans are professionally connected to the bees. On the one hand, they need their honey to empower their divination crystal and, on the other hand, their knowledge can be traced back to a primordial stingless bee.

8.6 Shared earths, shared histories, shared destinies

"*Xunan kab* always has small creatures living in the wood of the log. We call them *Pai*. Normally, they don't harm the bees. However, if you do not take good care of your bees, if you fail to perform the *U Hanli Kab*, for instance, you will feel their bite. These are the *Pai*. You don't see them. You just feel them biting you" (Don Kanuto, *hmen*, Tepich).

How can an animal that disturbs *Xunan kab*'s hive (or one's house, as Don Medardo explained in Section 8.4) at the same time disturb the owner of the hive? In the light of the homologies between the earth that is the human body, the earth that is the dwelling place of the Maya and the earth that is the dwelling place of the bees, this mystery is resolved. In this sub-section, I attempt to demonstrate that the Maya take the structural equivalences between these earths much further, incorporating them in their day-to-day reality. As such, the equivalences do not only play a key role in ritual discourse, they are part and parcel of the reality of lay people too. I first examine the homology that the Maya see between the production of corn and the production of honey. I then discuss how the Maya see themselves as inextricably linked to their domesticated bees.

Beekeepers maintain that, if *Xunan kab* produces plentiful honey, the owner of the hives can also be sure of an ample harvest of corn:

"Once the bees have become poor, even the people will become poor. They won't have sufficient corn to eat. It is like their [the bees'] being unable to obtain honey. [Question: can you do anything to change this?] No, you cannot; you can only buy a little honey so that they will have something to eat" (Don Pascual, Señor).

Don Cipriano told me that, for three consecutive years, his *Xunan kab* had stored large quantities of honey in the hive. As a result, he himself was successful in growing corn in each of those years. In the two following years, however, the bees were unsuccessful in making honey and therefore his crops failed, even though he had done everything possible to obtain a good crop. He had performed the rituals for the appropriate deities, he had sown at the right time of the year; nonetheless, his corn plants did not develop ripe cobs. To Don Cipriano, the reason was obvious: his *Xunan kab* had proved unproductive, so how on earth could he succeed? There are, in fact, many beekeepers who regard their corn production as directly related to the production of their *Xunan kab*. His brother explained his own agricultural strategy for 1994:

"The *Habim* [*Piscidia piscipula*] tree flowers three times a year. In this year's first flowering period, the blossoms didn't open fully because there was too little rain. The same thing happened in the second period. The *Habim* blossoms only opened in the third period. This will also happen to the corn plants. People who sowed early won't get a rich harvest due to lack of rain. Only those who sowed towards the end of the period will get a good yield" (Don Hipólito, *hmen*, Tepich).

According to Don Hipólito, the *Habim* is one of the most important food plants for *Xunan kab*, which explains why he drew a parallel between that tree, rather than any other, and his corn plants. The quote is just one everyday example of how the set of structural equivalences between the bee-earth and the human earth is extended to a directly related sub-set of equivalences. In general, when talking about their bees, the

Maya often link the low productivity of the colonies to their own misfortune.[34] Hardly surprisingly, they regard their corn plants and hives as being equally dependent upon rainfall for the production of cobs and honey. It therefore seems logical that, when they want rain, they petition *Kun K'u*, who is both principal authority among the *Chakob* and the bee-deity. Some people, however, take this relation further, into the realm of destiny:

"The destiny of *Xunan Kab* is our own destiny. If I find a nest of bees in the forest and it is rich in honey, I'm sure of a good corn harvest. But if the bees are poor, I known my harvest is going to be a bad one. If the bees don't manage to get a good harvest, the people won't either, because the history of the bees is like the history of the people" (Don Yermo, Tepich).

The Maya do indeed see their own existence as bound up with the life of their bees. Hence, *Xunan kab* can proclaim the impending death of their keeper or one of his close relatives:

"The bees let you know when somebody's about to die. They tell you by fighting amongst themselves. The bees in my son's *solar* fought for two whole weeks and, a few weeks later, my wife passed away. Of course, I knew that somebody in my family was going to die soon. They tell you. The same thing will happen to you or your family!" (Don Abundio, Señor).

When I asked Don Abundio's son to confirm this, he told the same story. There are other ways in which *Xunan kab* may announce a death in the family. Don Pedro of Chan Chen Comandante told me that, just before his father died, the bees took leave of their owner by swarming around the house and then flew off into the forest. In this particular example, the bees themselves did not die. Usually, though, they are said to start fighting among themselves, and some beekeepers even claim that the domesticated *Xunan kab* may 'eat each other' in an orgy of self-destruction. *Xunan kab* is not the only animal that is associated with death. An owl (*buhu*) hooting around the house at night is feared as a harbinger of sickness and death in the family *solar*. When I asked Doña Martina of Pino Suarez why her family had lost so many colonies of *Xunan kab*, she answered:

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[34]In contrast to the negative relation between ants and corn plants found in the Codex Pérez (see Note 15, Section 7), there seems to be a positive relation between planting corn and keeping bees. According to the 'Foretelling of the Days', an almanac incorporated in the Codex, these two activities have the same auspicious days. Conversely, when the prognostication for the land and the people is bad, so will it be for the bees: "Father will punish us with heavy rains that will turn the land cold. There will be great misfortunes, bees will die" (Craine & Reindorp 1979: 80, 159, 169-170).

"It is because of the *buhu*. When he comes to your house to sing at night, he announces sickness and death. I heard the *buhu* [...] just before my mother-in-law fell ill. He does the same thing to the bees. If the *buhu* comes, the bees leave. That bird harms the bees when he makes his sound nearby. He's an evil bird. He brings sickness to your family and harms the bees as well, he tells them he is going to harm them" (Doña Martina, Pino Suarez).

When the owl brings misfortune upon the family, the same fate befalls the bees.[35] Don Hipólito takes this connection between people and bees even further:

"When Adam and Eve had their first child, they brought him before God. But God punished them, for they had disobeyed Him. So they had to offer their first child, and cut off his head. Instead of blood, honey issued from the body of the child. And from the spreading honey, different sorts of bees emerged, such as *E'hol*, *Bool*, *Xiik'*, *Ko'olel kab* [i.e. *Xunan kab*], *Xnuuk*, *Kansak*, *P'uup'* and *Muul*" (Don Hipólito, *hmen*, Tepich).

This story, popular in Tepich, may explain why beekeepers often call bees *gente* (Spanish for 'people'), for it links bees and humans to the same progenitors through the medium of honey-blood. Bees are even said to behave like people: many beekeepers claim, for example, that a bee out foraging for nectar deep in the forest will camp overnight under a leaf if it is too far from the hive, just as the *milpero* working his distant cornfield will sling his hammock between two trees rather than trudge home. Bees, just like their human kin, are cultivators of a sort and are governed by the same weekly routine:

"People go out to work in the week. But they return home on Saturday; not too late, though, because it's the last working day. They rest on Sunday and start working again on Monday. They say the bees do it that way too. Well, they stop work at noon on Saturday and, come Monday morning, they're back to work again" (Don Rocío, *hmen*, Tepich).

According to the Maya, then, bees and humans behave similarly because they have common ancestry. It seems that such explanations have arisen mainly because bees are social animals (in the 'emic' view, that is): they build their homes, nurture their offspring, communicate, make war and, in particular, 'cultivate' their food. The equivalence between the human earth and the bee-earth thus extends to the sub-sets 'people-bees' and 'corn-honey'. It is precisely because of the common ancestry, behaviour and destiny that bees are so important to the Maya, especially to shamans.

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[35]Mystery surrounding their nocturnal habits and their lugubrious cries, owls have formed a part of mythology all over the world. They have been depicted as portents of calamity and death (when they appear near to the sick) but also as a bird of wisdom (Encyclopedia Americana, 1965).

What strikes one most in this context is that the production of honey by *Xunan kab* is declining at an alarming rate. Nowadays, very few keepers of stingless bees find their hives fully stocked with honey, even during the peak period of nectar flow. In fact, most of them complain that their bees are producing quantities of honey that are hardly sufficient to sustain the colonies themselves, let alone their keepers. Some say that they no longer multiply their colonies for this very reason: that the bee populations are too impoverished to survive being split (Sections 5.8.7 and 5.9 - Conclusions). How do beekeepers account for this lamentable state of their *Xunan kab*? Why do they not act to help the bees?

The beekeepers cite various reasons for the dearth of *Xunan kab* honey. Many of them blame the foreign intruder, *Americano kab*. This bee wakes up early in the morning, hours before *Xunan kab* goes to work, and is said to be far less selective about food plants, though it prefers the same flowering species as its stingless counterpart. By the time *Xunan kab* arrives on the scene, *Americano kab* has taken all the nectar. In addition, some claim that *Americano kab* and *Xunan kab* fight for flower resources whenever their paths cross. Not all the people believe that the bees are rivals, however, for *Xunan kab* can always obtain divine honey in *Xmaben*, the celestial field of flowers, to which *Americano kab* has no access. Others argue that, in general, the people no longer respect the Maya gods and neglect the rituals that used to be performed so zealously. Indeed, the only ceremony that is regularly performed by the majority of the people is that for the cornfield. Occasionally, other rituals may be called for, but only when a serious illness or epidemic reminds the people of the need to appease the responsible deities. For this reason, the gods are said to be angry with the people, withholding from them the rain that is essential for the cultivation of sufficient corn and honey. Nonetheless, when asked what they do to aid their *Xunan kab*, almost all beekeepers respond with resignation: that nothing can be done. From time to time, some beekeepers do supply their *Xunan kab* with a little honey of *Americano kab*, though most people claim that the native bees do not even like it. More importantly, this form of charity is often deemed unnecessary because, after all, *Xunan kab* can go to *Xmaben*. Nobody cultivates extra food plants for *Xunan kab* in the homestead, for *Americano kab* would surely take all the nectar and pollen. One might even be tempted to think that these arguments are just excuses. Do the Maya beekeepers really care about their *Xunan kab*?

The beekeepers do care and never give up, even when they are down to their last colony. In that event, they spare the bees as far as possible by refraining from harvesting honey or from attempting to multiply the colony by splitting the brood.

Xunan kab are vital to them in many ways: they produce honey of the finest quality, divine honey to be precise; a substance with which the beekeepers can cure the ill. They can even prove their own worth as husbands by administering the divine honey to their wives as a sort of fertility drug to help them become pregnant, should this be problematical. *Xunan kab* honey is also an essential ingredient in ceremonial mead and breadstuffs, the currency in which the Maya pay their dues to the easily angered gods, to appease them and to avoid being punished with failed crops or sickness in the family. Many beekeepers care about their insect charges as if they were part of their family; they view their own lives and fates as being so spiritually intertwined with those of the native bees that impoverishment or death of the *Xunan kab* in their homestead inevitably leads to similar misfortune among their human relatives. The difficulty of obtaining a bottle of *Xunan kab* honey reflects its value to the people, who will not willingly sell a 0.75- litre bottle even for 20 to 30 pesos, the equivalent of hiring labour to clear 2.5 to 3.5 mecates (0.10 to 0.14 hectares) of secondary vegetation: they prefer to keep the honey for their own people. Beekeepers are even more reluctant to sell their hives, even if the bees are no longer productive. If the bees are so important to the Maya, why do they not help them? As the following statement testifies, beekeepers sincerely believe they are powerless to intervene:

"God put the bees on earth: *Xunan kab*, *E'hol*, *Kansak*, *Xiik'*, *Bool*, *P'uup*, *Tsots* and so forth. They're like all the different races of humankind. The Maya are similar to *Ko'olel kab* [i.e. *Xunan kab*]. The Spaniards came and fought against the Maya. The same thing is happening between *Americano kab* and *Xunan kab*. The Spaniards started it all, that's why the bees are fighting too. But in the beginning, it was just between the Spaniards and the Maya. The forest bees do not fight with the foreigner. But whenever *Americano kab* runs into *Xunan kab*, he bites into her wings and kills her. *Xunan kab* cannot exist" (Don Hipólito, *hmen*, Tepich).[36]

Like the Yucatecan Maya in the aftermath of the conquest, *Xunan kab* flees to the forest to hide: human history, marked by conflicts between races, has determined how the different species of bees must interact. In this context, it might seem strange that the pillaging forest bee *Nii' kib* never figures as an aggressor in the story, even though the people know that it steals honey from *Xunan kab* (Section 4). Yet the Yucatecan Maya only speak of repression by 'the Spaniards' and 'the Mexicans', so it is understandable that they point a finger at the foreign intruder, *Americano kab*, and feel

[36]Another man told me a slightly different version of this story, explaining that *Xunan kab* cannot fight against *Americano kab* because 'she' is 'a woman', whereas the other native stingless bees are 'males', like *Americano kab*.

powerless to help their cherished native bees. However, just as the human past has determined current relations between the 'races' of bees, so the future of the Maya ultimately holds a great promise. This world will eventually come to an end, and as that day draws near, everything will become scarce: the *milpa* will produce less corn, the bees will make less honey, and the day will dawn when man's seed fails and woman's womb becomes barren. According to some Maya, the decline has already started. It is foretold, however, that at the end of the world, the petrified animals of Chichén Itzá will come back to life. It is a 'public secret' that the ancient Maya, who built pyramids and other magnificent edifices, who zealously honoured the gods and conquered their enemies, will rise again and tip the scales uneven of contemporary relations between their descendants and their oppressors. On that great day, the people will again read the Testament that disappeared from the cross at Xok'en. The Maya will finally vanquish the Europeans. With the return of the ancient Maya, new life will be breathed into lost traditions. And because the welfare of the most divine of native stingless bees is intimately bound up with the welfare of the Maya, *Xunan kab* will also be restored to her right place and finally crush the invader, *Americano kab*.

8.7 Conclusions

In the utterance *kab*, many different concepts are united. In cultures outside Yucatan these concepts may be unrelated, yet for the Maya of the peninsula they express a multi-dimensional reality which determines many aspects of day-to-day life and shamanistic practice. As stated in the preamble to this section, the Tedlocks (1985) described a similar mechanism in another context: among the K'iché Maya. As I have argued in this section, two sets of structural equivalents can be inferred from the semantic field of *kab*. The first set comprises the various 'earths': the earth upon which we live, specific areas of its surface demarcated by ritual (i.e. the cornfield, the homestead, the village), the log populated by bees; the human body; the altar in ritual practice and the divination crystal of shamans and midwifes that, in the flame of an artificial sun, reflects motions in the spirit world. The second set comprises elements derived from the first: the life-giving and life-sustaining fluids of the various earths: i.e. water, honey, blood, ritual mead and corn-gruel. Without these fluids, the corresponding 'earths' could not exist, they would be devoid of life; when these fluids become scarce, life wanes on the 'earth'. A third set of equivalents, which was discussed in Section 7, is closely related to the second set, for its elements are also derived from the first set and also concern the stuff of life: they are honey (again), corn and semen, which are considered to be the 'seeds' (*semillas*) of emergent life.

In ritual practice as in certain aspects of day-to-day life, an element of one set can be harnessed to influence the equivalent element in another set. Honey, for example, is used in rituals such as the cornfield ceremony to fertilize the earth and, in day-to-day, is given to women as a sort of fertility-enhancing medicine to help them become pregnant. As was shown in Section 4.6.1, at a dangerous time of the year, when living things are not always what they seem, honey poured onto meat can even give life to snakes. In the context of agriculture, corn has similar connotations: man plants it in the earth, just as he 'plants children' in woman's womb. Furthermore, corn in the form of gruel gives power to the midwife's *sastun*. Mead, representing blood, is used to consecrate ritual foodstuffs such as bread and chickens, as well as the cross and the corners and centre-point of the altar. This 'divine blood' vitalizes the transparent 'earth' that is the *sastun* of the shaman. The equivalence between the human earth and the beehive seems to pivot on the belief that corn production depends upon honey production. To the Maya, both the cornfield and the hive are productive 'earths' and, therefore, both the corn grower and the bee are cultivators. Since the growth of corn plants and the blooming of flowers depend primarily upon rainfall, both the growing of corn and the making of honey are subject to the whim of *Kun K'u*, the principal authority of the rain gods. Precisely because both the cornfield and the bee-log are regarded as earth-areas specifically demarcated for cultivation, the ceremonies of thanksgiving or payment of dues for the produce yielded by these 'plots' are virtually identical in gesture, forms of offering, symbolism and prayer; the altar functioning as a scale model of the demarcated earth-area. For this reason, the shaman greatly emphasizes the four corners and centre of the altar, which also models the much larger surface of the full-scale earth he inhabits. This fundamental pattern, known as *yook'ol kab* ('upon the earth'), also appears on the bee-log as a quincunx figure with centre-cross inscribed around the nest-entrance. In that central hole stands the soldier bee or *cintenela*, formerly known as *Balam kab* ('Jaguar bee'). *Balamob* are essentially spirits that guard the earth or specially demarcated areas thereof.

In Section 4, we saw that people, not spirits or deities, are the protectors of *Xunan kab*. In this section, we have also learned that the death of bees and a member of the beekeeper's family are linked: the bees and the human die at approximately the same time. There is a parallel here to the life-and-death relationship between the non-human *ah kanulob*, i.e. the collective animal spirits, and the species with which they are associated: their own flesh and blood. If an animal is killed, the relevant *ah kanul* thus loses part of the very substance of his life. By extension, it may be that the *ah kanul* would die if most of his animals were killed. Similarly, if most of the colonies kept by a family die, one of the kinsfolk is doomed. In addition, as we have seen, the Maya regard both the bee-log and the human body as 'earths'. Therefore, problems that occur in the hive (or in a demarcated area of the earth such as the homestead) can also become manifest in the human body. However, among the native bee species, this link is only established to *Xunan kab*. The self-destruction of this species, as evident in battles between colonies, therefore reflects the degradation of the human body. Indeed, there is an even stronger link, for in contemporary Maya religion, humans and bees have the same progenitors: the primordial parents Adam and Eve. People and bees thus have a common history and future. The slash-and-burn agriculture of the Maya is cyclical, just like the march of time itself, in which events since the dawn of time, the creation of the universe, are endlessly recapitulated. This implies that certain key events in the past will be repeated in the future. Hence it is just a question of time before the mighty Maya of pre-conquest Yucatan redress the balance of relations between the contemporary Maya and their oppressors; before the indigenous bee *Xunan kab* triumphs over its foreign tormentor *Americano kab*. Even though at least one of the native species of forest bees is a pillage bee (*Lestrimelitta* sp.), the Maya exclude all the indigenous forest bees from this relationship of dominance and oppression. Instead, they link them to other, unspecified groups of foreign people with whom they have no real contact.

The various kinds of earth are all influenced by general cosmological motions. The earth on which humans live is heated by the daytime sun, just as the human body is heated when exposed to solar rays. In this context, the Maya distinguish normal and abnormal modes of heating, the latter occurring when beings that normally pertain to shady areas are over-exposed to the sun. The resulting overheating of the body causes illness and gives rise to abnormal and dangerous situations, as in the case of the Feathered Snake (*Kukulkan*, Section 4). As we have seen, the hive of *Xunan kab* is subject to the same cosmological influences as the other earths, whereas the hives of forest bees are not. There are three reasons for this distinction: firstly, logs of *Xunan kab* are always laid horizontally in the bee-house; secondly, all bee-houses run east-west; and thirdly, the ends of all the bee-logs in the bee-house face east or west. As the daytime sun arcs across the sky, it passes over the hive from the east to the west in exactly the same way as it passes over the earth's surface (*yook'ol kab*). The sun thus makes the honey of *Xunan kab* as warm and as fertile as semen. The homology between the hive and the human earth resolves the paradox, discussed in Section 7, of relatively 'warm' honey being produced by 'female' and therefore 'cold' forest bees. Unlike cultivated *Xunan kab*, the forest bees live in the shade of the forest, where, according to some people, they nest in the vertical trunks of trees (Section 4). In exceptional cases of forest bees being kept in the homestead, they are physically separated from *Xunan kab* hives and, what is more, generally placed upright. As a result, the sun does not pass over the hives of forest bees in the same way as it does over the hives of *Xunan kab* and therefore does not heat the honey of the former bees. With the exception of *P'uup'*, which 'borrows' honey from *Xunan kab*, all these forest bees therefore produce 'cold' honey, which is not considered an agent of fertility and is not an element in the set of equivalences previously described. *Xunan kab* hives may become 'overheated', by absorbing too much *k'inam*, a kind of energy. Any 'normal' degree of warmth (i.e. as naturally derived from the sun and as generally possessed in greater quantities by men than by women) can be counteracted by applying 'cold' *Chakah* leaves. Yet these leaves have no effect on the excessive warmth that results from the *k'inam* of the ill or the dead, the pregnant or the menstruating. When bees come into contact with such excessive energy, which arises from some kind of 'abnormal' state, they either die or flee to the forest.

The homology between the Maya and their *Xunan kab* leads to yet another interesting paradox. While these bees are vitally important to their keepers, who regard their own existence and subsistence as connected to the life of their colonies, in practice they do nothing to arrest the gradual extinction of the bees. They are unable to assist because they regard their own and the bees' destinies as being inextricably bound up with each other. In their resignation, do they not themselves constitute a key factor in the decline of meliponiculture? The next section addresses this question from an 'etic' point of view, by examining the bees' environment as understood by biologists.

9 The habitat of *Melipona beecheii* under pressure: Tepich as case-study

When we compare the limited scale on which meliponiculture is currently practised in Yucatan with the historical reports of vast meliponaries discussed in Section 2, it becomes clear that the practice has suffered an enormous decline over the past five centuries. In the village of Tepich, there are now about 100 meliponine colonies in total (1996 survey), and most of them are seriously impoverished. How, then, were the keepers of stingless bees who lived at the time of the Spanish conquest able to maintain meliponaries with hundreds of hives? It becomes clear that the decline has accelerated sharply in the modern era when we consider that, only 20 years ago, biologists described Yucatecan bee-houses in which 200 to 400 hives were packed together (Wagner 1993; Weaver & Weaver 1981; and photographs in the possession of *Licenciado* Gonzáles Acereto, *Universidad Autónoma de Yucatán, Escuela de Veterinaria*). Are *Americano kab* (the European honeybee *Apis mellifera*) and *Africano kab* (the Africanized sub-species) solely responsible for the decline, as many researchers and Maya claim? What has changed so dramatically, especially in the past few decades, to account for the worsening decline? In preceding sections, I have described the environment *for* the Maya beekeepers (i.e. the environment as they perceive and interact with it). In this section, I describe the environment *for* the native stingless bee which is most important to the Maya beekeepers, *Melipona beecheii*. On the positive side, I argue that the continuing practice of traditional slash-and-burn agriculture results in a favourable foraging area for this bee species: the typical patchwork of mature forest enclosing plots of secondary vegetation in successive stages of development, which I describe in detail in Section 9.5. In Section 9.8, I also discuss the distribution of some of the more important meliponine food plants in Central America and Yucatan. On the negative side, in an attempt to identify possible causes for the decline in meliponaries and the impoverishment of colonies, I discuss some significant changes that have recently taken place in the immediate environment of *M. beecheii*: the boom in apiculture, i.e. the keeping of *A. mellifera*, at village level (see Section 9.2); the expansion of the village (see Sections 9.3 and 9.6); and changes in the use of homesteads (see Section 9.4). In Sections 9.1 and 9.7, I return to an aspect of the

Maya mode of subsistence which is reflected in the cosmological concepts of this ethnic group: the homology or interdependence that the Maya see between the cultivation of corn (*Zea mays*) by themselves and the making of honey by their domesticated stingless bees. Of great importance in this context is the following question: does this conceptual link have a biological foundation? More specifically: does corn play an important role in the environment as a food plant for these bees? There is a second important question that relates to the foraging behaviour of *M. beecheii*: might there also be a biological foundation for the idea that *M. beecheii*, rather than depending upon earthly vegetation, collects divine honey from celestial *Xmaben* (Section 4.3.1). A third question relates directly to describing the environment for the bees, though it does not seem to occur to the Maya themselves: why do they not speak of the role of bees as pollinators? Before moving on to the main body of this case-study, please note that all the field- data incorporated in this section were gathered exclusively in the village and *ejido* (communal land-use area) of Tepich. As I have seen with my own eyes, however, recent developments throughout the Maya Zone of Quintana Roo State do not differ much from those described here.

9.1 Bees: agents of plant fertility?

Knowing that bees play a key role in the pollination of trees and plants, the emic link between bees and fertility described in Section 7 should hardly surprise us; it seems quite logical to me, at least. Interestingly, however, our etic view of the link does not appeal to the Maya, as soon became apparent in my discussions with them. On the whole, contemporary Maya farmers and beekeepers do not seem to be aware of any ecological interrelationship between plants and bees. Except for a few beekeepers who had taken government courses in apiculture, none of my informants had ever thought of bees as agents of pollination. Some argued that bees' visits to flowers had no influence on their fruiting. Others insisted that bees actually damage flowers and thus prevent fruit from developing, pointing out that flowers wither and die after being visited by bees! This idea seems to be quite commonplace: it is certainly not restricted to those Maya whose knowledge, opinions and beliefs are incorporated in this dissertation. Small-scale orange growers even refuse to have hives of *A. mellifera* on their land, arguing that the bees would destroy the blossom and reduce the orange harvest (*Licenciado* Gonzáles Acereto, personal communication). Rather than agents of fertility, these bees are thus regarded by some as its repressors vandals! How, then, are plants thought to come to fruition? In the *ejidos* of Tepich and Xmaben, people argue that plants automatically develop fruit after flowering, with no need for bees or any other insects. This widespread unawareness or denial of the mutual relationship between foraging bees and the reproduction of flowering plants is emphasized by the common belief that *Xunan kab* (*M. beecheii*) obtains honey from celestial *Xmaben* (which, to some, is a canoe filled with honey and, to others, is a field of flowers in the realm of the gods: Section 4.3.1). However, it is important to note that Maya concepts relating to bees (and, indeed, to other aspects of their environment) are not just products of human culture. For certain biological and behavioural characteristics of bees can be seen to be consistent with, or to give scope for, such concepts. This is particularly true of *M. beecheii*, which is kept in the homestead and is therefore the most closely and frequently observed of the various bee species. *M. beecheii* is highly selective in the food plants it visits, far more so than *A. mellifera*, and is known to avoid competition with other species (Biesmeijer 1997: 80-81; 87-89, see also Appendix I). This native stingless bee is often difficult to detect when foraging, especially when it is high up among blooms in the forest canopy. Many other bee species are more easily seen when foraging (e.g. *A. mellifera*; *Trigona* spp.; *Partamona* spp.), possibly because they are less selective and, certainly in the case of some stingless species, because their bodies are black. Furthermore, corn, the staple food-plant of the Maya, is wind-pollinated and does not require bees in order to produce cobs. To summarize, then, the Maya have their own way of explaining the fact that they do not often see *M. beecheii* foraging, and the primary food-plant of the people provides no evidence of an ecological relationship between bees and plants. However, many Maya who are involved in apiculture acknowledge that *Xunan kab*, that most cherished of native bees, does depend upon the flowering of trees and other plants for nectar. While this may all seem to be rather contradictory or paradoxical, it must be realized that in Maya communities in general, people use various cognitive systems that do not necessarily tie into each other. They may make use of different systems on different occasions and, as a result, give explanations that appear to contradict what they said earlier.[1] When necessary, they may even interweave ideas derived from different explanatory models,

[1]Similarly, if you ask a beekeeper why his bee-logs are empty, he may reply on one occasion that this is due to a death in the family, whereas, in another context, he may explain that Phorid flies invaded the hives (Sections 5.6.2 & 8.6). Beyond the field of beekeeping, there are other examples of how views that differ, while not necessarily being contradictory or paradoxical in conjunction, tie into each other. Sickness and cure are often explained in dual terms of divine influence and western medical theory. Villagers may consult both the doctor, who has surgery several times a week, and the shaman, who may decide to perform a healing ritual. Better safe than sorry' seems to be the motto here!

as some people do when they argue that *Xunan kab* needs earthly flowers but also collects additional, divine honey from *Xmaben* (see: Jong 1997).

9.2 How the boom in apiculture has affected meliponiculture in the village

Many meliponiculturalists blame *A. mellifera* for the decline of *M. beecheii*. While some of them see the decline solely as the inevitable outcome of the history of people and bees (Section 8.6), others acknowledge that the most important factor is competition for food resources, which has intensified because of the success of stinging honeybees. Are they correct in this assumption? What is the current extent of apiculture on the peninsula? In particular, can the situation in Tepich serve to clarify this issue? In 1994 and 1996, I surveyed the village's bee- colonies in an attempt to answer that question. The 1994 census was of meliponine species only, while the 1996 census included *A. mellifera*.

Whereas apiculture began to be widely practised in Yucatan State in the 1950s (Section 2.3), in Tepich the first apiculturalists did not start their operations until about 1975. That apiculture developed more slowly in Quintana Roo was probably due to the area's relative isolation. Under a government programme based in Felipe Carrillo Puerto, which provided colonies and training, ten inhabitants of Tepich went into apiculture, each of them keeping ten hives of the European honeybee. Their success inspired other villagers to join the programme. By multiplying existing colonies and capturing swarms in the wild, the new apiculturalists gradually increased their stock of hives. By the beginning of the 1990s, the activity had become widespread in Tepich, though the mean honey production per hive started to fall. Was this because the European honeybees had crossed with the Africanized variant? The invasion of the Yucatan peninsula by Africanized honeybees began in 1987, but no one knows exactly to what extent the Tepich apiaries had become Africanized by the beginning of the 1990s. Despite predictions that the process would be as rapid in Yucatan as elsewhere, by 1995 - eight years after the more aggressive bees reached the peninsula - less then 80% of the colonies had become Africanized (Echazarreta 1997: 98).[2] Interestingly, those Tepich beekeepers who were managing apiaries of around 60 hives reported that

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[2]In Latin America, Africanization of European honeybee strains spread at 375 kilometers per year. According to Villanueva and Colli-Ucán (1996), the higher density of honeybee colonies on the Yucatan peninsula could explain the fact that Africanization was slower there (1996: 65 & Section 2.4).

their Africanized colonies were producing more honey than had been harvested before cross-breeding started. Claiming that the overall fall in production had nothing to do with Africanization, they convened a meeting which called for an investigation. In late 1993, the commissioner of the *ejido* gathered statistics on the number of *A. mellifera* hives and their location in the *ejido*.[3] After he had concluded that the apiaries were too close together, a new regulation was adopted, stipulating that the distance between any two apiaries should not be less than one kilometre. However, the apiculturalists ignored this and did not move their hives.

Yucatecan apiculture is directed mainly at international markets and, by local standards, quite large profits can be made in good years. In their production and

Table 9.1 Size of apiaries in Tepich

number hives *A. mellifera* (n = 837)	number apiaries in % (n = 74)
1-9	51.4
10-19	31.1
20-29	6.7
30-39	5.4
40-60	5.4

marketing strategies, the Maya apiculturalists try to keep pace with fluctuations in the international price of Yucatecan honey and the exchange rate of the peso. In 1994, for example, honey prices dropped to 1.5 pesos (0.75 US dollars) per kilogram. In response, many beekeepers reduced the number of colonies they kept and the overall colony density in the *ejido* dropped. The problem of competition with *M. beecheii* for limited floral resources appeared to have been solved for the time being. In 1996, however, with mounting inflation in Mexico and a shortage of honey on the world market pushing prices up to 12 pesos (nearly 2.00 US dollars) per kilogram, the apiculturalists rushed to expand their stocks of hives. The figures for April 1996 (see Table 9.1) show that 74 beekeeping families in Tepich owned apiaries with a total of 837 colonies. Just over half of them (51.4%) had less then 10 hives each, while nearly one third (31.1%) had between 10 and 19 hives. However, the categories with 30 to 39 and 40 or more hives are much smaller, each accounting for just 5.4% of all the apiculturalists in the village. The owners of the larger apiaries (over 40 colonies)

[3]Unfortunately, the report of this investigation was lost during the construction of a new building for the *ejido* administration.

'migrate' their hives around the peninsula to get maximum benefit from the geographical variation in the flowering seasons of important food plants, but in April all the hives are back in the *ejido* (Section 6.3.2). April is also the peak honey-production period of *M. beecheii.*

The general expansion of apiculture on the Yucatan peninsula and its temporary setbacks, including those of the past two decades, are described in the literature (see, Villanueva & Colli 1996; for example: Merrill-Sands 1984). The peninsula supplies 30 to 40% of Mexico's total honey production, while it has a mere 8% of the country's total land area (Echazarreta 1997: 94; Villanueva & Colli-Ucán 1996: 65). According to a 1993 survey, the *A. mellifera* population of the peninsula was 778,996 hives, 59% of which were in Yucatan State, 24% in Campeche State and 17% in Quintana Roo State. Yucatan State also has the highest density of hives, for it is the smallest of the three peninsular states, with 24% of the land area, as against Quintana Roo's 35% and Campeche's 37% (Echazarreta 1997: 95). The 1994 price-driven decrease in colony density in Tepich was typical of the whole peninsula, which by the end of 1995 had only 398,000 hives; 51% of them in Yucatan State, 29% in Campeche and 20% in Quintana Roo (Villanueva & Colli-Ucán 1996: 62-63).[4] Hence, in a period of less than three years, there was a 49% decrease in the total number and overall density of *A. mellifera* hives on the peninsula. The worst year for apiculture was 1995. Villanueva and Colli-Ucán cite two reasons for this temporary dip: Africanization and the infestation of hives by Varroa mites. In 1996, however, the Tepich apiculturalists had not yet been confronted with problems caused by Varroa. Furthermore, as previously stated, the larger-scale beekeepers among them had actually seen honey production per hive increasing with Africanization and, before the 1996 price-hike, had reduced their numbers of colonies because of the low international honey price. It seems highly probable that many other Yucatecan apiculturalists opted for this strategy. Therefore, the unfavourable global honey-market must be considered as a third factor in the 1995 dip in apiculture. The figures also indicate that Quintana Roo has the lowest colony density of the peninsular states, leading Echazarreta to conclude that apiculture is not developed to its full potential there; that colony density can be increased still further (1997: 95). However, apiculturalists in Tepich claim that they get roughly the same

[4]According to this source, in the same year there were 13,200 apiculturalists on the whole peninsula, 53% of them in Yucatan State, 26% in Campeche State and 21% in Quintana Roo State. Overall, 90% of the apiculturalists owned between one and 50 hives (pages 62-63).

total production from 60 colonies as they get from 100. This can easily be explained by the fact that the apiaries are not evenly spread out over the whole *ejido*, but are closely packed together. Under such conditions, an increase in colony density does not automatically lead to an increase in honey production. On the contrary, that could only be achieved by dispersing the hives. In other words, assuming that Tepich exemplifies the general state of affairs on the Yucatan peninsula, the concentration of apiaries around villages in the *ejidos* has reached 'saturation point' - production cannot be increased further.

What possible effects has the expansion of apiculture had on meliponiculture? Developments on a small scale give the greatest insight into the process. Available data show that as apiculture expanded in Tepich, meliponiculture declined. In the past twenty years, the number of domesticated hives of *M. beecheii* within the village perimeter has dropped from an estimated 754 in 1974[5], through 114 in 1994 (plus 12 hives of other meliponine species), to 93 in 1996 (plus 10 hives of other meliponine species). It is unlikely that the overall decline of about 87% happened gradually over those twenty years, for several meliponiculturalists claim that they began to lose large numbers of colonies about ten years ago. A general decline of meliponiculture has also been reported in the literature (e.g. Wagner: 1993; Calkins 1974). Can it be attributed to increased competition for food resources?

The Tepich village area lies within the flight-range of some *A. mellifera* colonies. As a rule, apiaries are placed in the cornfields (*milpas*) well beyond the village perimeter. Cornfields may be located anywhere in the *ejido*, yet, for easy access, most are within three to four kilometres of the village (Section 6.3). Generally, *A. mellifera* can find adequate floral resources in the vicinity of their apiaries. In theory, however, their foraging ranges may overlap with those of *M. beecheii*, even though domesticated colonies of these stingless bees are usually kept in village homesteads. More importantly, small-scale apiculturalists with four or five hives tend to place these in the homestead to avoid regularly having to trudge through the forest to the *milpas* and back. It has been reported that, in Mexico as a whole, Africanization has led to an increase in the number of small-scale apiculturalists. I was unable to determine how

[5]As no hard data were available for 1974, I estimated the number of meliponine hives in that year by asking beekeepers: "How many hives of domesticated stingless bees did you have 20 years ago?" I ensured that the person in question spoke only for himself, not for family members, so that no hive would be counted more than once. Of course, this method ruled out some people - the deceased, for example - though it also reduced the possibility of colony numbers being exaggerated.

many inhabitants of Tepich had set up new apiaries as a result of Africanization making it easier to them catch wild swarms (Guzman-Novoa & Page; and Section 2.4). Clearly, after Africanization, some medium- and large-scale apiculturalists deliberately let the number of hives in their apiaries fall below five and then moved them into their homesteads. Competition between *A. mellifera* and *M. beecheii* therefore increased significantly. This was the result of beekeeping strategy in response to Africanization, rather than a direct consequence of cross-breeding itself. In Tepich in 1996, 31 hives of *A. mellifera* were located in homesteads. Although this number may seem rather low, the effect of such a change should not be underestimated. Meliponiculturalists whose neighbours keep *A. mellifera* in their backyard say that the proximity of non-native honeybees has generally caused *Melipona* honey yields to decrease and the colonies to decline. *A. mellifera* is known to collect from important *M. beecheii* food plants such as *Gymnopodium floribundum*, *Viguiera dentata*, *Mimosa bahamensis*, *Bursera simaruba* (Villanueva: 1994; Chemas & Rico-Gray 1991).[6] Moreover, the competition between these two bee species is highly unequal due to certain differences in their biological characteristics. Firstly, *A. mellifera* colonies have far greater populations than those of *M. beecheii*, typically about 50,000 workers of the former species against only 500 to 3,000 workers of the latter (Biesmeijer 1997: 29). Secondly, the foraging range of *A. mellifera* is about two kilometres (Dr. M.J. Sommeijer, personal communication), whereas *M. beecheii* is estimated to forage no further than a few hundred metres from the hive (Section 9.3). Thirdly, *A. mellifera* are more aggressive foragers and their colonies, through a highly effective recruitment system, have a far greater foraging capability than those of *M. beecheii*. Finally, *M. beecheii* is known to avoid competition for floral resources, meaning that as soon as *A. mellifera* workers arrive at a particular spot, the number of *M. beecheii* workers collecting nectar is significantly reduced (Biesmeijer[7] 1997: 80-81, 87-89; see also Appendix I). For all these reasons, the presence of even a limited number of *A. mellifera* hives in a village should be regarded as very tough competition for *M. beecheii*.

In the forest as well, competition for food resources and nest sites has increased. In sharp contrast to European strains of *A. mellifera*, Africanized bees penetrate deeply into the tropical forest and are not selective about nest sites. Whereas, before

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[6]For information on the overlap in food resources of a meliponine species and Africanized honeybees in Brazil, see Ramalho *et al.* 1990. For food resources of specific Meliponinae in Chiapas State, Mexico, see Martinez Hernandez *et al.* 1993.

[7]Biesmeijer experimented on *M. beecheii* with *M. fasciata*. However, a similar interaction is to be expected with *A. mellifera* (1997: 81).

Africanization, wild *M. beecheii* colonies in forest areas did not experience much competition from *A. mellifera*, nowadays *M. beecheii* face the more aggressive rivals everywhere they go. This also has serious ecological consequences, as Africanized bees are less effective pollinators of indigenous trees (Roubik: 1978). Furthermore, many of the indigenous tree species are important food plants for *M. beecheii*, which will thus be hit doubly hard in the long run. This all means that beekeepers who depend on the forest for a supply of new meliponine colonies will be confronted with a further decline in the numbers of wild nests, which are already very scarce.

While it is plausible that the apicultural boom in Tepich has been a factor in the downfall of meliponiculture, it is unlikely to have been the sole cause. Significantly, there is a marked difference between mean yields of *M. beecheii* colonies in homesteads and those in cornfields or on ranches outside the village. The hives in the villages can generally be harvested only once a year, in April. Only under favourable circumstances will a little extra honey be harvested in November. Moreover, the logs in which the bees are kept are never completely full of honey at harvesting time in the village. On the outlying ranches, in sharp contrast, beekeepers harvest their *M. beecheii* hives three times a year and do not face any particular problems of colony impoverishment, even though their *A. mellifera* hives are only one kilometre away (Table 5.1, 'Rancho Flor de Mayo'). Here the bee-logs are filled to the stoppers with full honey-storage pots. Considering this and the historical reports of huge meliponaries, it seems that there may also have been a quantitative and qualitative change in the food plants available to *M. beecheii* in recent decades. What could be the reason for this?

9.3 The expansion of the urbanized zone

Increasing deforestation since early colonial times has decimated the vegetation of the Yucatan peninsula as a whole. However, when we consider that the maximum flight-range of *M. beecheii* when foraging is only one kilometer and that 75% of the foraging activity takes place within 40% of the maximum range (Nieuwstadt *et al.* 1996), we realize that the presence of vegetation in and near the village is far more important to domesticated meliponine colonies than any surrounding wild forest. The vegetation complexes within a 400-metre radius of the hive are of prime importance for the sustenance of these stingless bees. As *M. beecheii* has such a short flight-range, the expansion of villages in the Maya Zone of Quintana Roo State may be an important factor in the local decline of meliponiculture. I now describe the expansion before going on to examine its consequences in the next sub-section.

In the past few decades, the villages of the Maya Zone have expanded because of natural population growth and migration into Quintana Roo State. Another important factor has been the construction of a highway between Valladolid and Felipe Carrillo Puerto, completed in the 1970s (Dachary & Arnaiz-Burne 1983: 23).[8] The highway facilitated goods transport to the towns and, as a result, villages along the route attracted people from less accessible settlements. For example, most of the 182 people living in Pino Suarez at the time of writing lived in San Jose Primero before the road was built. Their old village is three kilometres from the road (Murphy 1990: 78). Along the highway, then, the settlement pattern has become more concentrated.

In Carrillo Puerto District, population density increased because of natural population growth and influx from the Yucatan State, where there was a shortage of land for *milpa* agriculture (Dachary & Arnaiz-Burne 1984: 145). Table 9.2 shows that the population in Carrillo Puerto District surged from 2,170 in the 1930s to 44,626 in the 1980s, though part of this increase is due to the official expansion of Carrillo Puerto District from 6,693 to 15,918 km^2 in the 1960s (ibid: 152). From the 1930s to the 1950s, the population almost quadrupled and from the 1960s to the 1980s it more than doubled, without any re-drawing of the district borders. In 1983 (not included in Table 9.2), the area of Carrillo Puerto District was reduced to 13,806 km^2 (ibid: 163). The table also shows that the number of inhabitants per village increased. In 1930, the largest settlements had fewer than 500 inhabitants; in 1980, the largest was a town of approximately 10,000 inhabitants. In the 1980s, 33.8% of the district's population was living in communities of 2,000 to 10,000 people. Even today, nearly two thirds of the population (66.2%) live in settlements of fewer than 2000 people: the villages located in *ejidos*. Although these villages have expanded as their populations have grown, Carrillo Puerto District still has the least concentrated settlement pattern of all districts in Quintana Roo State (ibid). The relatively low population density makes it possible for the people to continue using the traditional slash-and-burn system of *milpa* agriculture as their basic mode of subsistence.

The general population growth in Carrillo Puerto District is reflected in the villages of Tepich and Señor. According to elderly residents of Tepich, the village had only fifteen families at the beginning of the 1930s and started expanding in that decade. At

[8]Dachary and Arnaiz-Burne do not specify in which year the highway was completed, they just state that a network of minor roads and highways was constructed in the 1970s, which is confirmed by my informants in Señor.

Table 9.2: Settlement density and number of inhabitants in Carrillo Puerto District, 1930-1980

year	village size (inhabitants)	number of villages	number of inhabitants (%
1930	100-500	3	765 (35.2)
	50-100	9	674 (31.1)
	<50	42	731 (33.7)
		total: 54	total: 2170
1940	500-700	2	1164 (26.5)
	100-500	8	1228 (28.0)
	50-100	16	1065 (24.3)
	<50	66	931 (21.2)
		total: 92	total: 4388
1950	500-1000	2	1474 (17.9)
	100-500	22	4583 (55.6)
	50-100	13	1028 (12.5)
	<50	76	1159 (14.0)
		total: 113	total 8244
1960	1000-2000	2	2679 (13.5)
	500-1000	4	3154 (15,9)
	100-500	40	9561 (48.0)
	50-100	27	1854 (9.3)
	<50	233	2652 (13.3)
		total 306	total: 19,900
1970	1000-3000	6	9804 (30.2)
	500-1000	12	7525 (23.2)
	100-500	45	9855 (30.4)
	50-100	36	2613 (8.1)
	<50	198	2629 (8.1)
		total 297	total: 32,426
1980	2000 - 10,000	3	15,094 (33,8)
	1000-2000	6	8667 (19.4)
	500-1000	8	6004 (13.5)
	100-500	37	9921 (22,2)
	50-100	20	1393 (3.1)
	<50	717	3547 (8.0)
		total: 791	total: 44,626

* In 1960, the territitory of the district expanded from 6,693 to 15,918 square kilometers
Source: Dachary Arnaiz Burne (1984)

the time of writing, Tepich has 2,032 inhabitants (*delegado* or elected representative of the Tepich *ejido,* personal communication) and more than 330 nuclear families (1996 survey). Similarly, the village of Señor had only thirteen families comprising 71 inhabitants in the 1930s (Villa Rojas 1978: 146), whereas it had grown to over 2,000 inhabitants by the early 1990s (Murphy 1990: 78). As a result, the built-up area expanded in both *ejidos* and this increasing urbanization exacerbated the decline of meliponiculture in two ways: firstly, it led to a general change in the internal structure of the homesteads and, secondly, the mean distance from hive to forest and secondary vegetation increased.

9.4 Changes in homestead vegetation

How has the structure of the homesteads (*solares*), in which *M. beecheii* is kept, changed over the past few decades? In 1996, I surveyed homestead vegetation in a 25% sector of Tepich village with the co-operation of the owners, whom I interviewed to determine how they used the homesteads.

As the village's population has grown, the homesteads have become smaller. This is particularly apparent in the heart of the village, where there is no more space to enlarge homesteads; for example when a son or daughter gets married and a new house must be built in the *solar*. As the extended family expands and more people make use of the same *solar*, this has to be divided between several nuclear families. As a result, there is less space available for vegetation. A similar reduction in the mean size of homesteads has occurred elsewhere on the peninsula (see Herrera Castro 1994). In addition, further from the centre of Tepich village, increasing numbers of new homes are being built on plots of fallow land, though this is only permitted in a limited area.[9]

In the village, then, the gradual reduction of homestead size has led to an overall change in vegetation complexes, which in turn has had an important impact on the domesticated meliponine bees. Traditional homesteads consist of two parts: one in which the main dwellings, kitchens, animal-sheds and other structures are situated; the other in which secondary vegetation abounds (Section 6.2.1). Cultivated crops and trees grow in the former. In Tepich, many homesteads are on stony ground and,

[9]Pursuant to a 1992/93 amendment of *ejido* law, homesteads became private property (Section 2.6.2.3) and therefore plots in the area in which urbanization is permitted can now be bought and sold, which may lead to changes in the size of homesteads.

moreover, the villagers say the quality of the soil in these plots has decreased over the years due to long-term utilization and because the older trees give more shade and grow larger roots, thus restricting undergrowth. In the cultivated part of their homesteads, people occasionally grow crops such as radishes, peppers and tomatoes. *M. beecheii* are known to collect from tomato plants (Silveira Silveira 1990). In addition, several wild plant species are left to grow around the buildings and among the few crops. These 'weeds' include some nectariferous and/or polliniferous species, for

Table 9.3: Occurrence of cultivated trees in the homesteads of Tepich, by the number of homesteads in which the trees are reported to occur (total number of homesteads: 16)

Common name	Species	number of homesteads	Food for	Source
Naranja	*Citrus* sp.	16	*M. beecheii / A. mell.*	A, C
Ramon	*Brosimum alicastrum*	9		A
Ciruela	*Spondias* sp.	8	*A. mell.*	C
Limon	*Citrus aurantifolia*	8		A , B, C
Platano	*Musa* sp.	5	*A. mell.*	A, C
Cocoyol	*Acrocomia aculeata*	5		
Jicera	*Crescentia cujete*	3		
Huaxim		3		
Aguacate	*Persea americana*	3		
Limonaria	*Murraya paniculata*	3	*M. beecheii / A. mell.*	C
Tamarindo	*Tamarindus indica*	3		A
Almendra	*Terminalia catappa*	3		
Zapote	*Pouteria sapota*	2		A
Papaya	*Carica papaya*	2		A
Pimienta de Tabasco	*Pimenta dioica*	2	*A. mell.*	C
Saramuya	*Annona squamosa*	2		
Achiote	*Bixa orellana*	2		A, C
Mango	*Mangifera indica*	2		A
Cayomito	*Chrysophyllum cainito*	2		A
Huaya	*Talisia oliviformis*	2		A
Piich	*Enterolobium cyclocarpum*	1		A
Cedro	*Cedrela odorata*	1		
Habim	*Piscidia piscipula*	1	*M. beecheii / A. mell.*	A, C
Pixoy	*Guazuma ulmifolia*	1		A , B
Nance Blanco	*Byrsonima crassifolia*	1		A
Anona	*Annona purpurea*	1		
Mandarin	*Citrus reticulata*	1		

Identification of species according to Sosa *et al.* 1985
A: Palacios Chavez 1991
B: Herrera Castro 1994
C: informants

example *Ocimum micranthum* (*Kakaltun*). However, the value of this intensively used part of the homestead as a supply of *M. beecheii* food plants is rather low. Only the fruit trees are a good source of bee-food.

Several fruit tree species grow in the homesteads, though the villagers have a particular preference for orange trees. Of the 16 homesteads summarized in Table 9.3 (species density not indicated) all have orange trees, which are the most abundant of the various species. The second most common fruit tree, occurring in 9 of the 16 homesteads, is the *Ramon* (*Brosimum alicastrum*), a food plant for cows and horses, though not a source of nectar, according to the beekeepers. *Ciruela* (*Spondias* sp.) and *Limon* (*Citrus aurantifolia*) are almost as common, occurring in 8 of the 16 homesteads. The rest of the fruit tree species are not abundant in the homesteads. While orange trees are the most common and an important source of nectar for *A. mellifera* and *M. beecheii*, they flower only once a year. Domesticated *M. beecheii* need additional nectariferous plants and a staggered pattern of flowering in order to survive and to yield honey to their keepers.

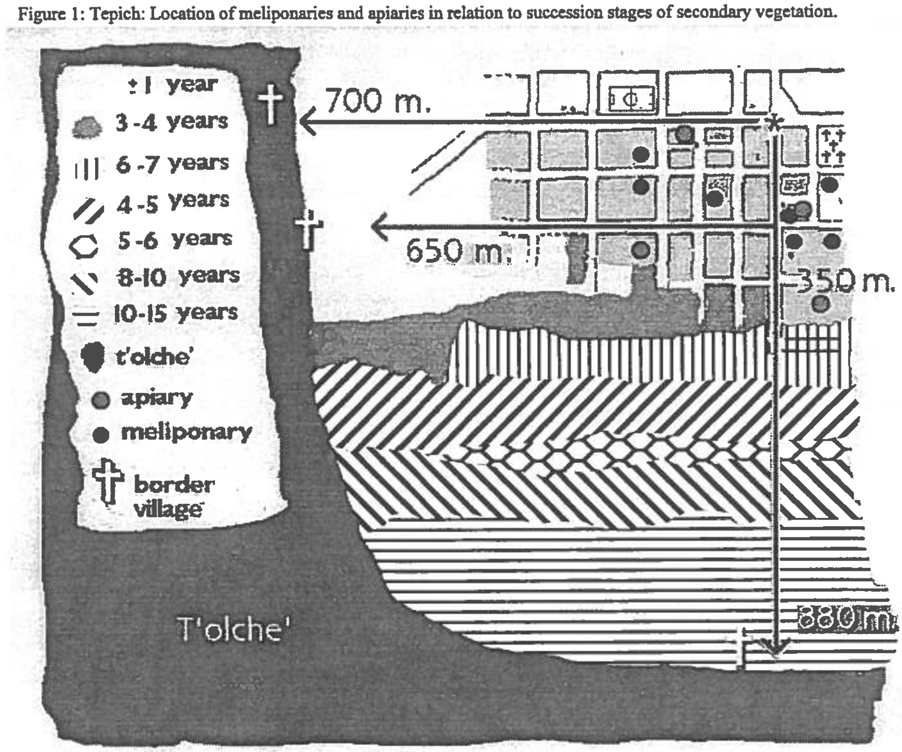
'Secondary vegetation' is a general term for complexes, i.e. combinations of several plant species, at different stages of development. The secondary vegetation in the less intensively used part of the *solar* has several functions: it acts as a wind-break and provides firewood, seeds and seedlings (Section 6.2.1). In terms of the variety and incidence of plant species, this secondary vegetation is similar to that growing in the fallow plots, including former *milpas*, beyond the village perimeter (Herrera Castro 1994). The vegetation complexes in such plots can be categorized into successive developmental stages, the initial stage being characterized by colonizing plants (weeds) and the ultimate stage being virtually indistinguishable from fully grown semi-deciduous forest (see Levy Tacher & Hernández Xoloctzi 1992). As I show in the following sub-section, *M. beecheii* food plants are particularly abundant in the fallow fields, whatever their stage of development. In homesteads, however, the secondary vegetation is the first thing to be sacrificed when there is a shortage of space: for example, when the homestead itself must be reduced in size or when the family living in it expands. Nowadays, indeed, very few of the Tepich *solares* have a significant area of secondary vegetation.

To summarize for Tepich, then, secondary vegetation in the homesteads has come under increasing pressure in recent decades, and there has been a concomitant decline in the quantity and quality of *M. beecheii* food plants as the village within the *ejido* has expanded and become more densely populated. Although fruit trees in the homesteads are an important source of bee-food, they alone do not provide sufficient foraging opportunities for the domesticated stingless bees. In addition, long-term utilization of homestead soils and the advanced age of trees growing in them has made these plots less suitable for the cultivation of crops. The deteriorating and disappearing homestead vegetation does not provide sufficient variety and numbers of food plants for the domesticated colonies to be productive.

9.5 Dominance of nectariferous plants in secondary vegetation

Not only is secondary vegetation becoming increasingly rare within the village perimeter, but the building of new homes is gradually encroaching on the fallow fields surrounding the village. Figure 9.1 is a schematic plan of the surveyed 25% sector of Tepich village. Around the village perimeter is a zone of forest, two kilometres wide, known as the *t'olche'*. Following a serious forest fire about 40 years ago, tree-felling in this zone was prohibited, as it still is. Between the forest and the homesteads are plots

Figure 1: Tepich: Location of meliponaries and apiaries in relation to succession stages of secondary vegetation.



of secondary vegetation in successive stages of development. These plots are occasionally used to grow corn and other crops such as chilies, tomatoes, beans, etc. Like the cornfields (*milpas*) at the outer rim of the forest zone, they are cultivated using traditional slash-and-burn techniques, which provide for a lengthy fallow period, during which the soil regains its fertility. Typically, the vegetation in these fallow plots is the result of 1 to 15 years' uninterrupted growth. Which plants dominate in these complexes? Are they important food plants for *M. beecheii* and/or *A. mellifera*? The results of my survey are summarized in Tables 9.4 and 9.5.[10]

The youngest vegetation consists of wild colonizing plants (weeds), which appear on plots shortly after the burning. As small patches of such vegetation can also be found throughout the village, I did not perform a transect for this developmental stage, so the tables include no corresponding data. Among the weeds grows *Ocimum micranthum* (*Kakaltun*), an *M. beecheii* food plant, which is particularly abundant in verges alongside paths. Another weed common in this type of vegetation is *Bauhinia divaricata* (*Pata de Vaca*), from which *A. mellifera* collects, as I have observed. Remarkably, this species is in flower nearly all the year round. The beekeepers of Tepich consider *Ipomoa crunicalix*, which is also characteristic of such initial vegetation complexes, to be an important source of pollen for both *A. mellifera* and *M. beecheii*, although it is comparatively rare among secondary vegetation in the village itself. *Viguiera dentata* (*Tajonal*), an important food plant for both *A. mellifera* and *M. beecheii*, is particularly abundant from December onwards, though no specimens were found in the surveyed sector of the village.

Table 9.4 shows that, in the transects of 4 to 5 years' growth, the most abundant species was *Neomillspaughia emarginata* (40% of the total specimens counted), which is an important food plant for *A. mellifera* and *M. beecheii*. Other common plants in this transect were *Eugenia* sp. and *Lonchocarpus yucatenensis*, the latter of which must be a source of pollen for *M. beecheii*, as it was identified among pollen samples taken from hives. *Neomillspaughia emarginata* also dominated the 5-to-6-year transect, while the shrub *Gymnopodium floribundum* was only slightly less abundant there. Beekeepers consider *Gymnopodium floribundum* to be the most important *M. beecheii* food plant, for its copious supply of nectar ensures that the hives can be harvested three weeks after it blooms (Section 5.3.1). *A. mellifera* also collects from this shrub. *Senna racemosa*, an important source of pollen for both species, also occurred in this transect. *Gymnopodium floribundum* dominated in the 5-to-6-year transect, the incidence of

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[10]The methods are described in Section 1.9.3.

Table 9.4: Dominant plants of thedifferent development stages in secondary vegetation around Tepich, Quintana Roo

	Species	Common name	Abundancy	Visited by	Source
Transsect 35 m. veg. 4-5 y.		n. of identified species (total 85)			
	Neomillspaughia emarginata	*Sak iitsa*	34	*M. beecheii./A.mell*	A ,B,C, D
	Eugenia sp.	*Chak ni' che'*	9	*A. mell.*	A, D
	Lonchocarpus yucatenensis	*Balche'*	8	*M. beecheii*	C, E
	Verbesina sp.	*Chul keh'*	8	*A. mell.*	A, C, D
Transsect 35 m. veg. 5-6 y.		n. of identified species (total 42)			
	Neomillspaughia emarginata	*Sak iitsa*	15	*M. beecheii./A.mell*	A ,B, C, D
	Gymnopodium floribundum	*Ts'its'il che'*	13	*M. beecheii./A.mell*	D, F
	Senna racemosa	*K'an lol*	5		A, C, D
Transsect 25 m. veg. 6 -7 y.		n. of identified species (total 42)			
	Gymnopodium floribundum	*Ts'its'il che'*	13	*M. beecheii./A.mell*	D, F
	Leguminosae indet		12	*M. beecheii*	E
	Senna racemosa	*K'an lol*	5		A, C, D
	Neomillspaughia emarginata	*Sak iitsa*	3		
	Mimosa bahamensis	*Sak katsim*	2	*M. beecheii*	A,B,C, E
Transsect 50 m. veg. 10-15 y.		n. of identified species (total 24)			
	Bursera simaruba	*Chakah*	7	*M. beecheii./A.mell*	A ,B, D
	Gymnopodium floribundum	*Ts'its'il che'*	6	*M. beecheii./A.mell*	D, F
	Leguminosae indet		6		A
	Acacia sp.	*Subim*	1	*A. mell.*	A, C, D
	Senna racemosa	*K'an lol*	1		A, C, D
	Acalypha sp.		1		
	Lysiloma bahamense	*Tsalam*	1	*A. mell.*	B, D

Species identified by A. Parra Canto E. Ucan L.M. Ortegon
A: Palacios Chavez 1991
B: Herrera Castro 1994
C: Souza Novelo 1981
D: Informants
E: Pollen sample (identified by R. Villanueva)
F: personal observation

Neomillspaughia emarginata having decreased significantly. Almost as abundant as *Gymnopodium floribundum* were various Leguminosae species, many of which are important sources of pollen for meliponine bees. In the 10-year and 10-to-15-year transects, many plant species could not be conclusively identified because the specimens taken lacked flowers or fruit at time of survey. Only six specimens of *Gymnopodium floribundum* occurred in the 10-year transect, along with several Leguminosae species. *Gymnopodium floribundum* was absent from the 10-to-15-year transect, where *Bursera simaruba* was the most abundant. As well as serving as a resource for meliponine bees, the leaves of this plant (known as *Chakah*) are also used in meliponiculture to rub the inner surface of the logs in which the domesticated stingless bees are kept, probably because this impregnates the logs with a scented substance repellent to Phorid flies (Section 5.7).

The tree species in the forest zone (*t'olche'*) surrounding the village are summarized in Table 9.5. The trees there have an average age of about 40 years. The beekeepers pointed out a few species that are important food plants for *M. beecheii*: i.e. *Piscidia piscipula* (*Habim*), *Turbina corymbosa* (*Xtabentun*) and *Vitex gaumeri* (*Yaax niik*). These trees are also food plants for *A. mellifera*. In contrast, *Caesalpinia gaumeri* (*Kitanche'*), *Chiococca alba* (*Kan chak che'*) and *Coccoloba spicata* (*Bo'op*), which also grow in the *t'olche'*, are only said to be *A. mellifera* food plants.

The tables indicate that certain plant or tree species, all of them important sources

Table 9.5: Food plants of *M. beecheii* and *A. mellifera* in *T'olche'* forest area

Species	Common name	*M. beecheii*	*A. mell.*	Nectar	Pollen	nectar/pollen accordin
Piscidia piscipula	*Habim*	*	*	*		A, D
Malpighia glabra	*Nance blanco*		*			A, B, D
Caesalpinia gaumeri	*Kitanche'*		*		*	A, B, C, D
Turbina corymbosa	*Xtabentun*	*		*		B, C, D
Vitex gaumeri	*Yaax nik*	*	*	*	*	A, B, C, D
Metopium brownei	*Chechem*		*		*	A, D
Ceiba pentandra	*Yaax che'*	*	*	*		A, C, D
Acacia sp.	*Subim*	*	*		*	A, C, D
Bursera simaruba	*Chakah*	*	*		*	A, B, D
Chiococca alba	*Kan chak che'*		*			D
Coccoloba spicata	*Bo'op*		*			D
	Xpuuk ak	*	*		*	D
Casimiroa tetrameria	*Yuy*		*		*	C, D
Citrus sp.	*Naranja*	*	*	*		C, D
Cordia dodecandra	*K'oopte' (ciricote)*	*	*		*	A, C, D
Mormodica charantia	*Cundeamor*	*	*	*		D
Sabal yapa	*Huano*	*	*	*		C, D
Acacia gaumeri	*Katsim*		*		*	A,C
Cedrela odorata	*Cedro*	*	*		*	A,C

Identification species according to Sosa *et al.* (1985)
A: Palacios Chavez (1991)
B: Herrera Castro (1994)
C: Souza Novelo (1981)
D: Informants

of bee-food, dominate in vegetation complexes at each successive stage of development *Neomillspaughia emarginata* abounds in relatively young vegetation but gradually peters out after about six years. *Gymnopodium floribundum* becomes most abundant between five and ten years and still occurs in complexes of up to 15 years' growth, though far less commonly, and is all but absent when shrubs and young trees give way to mature trees. In the *t'olche'* forest zone around the village; there are mature trees of several nectariferous and/or polliniferous species which, in younger complexes, have little value as food plants for meliponine bees: i.e. *Piscidia piscipula, Turbina corymbosa, Vitex gaumeri, Ceiba pentandra, Acacia* sp., *Bursera simaruba.* Of great importance to stingless bee colonies is the fact that different species flower at different times of the year: e.g. *Neomillspaughia emarginata* in February, *Piscidia piscipula* in March, *Gymnopodium floribundum* around April and May, and *Acacia* sp. from April to July (Palacios Chavez *et al.* 1993). To sum up, because the complexes of secondary and mature forest vegetation described above are heterogeneous, they produce a staggered pattern of flowering. As the blooms include many from which *M. beecheii* collect nectar and/or pollen, these stingless bees can find food nearly all the year round. Such vegetation constitutes a highly sustainable environment for meliponiculture.

9.6 Distance from meliponary to forage area

The transect surveys of secondary vegetation in Tepich indicate that important nectariferous and polliniferous species commonly occur in and, particularly, around the village. Why, then, do the *M. beecheii* hives yield so little honey? As was explained above, *M. beecheii* has a relatively short flight-range. In addition, the village has expanded over the years and the mean distance from meliponaries to secondary vegetation complexes has increased. Can it be demonstrated that the present-day distances from hives to foraging areas limit production by *M. beecheii*?

Most meliponaries are located in village homesteads. Figure 9.1 shows the present-day positions of meliponaries and apiaries. The distance from the centre of the village to the *t'olche'* forest zone varies, depending on direction, from 650 to 900 metres. Distances to secondary vegetation in and immediately around the village are less, but still several hundred metres. For example, the vegetation complex in which *Gymnopodium floribundum* abounds is approximately 600 metres from the village centre. Another important source of nectar and pollen for *M. beecheii* is *Viguiera dentata* (*Tajonal*), which mainly grows in poor soils, particularly in roadside verges. In the surveyed sector of Tepich, the distance to this resource is approximately 700 metres. Given the foraging range of *M. beecheii* (max. 1000 m; 75% of foraging within 400 m), it is clear that most of the secondary and forest vegetation is inaccessible to the bees. This poses a serious problem for sustainable honey production.

9.7 The compatibility of slash-and-burn agriculture and meliponiculture

The transects taken in Tepich demonstrate that a mixed pattern of secondary vegetation, with patches in different stages of development, is an important source of plants from which *M. beecheii* can collect nectar and/or pollen. Such a pattern is produced by slash-and-burn agriculture, the traditional mode of subsistence in Maya communities, whereby new plots (*milpas*) are cultivated for only two or three years and then lie fallow, typically for one or two decades. As has been shown, *M. beecheii* food plants dominate in these secondary vegetation complexes and flower in a sequence so staggered that these stingless bees can find honey and pollen at nearly all times of the year. In return, by pollinating the food plants in patches of secondary vegetation that lie within foraging radius, these bees play an important role in ensuring that these particular species continue to reproduce. Soil fertility is maintained by burning the secondary vegetation that has grown in the fallow *milpa* and feeding back the ashes (Section 6.3) and therefore does not depend *directly* upon the diversity of plant species there. There is an indirect link, however, for the domesticated stingless bees do contribute to the overall sustainability of the system. By transporting pollen, they help to maintain the diversity of the vegetation complexes. Well-documented evidence indicates that bio-diversity acts as a buffer to environmental impacts, enhances adaptation to new conditions, and increases carbon dioxide intake and therefore plant productivity (i.e. produced biomass). Serious deforestation, resulting in isolated patches of forest, puts pressure on bees and other pollen vectors and may cause a downward spiral in the effectiveness of cross-pollination (Ek 1997: 11). Such resource fragmentation also hampers the natural creation of daughter-colonies by stingless bees migrating from existing nests (see Appendix I). Another important point is that Leguminosae, some species of which are pollinated by stingless bees, are nitrogen-fixing plants and therefore contribute to the fertility of *milpas* not only through their ashes (Dr. R. Ek, Utrecht University, personal communication). Clearly, then, *milpa* agriculture and meliponiculture are environmentally compatible and contribute to the survival of a diverse ecosystem.

In view of this, can the interdependence that the Maya see between their cultivation of corn and the making of honey by the bees be substantiated from an ecological viewpoint? Although, in theory, the bees as pollinators play an indirect role in the production of soil nutrients and thus ultimately contribute to the corn harvest, a direct biological link must be ruled out, at least provisionally. Certainly, *M. beecheii* shows no particular interest in corn as a food plant, while corn is not dependent on bees for its pollination. Furthermore, as corn is generally cultivated in plots a few kilometres from the village (i.e. at the outer rim of the *t'olche'* forest zone) and as hives of *M. beecheii* are generally kept in village homesteads, the *milpa*s are beyond the flight-range of these bees. The only sizeable plots of secondary vegetation that the bees can reach lie between the *t'olche'* forest zone and the village itself, but these are only occasionally used for slash-and-burn cultivation of corn.

The *t'olche'*, between the village and the fallow *milpas* (Figure 9.1), also provides the bees with important food plants. In addition, this area includes many mature trees, which tend to have hollows: the natural nest sites of *M. beecheii*. As these bees have a limited flight-range and, when migrating to new nest sites, must be able to transport materials from the mother- to the daughter-colony, they depend upon tree-hollows in their immediate environment for their survival and proliferation. Although the forest zone surrounding the village is only about two kilometres wide, as long as there are sufficient tree-hollows, conditions will be favourable for *M. beecheii* to proliferate naturally. This aspect has become particularly important in recent decades, since the domesticated colonies of these bees have become so impoverished that their keepers can no longer multiply them by dividing brood. In Tepich, the forest zone is relatively young (approximately 40 years' growth) and therefore has few trees with hollows. The forest in the *ejido* of Xmaben is older and provides more natural nest sites. There, indeed, beekeepers still find wild nests of *M. beecheii* from time to time.

M. beecheii has a particular morphological characteristic that makes it a more effective forager in the typical secondary vegetation of the Yucatan peninsula than most of the other *Meliponinae* exploited by the Maya there. Research has shown that the body colouration of stingless bees has consequences for their foraging behaviour. Even in the shade, air temperatures can be as high as 35°C, but when bees are exposed to direct sunlight they can become overheated. In an experimental setting, the yellowish-brown *M. beecheii* and the darker brown *M. fasciata* were put to forage on a patch of vegetation that was partly sunlit and partly in shade. Significantly, the foraging *M. beecheii* showed a marked preference for the sunlit spots, while *M. fasciata* clearly selected shady spots. The researchers concluded that there was a strong correlation between body colour and this aspect of foraging behaviour (Biesmeijer 1997: 92). On the Yucatan peninsula, the lighter *M. beecheii* are generally kept in villages, where there are few trees, all of which have relatively small crowns and therefore provide little shade. The same is true of the areas of secondary vegetation within flight-range of these domesticated bees. They therefore forage mainly in sunlit spots. As was explained in Sections 4 and 5.2, a few other species of stingless bees are kept in homesteads, though only incidentally. Generally, the Maya take honey and other products from wild colonies of these bees in the forest. They are therefore known as 'forest bees' (*kaaxi kab*). Significantly, most of them are dark-coloured. Further research with these species is necessary to confirm whether the body-colour principle applies in general. So far, experimental evidence suggests that the meliponicultural practices of the Maya may reflect the natural foraging preferences of the stingless species.

In theory, Maya subsistence by *milpa* cultivation and the presence of a forest zone surrounding the village should sustain meliponiculture by providing sufficient food plants and nest sites. As the secondary vegetation in fallow fields is dominated by important *M. beecheii* food plants, and the bees pollinate such plants, the two systems are interdependent and mutually sustaining. In addition, as *M. beecheii* prefers to forage in sunlit spots and the secondary vegetation produced by *milpa* cultivation provides only patchy shade, such vegetation is an ideal and indispensable source of food for these bees. In theory, the traditional agricultural and meliponicultural practices of the Maya are in equilibrium. In practice, however, most of the secondary vegetation is not within reach of the domesticated stingless bees.

9.8 Vegetation in Yucatan and other parts of Mesoamerica

The general importance of secondary vegetation to the bees of Yucatan is emphasized by the fact that all the honey exported from the peninsula is made from nectar produced by wild vegetation. According to Echazarreta:

> "the blooming of *Viguiera dentata* [...] and *Gymnopodium floribundum* [...] from December to May provide the richest nectar flow in Yucatan from which massive amounts of honey are harvested [...]. A wide variety of species sustains colonies during the rest of the year [...]. All the honey exported from Yucatan is multifloral, coming from wild vegetation, mainly *Tah* (*Viguiera dentata*) [...] and *Ts'its'ilche'* (*Gymnopodium floribundum*)" (Echazarreta 1997: 92).

As the peninsula produces a mean annual total of 22,000 tonnes of honey, 12,500 tonnes (56.8%) of which comes from the most deforested state, i.e. Yucatan State, this wild vegetation must be very productive indeed. According to Mexican botanists at the *Universidad Autónoma de Yucatán*, the complexity of this peninsular vegetation is unique, and the species that are important food plants for bees flower in succession during the year so that there is an uninterrupted supply of nectar (personal communication). Although verifying these claims is beyond the scope of the dissertation, it is possible to give a brief summary of the geographical range of some of the more important *M. beecheii* food plants: i.e. *Gymnopodium floribundum* (*Ts'its'ilche'*), *Neomillspaughia emarginata* (*Sak iitsa*), *Viguiera dentata* (*Tah* or *Tajonal*) and *Turbina corymbosa* (*Xtabentun*).

The nectariferous food plant that is indicated as the most important to *M. beecheii* (Section 5.3.1), *Gymnopodium floribundum*, occurs in an area extending from Yucatan to Chiapas and Belize (Standley & Steyermark 1946). Also fairly limited in range is *Neomillspaughia emarginata*, which occurs from Yucatan to the Petén area (Standley 1946: 123). In contrast, *Viguiera dentata* grows widely from Texas to Honduras (Blake 1918: 80), while *Turbina corymbosa* is the most extensive, growing from Mexico to Bolivia and southern Brazil (Austin & Staples). According to these sources, then, *Gymnopodium floribundum* and *Neomillspaughia emarginata* are endemic to the Yucatan peninsula and an adjacent area, as is an estimated 17 % of the Yucatecan flora (Standley 1930). The two other species are more widespread, though *Viguiera dentata* apparently does not occur further south than Honduras. Roughly speaking, this means that precisely those plant species that are indicated as the Yucatan peninsula's most copious suppliers of nectar (Echazarreta 1997: 92) are not found in southern Mesoamerica. Although this information hardly provides a basis for firm conclusions, it may be reasonable to assume that the Yucatecan vegetation complexes, in combination with favourable climatic conditions, are responsible for the high productivity of bee species kept on the peninsula when compared to other parts of the region.

9.9 Conclusions

It is possible to indicate various factors that, at least in the village of Tepich and probably more generally in the Maya Zone of Quintana Roo State, are contributing to the numerical decline and general impoverishment of domesticated colonies of stingless bees (*M. beecheii*). Apiculture started in the village about twenty years ago and gradually expanded until, by 1996, 74 families were keeping at least one hive of honeybees (*A. mellifera*). Because *M. beecheii* workers have a short flight-range, they must compete for limited food resources, in particular with the much larger and more aggressive colonies of *A. mellifera* kept in village homesteads. Apiculturalists with small apiaries, who have increased in number since the general Africanization of honeybee colonies, tend to locate their hives in the homestead for convenience. Since these bees have a considerable competitive advantage over domesticated *M. beecheii*, it must be concluded that apiculture has been a key factor in the downfall of meliponiculture. However, honeybees do not have the same impact on M. beecheii in all parts of the Maya Zone, for in areas where sufficient food plants are available, such as on outlying ranches, apiculture and meliponiculture can co-exist, even though the foraging ranges and preferences of the two species largely overlap. Only 20 years ago, the vegetation complexes in and around Yucatecan Maya villages could sustain large meliponaries, each with 200 to 400 hives. The influence of apiculture alone does not account for the obvious fact that, in terms of the sustainability of meliponiculture, the habitat of *M. beecheii* is being pushed ever closer to the brink. Indeed, surveys show that the availability of food plants within flight-range of the meliponine hives in the village of Tepich has decreased significantly in the past few decades. Most of the floral nectar and pollen resources that are important to *M. beecheii* are located outside its circle of intensive foraging on land used for human subsistence. In such plots, different *M. beecheii* food plants dominate in secondary vegetation at different stages of development (i.e., after 4-5 years' undisturbed growth: *Neomillspaughia emarginata*; 5-6 years: *Neomillspaughia emarginata* and *Gymnopodium floribundum*; 6-7 years: *Gymnopodium floribundum* and various Leguminosae; 10-15 years *Bursera simaruba*, *Gymnopodium floribundum* and various Leguminosae). This pattern was clearly distinguishable in the Tepich transects, though further research is necessary to gain insight into the succession of other plant species and their importance as resources for *M. beecheii*. Presently, because the domesticated stingless bees are generally kept, as tradition demands, in logs in village homesteads, while the *milpa* system of agriculture that produces the favourable secondary vegetation is practised a few kilometres from the village, these bees are deprived of an ideal source of food. Furthermore, the fact that the fallow *milpas* are out of reach of the domesticated *M. beecheii* implies that there is no direct ecological relation between the production of corn and the production of meliponine honey. Such a relation would have constituted an interesting biological corollary of the conceptual linking of these two activities by the Maya. If colonies of

M. beecheii were to be located among such fallow plots, they would not only directly reap the benefits, but would indirectly contribute to the effectiveness of the traditional agricultural system by pollinating plant species found among secondary vegetation. This would enhance the re-occurrence and abundance of such secondary vegetation after cultivation ceases, as well as boosting the supply of nutrients to the soil when that vegetation is subsequently burned prior to a new cycle of cultivation. However, the area of intensive foraging by *M. beecheii* (up to 400 m in radius) mostly falls within the village residential area, which is becoming increasingly urbanized. As a result of this process, moreover, the secondary vegetation in homesteads is generally become scarcer and less diversified, providing fewer food plants for the domesticated stingless bees. For optimal honey production, *M. beecheii* require heterogeneous vegetation with nectariferous and polliniferous food plants flowering all year round. Although domesticated *M. beecheii* do play a role in the pollination of certain crops and trees in the homestead, these plants alone provide insufficient food for the bees. Under the present circumstances, the bees can reach some secondary vegetation; however, this important resource is mostly located outside their circle of intensive foraging. In conclusion: the numerical decline and impoverishment of domesticated *M. beecheii*, the native stingless bee that is most cherished and celebrated by the Yucatecan Maya, can be partly attributed to the qualitative and quantitative decline of food plants in their village habitat and to competition for those floral resources with the non-native *A. mellifera*.

10 CONCLUSIONS - The environment for the beekeepers and the environment for the bees: their interrelationship in a diachronical perspective

Having described meliponiculture as currently practised in western El Salvador and Yucatan in the preceding sections of this dissertation, in this final section I aim to answer the two most important questions that have arisen: why is the practice declining in both these areas and why is the decline most dramatic in El Salvador? In Section 1, I rejected a theory to which nearly all scientists who have researched beekeeping in Central America and Mexico seem to subscribe: i.e. that the sole reason why the region's inhabitants keep bees is to profit from selling honey made by the highly productive *Apis mellifera*, the stinging honeybee, which was originally introduced from Europe. The anthropologist Merrill-Sands seems to be the only researcher who does not lump together all the region's beekeepers in this way, for she acknowledges that many keepers of the stingless native bee *Melipona beecheii* have not switched to apiculture. Most researchers tend to trivialize meliponiculture, portraying it as a mere 'hobby' and explaining its decline as the logical consequence of a free choice by beekeepers. If this dissertation has established anything beyond doubt, surely it is that the special value which many people in El Salvador and Yucatan attach to the native stingless bees and their honey gives the lie to those who claim that the recent downfall of meliponiculture was deliberately instigated. In Section 1, I also denied that beekeeping and other agricultural practices could be approached as if humans existed beyond nature, controlling and mimicking it. Rejecting any dichotomy between nature and culture paves the way to studying them as inseparably related aspects of our world. Furthermore, as organisms and their biotic environment necessarily process each other's historical development, it is impossible to understand meliponiculture without viewing it in a diachronical perspective. Every sentient being seeks to make a 'meaningful' whole of its environment in the particular manner of its species. It has thus been possible to describe the environment as it is for the beekeepers in terms of the cultural values through which they themselves explain it (Sections 3-8), as well as to describe the environment for the bees (insofar) as biologists explain it (see Appendix I) and as I observed it in the *ejido* of Tepich (Section 9). Against an historical background (Section 2), it has become possible to describe how beekeepers have altered their environment and how this has influenced the bees they keep in that environment. I believe that describing these processes has given new insights into the practice of meliponiculture and its dramatic decline in recent decades. While putting beekeeping into a diachronical perspective in this concluding section, I also re-examine certain issues, and try to answer certain questions, which have arisen in the course of this dissertation and have yet to be satisfactorily addressed.

10.1 The distribution of meliponiculture and *M. beecheii* in Mesoamerica

It is striking that the region in which meliponiculture has been practised for centuries roughly coincides with the cultural area known as 'Mesoamerica'. It is no less striking that this area roughly coincides with the geographical range of the endemic stingless species *M. beecheii*. The ranges of several *Melipona* species, including *M. beecheii* and *M. yucatanica*, overlap in Costa Rica. In that country, *M. beecheii* occurs in an area of which the Nicoya peninsula - the southern tip of Mesoamerica - is by far the greater part. Furthermore, *M. beecheii* and *M. yucatanica* occur only in the northern part of the peninsula. In the southern part, other *Melipona* species are found, though these are very rarely kept. Of all the stingless species that occur in Mesoamerica, *M. beecheii* is generally favoured for cultivation and domestication because:

a) its honey is considered to be of high quality;
b) its behaviour is inoffensive to humans;
c) it is one of the most productive native stingless species in the area.

However, meliponiculture is practised in an area larger than the geographical range of *M. beecheii*. It is not known exactly how widespread *M. beecheii* is in Mexico, but the species certainly does not occur in the northern part of Mesoamerica, where meliponiculture was traditionally practised with another *Melipona* species. In the southern part of Mesoamerica, the distribution of meliponiculture coincided, as it still does, with the range of *M. beecheii*. In that area, therefore, the practice has developed in interaction with a particular environment which is intimately associated with this species.

10.2 The larger scale of meliponiculture in Yucatan and the trade in *Melipona* products during the colonial era

In areas where *M. beecheii* occurred in the wild, people cultivated it for its products, especially honey. On the Yucatan peninsula, the species was most successfully domesticated. Evidently, meliponiculture was practised on a much larger scale there than in other areas. This conclusion is based on:

a) early colonial descriptions of extensive traditional beekeeping;
b) records of great amounts of tribute paid to the Spanish *vecinos* in the form of bee products;
c) reports of a flourishing trade in *Melipona* honey from Yucatan to parts of southern Mesoamerica.

Another striking difference is that, beyond Yucatan, people have always hung logs of certain stingless bee species from the eaves of their houses, whereas Yucatecans have always stacked their bee-logs in specially constructed bee-houses, which can accommodate a much larger number of colonies. In Section 1, I indicated that cultural factors alone could not account for the larger scale of meliponiculture in Yucatan and the demand for *Melipona* honey in southern Mesoamerica. On the basis of the data presented in this dissertation, is it possible to turn back the clock five centuries and explain why meliponiculture was then so successful in Yucatan?

In general terms, it is certainly true that the geographical ranges of some very important *M. beecheii* food plants include or overlap with the Yucatan peninsula. Approximately 17% of the peninsula's vegetation is endemic, including a number of *M. beecheii* food plants which have been identified as copious producers of nectar and/or pollen (i.e. *Gymnopodium floribundum* and *Neomillspaughia emarginata*, which, roughly speaking, are confined to the peninsula; and *Viguiera dentata*, which, just as roughly, is confined to an area encompassing the peninsula, Honduras and the southern Mexican state of Chiapas). Meliponine bees are only productive if they have access to a plentiful supply of food all year round. The plant species that meet this requirement in Yucatan are virtually endemic to the peninsula (see Section 10.4). Significantly, many of the plants from which *M. beecheii* collects nectar and/or pollen are also important food plants for *A. mellifera*. It seems plausible that Yucatan has become one of the world's leading producers and exporters of honey (harvested exclusively from apiaries) because of the peninsula's unique vegetation complexes and favourable climatic conditions. The same factors may, of course, explain the equally remarkable success of Yucatecan meliponiculture five centuries ago.

Beyond the peninsula, certain species of the family Compositae that grow among secondary vegetation are known to be important food plants for *M. beecheii*. In Section 3, a *Vernonia* species of this family (probably *V. canescens*) was indicated as the most important of these plants in El Salvador. Two other important *M. beecheii* food plants in the secondary vegetation of that country are *Combretum eranthium* and *Coccoloba floribundum*. During my fieldwork in El Salvador, I collected no data on the flowering periods of such plants. It is therefore impossible to say whether nectar and pollen are as copiously and continuously available there as they are in Yucatan. Before any firm conclusions can be drawn, additional detailed research is required on the incidence and range of plants, their flowering periods, and their importance as food sources for meliponine bees.

So far as the Yucatan peninsula is concerned, it should be noted that the data presented in this dissertation provide grounds for nothing more than a cautious conclusion that the presence of specific food plants contributed to the success of meliponiculture. One thing is certain, however, there are no grounds for concluding that the practice flourished solely as a result of cultural traits.

10.3 How the Spanish conquest and colonization by Europeans affected meliponiculture

For a few centuries after the arrival of the *conquistadores*, Yucatecan meliponiculture seems to have continued undiminished. Indeed, some *vecinos* even started breeding *M. beecheii* themselves, as reports of large meliponaries on *haciendas* testify. The most important change in beekeeping after the Spanish conquest was the shift from honey to wax production. Extracting wax from a colony undoubtedly places a greater strain on the bees than harvesting honey. No exact data are available on the 'cost' to meliponine bees of extracting wax, though the figures for honeybees give some indication. *A. mellifera* consume seven kilograms of honey for the production of one kilogram of wax (Merrill-Sands 1984: 229). To meet the demands of the colonial tribute system, Yucatecans most probably had to supplement the production of their meliponine hives by collecting wax from wild nests in the forest. Another significant market-driven shift took place in the colonial period: bee-products from Yucatan were no longer traded within Mesoamerica but were shipped all the way to Europe. No historical sources indicate that significant quantities of bee-products were shipped to Europe from other colonial territories in southern Mesoamerica.

A. mellifera was successfully introduced to the Yucatan peninsula in the first decades of the 20th century, some 150 years later than it was brought to other parts of Mexico and to Central America (the first references to the breeding of *A. mellifera* in Honduras date from 1780; in El Salvador, from 1850). There are very few reports of indigenous groups taking up apiculture soon after introduction of the species; for a long time, the activity remained the exclusive preserve of European settlers. In the early 20th century, the Kekchi of Guatemala started breeding the European honeybee in addition to their customary meliponine species; people on the Nicoya peninsula of Costa Rica presumably adopted the practice later, for Wagner, who visited the area in the 1950s and whose study included detailed observations of beekeeping, does not mention apiculture in his 1958 publication.

Next to nothing is known of how deeply meliponiculture was embedded in the Mesoamerican cultures of the pre-conquest era, so we can only guess how the system was influenced by the arrival of the Spaniards. As we have seen in preceding sections, there are striking similarities between the contemporary systems of meliponiculture in El Salvador and Yucatan. In both areas, for example, *M. beecheii* honey is used to enhance human fertility, and the death of a beekeeper or close relative is associated with the death of stingless bees or their flight from the household. It has not proved feasible to compare these two cognitive systems: in El Salvador, the traditions are severely fragmented because of:

a) the disappearance or serious decline of meliponiculture in most areas;
b) the recent conversion of many people to newly introduced forms of Protestantism that reject traditional beliefs and practices;
c) the cultural heterogeneity of the population.

It is interesting to note that in some parts of El Salvador where European honeybees were introduced much earlier than in Yucatan, the conceptual link between a death in the beekeeper's family and the death or escape of their bees now applies to *A. mellifera* rather than *M. beecheii*. Medieval Europeans also recognized a link between the souls of humans and bees. Is it possible that this concept was brought to Mesoamerica by European colonizers? I am inclined to reject this theory for the reason that, in the remoter parts of present-day El Salvador and in Yucatan, the concept applies only to the native *M. beecheii*. Furthermore, such a spiritual linkage is perfectly consistent with the wider belief system of the contemporary Yucatecan Maya, which has roots in the pre-colonial era. It seems more likely to me that the two remarkably similar concepts evolved independently in Europe and among the Maya (and possibly other Mesoamerican groups). These may first have merged in the 16th century, in the same way that the pre-Hispanic Maya concept of the cross, as interpreted from hieroglyphic texts, became inextricably intertwined with Christian symbolism to produce the current, syncretic image. Similar processes may have occurred throughout Mesoamerica in relation to meliponiculture. As the striking similarities between meliponicultural practices in Central America and Yucatan include several on a cultural level, it seems unreasonable to conclude that the keeping of stingless bees in the former area was a less significant component of Mesoamerican culture than it was in the latter.

10.4 How meliponicultural and agricultural practices have interacted in a changing environment

In Section 1, I endorsed the view that, by growing crops and keeping bees, humans not only alter their environment but also create, and come to depend on, a mutual relationship between the bees and vegetation complexes which result from farming within their flight-range. No information was gathered on how bees influence agriculture; however, some conclusions can be drawn about how traditional farming and beekeeping systems affect the productivity of *M. beecheii*.

For a long time after the Spanish conquest, the indigenous communities of Mesoamerica continued to practise slash-and-burn cultivation of their basic foodstuffs: corn, beans and squashes. For beekeeping, the significant species are not the crop plants but the vegetation complexes that develop when cultivation ceases and plots lie fallow. Through their shifting pattern of farming (i.e. swidden agriculture), the people created patches of secondary vegetation in different stages of development, interspersed among mature forest. This was the environment in which they kept colonies of stingless bees. At successive developmental stages, the last of which is virtually indistinguishable from the surrounding mature forest, different plant species dominate in the secondary vegetation. On the Yucatan peninsula, some of these dominant species are very important sources of food for *M. beecheii*. Of great significance is the fact that different species flower at different times of the year. Collectively, then, the mosaic of secondary vegetation created by traditional farming practice presents a favourable variety of plant species. The flowering periods of dominant species are as follows (those not previously given are based on Palacios-Chávez *et al.* 1991):

a) among the colonizing weeds: *Bauhinia divaricata* (most of the year), *Ocimum micranthum* and *Viguiera dentata* (December and January);
b) in 4 to 5 years' growth: *Neomillspaughia emarginata* (approx. February and March), *Eugenia* sp.;
c) in 5 to 6 years' growth: *Neomillspaughia emarginata*, *Gymnopodium floribundum* (approx. April) and various unidentified Leguminosae;
d) in 10 years' growth: *Gymnopodium floribundum* and various Leguminosae;
e) in 10 to 15 years' growth: *Bursera simaruba* (April to August);
f) in 40 years' growth (mature forest): *Piscidia piscipula* (approx. March), *Turbina corymbosa* (approx. December) and *Vitex gaumeri* (February to April).

In other words, by practising shifting slash-and-burn agriculture in the neighbourhood of bee-houses stacked with logs of *M. beecheii*, the Maya created an environment in which their stingless bees could collect ample quantities of nectar and pollen at most times of the year. The continuous presence of high-quality food plants is very important to *M. beecheii*, as individual bees of this species do not readily switch to alternative floral resources if the flow of nectar at the original foraging area ceases not even if better resources are available elsewhere (see Appendix I). An individual meliponine bee is therefore likely to devote its entire foraging career to one species; in some cases, even to the same plant. There are indications that these bees are able to collect large quantities of nectar, even at their maximum foraging speed (Biesmeijer 1997). However, if *M. beecheii* colonies are to stock up their hives with honey and pollen in storage pots, they must have access to sufficient flowering plants that are rich sources of nectar and pollen. Although no data were gathered on successive vegetation complexes beyond Yucatan, important *M. beecheii* food plants are known to occur on previously cultivated plots in El Salvador and Costa Rica (e.g. *Vernonia*, probably *canescens*; *Combretum eranthium*; *Coccoloba floribundum*). There can be no doubt, then, that the typical traditional farming system once practised throughout Mesoamerica was, and still is, highly compatible with meliponiculture.

Slash-and-burn agriculture was also, and still is, highly compatible with the reproductive system of meliponine bees. There is no way of ascertaining whether, in the early colonial era, Mesoamerican beekeepers beyond Yucatan domesticated colonies (i.e. multiplied them by splitting the brood). Certainly, the environment provided ample opportunities for colonies to multiply by natural migration. When plots were cleared for cultivation, older trees were generally left intact. Such plots were surrounded by undisturbed, mature forest. In the bees' environment, then, there were plenty of older trees, which tend to have hollows. These are the sites where *M. beecheii* prefers to nest and upon which the species therefore depends for its reproduction in the wild. Beekeepers who can successfully multiply colonies by artificial means create additional daughter-colonies and thus enhance the proliferation of the species. Furthermore, any decline in domesticated colonies can be compensated without plundering the forest. In areas where beekeepers did not play a role in the reproduction of colonies, wild colonies were taken from the forest for cultivation. Of course, colonies must also have 'fled' from captivity back to the forest, for there is no evidence that beekeeping techniques prevented the bees from migrating naturally. As slash-and-burn cultivation supported the natural reproductive system of the bees and supplied a wealth of important food plants which may even have surpassed the floral resources in undisturbed forest, it is not inconceivable that colonies of *M. beecheii* kept in settlements were more productive than they would have been if left in the wild.

I have now proposed two reasons for the success of large-scale meliponiculture in Yucatan. Firstly, some very important *M. beecheii* food plants that are endemic to the Yucatan peninsula took advantage of swidden agriculture there; secondly, the Maya developed techniques for multiplying colonies. There is a third important difference between meliponicultural practices in Yucatan and Central America which is likely to have further increased the productivity of *M. beecheii* on the peninsula. From the early colonial period until today, the Maya have kept *M. beecheii* in the homestead, whereas almost all the other stingless species have always been left in the forest. The earliest reports of meliponiculture in Central America (which are more recent than the earliest reports from Yucatan) indicate that several stingless species were kept side-by-side under the eaves of human dwellings. Contemporary Salvadoran meliponiculturalists still keep a variety of species around their houses in this way. Correlating these practices with biological characteristics of stingless bees suggests the following advantages of separating *M. beecheii* from other species:

a) *M. beecheii* is of lighter colour than most other stingless species, many of which are black (e.g. *Trigona* spp., *Partamona* spp., *Plebeia* spp., *Scaptotrigona* spp.). Because of its paler hue, *M. beecheii* prefers sunlit spots. Black bees, being more susceptible to overheating, exhibit a clear preference for shady spots and are therefore better off in the forest (where they are, indeed, usually left by the Maya). Bees coming and going from hives kept in the homestead cannot avoid being warmed, for there is little shade. In addition, by creating plots of secondary vegetation in different stages of development around their dwellings, farmers provide many important *M. beecheii* food plants, most of them in sunlit spots. In other words, by keeping *M. beecheii* in their homesteads, the Maya reinforce the habitat preference of the species.

b) *Meliponinae* have a short flight-range which is roughly proportional to their body length. The maximum flight-range of *M. beecheii* is approximately one kilometre, while 75% of foraging is done within 40% of this maximum, i.e. from food plants no further than about 400 meters from the hive. In contrast to many other bee species (e.g. *A. mellifera* and *Trigona* spp.), *M. beecheii* avoids competition for floral resources. Therefore, by separating *M. beecheii* from other bees, Maya beekeepers also reinforce its not tendency to forage from patches where other species are collecting. In addition, the separation minimizes pillaging of *M. beecheii* nests by other species (particularly the infamous *Tetragonisca angustula*). The fewer floral resources there are in the vicinity, the more important it becomes to avoid inter-species competition and pillaging. In areas where *M. beecheii* food plants are abundant, the species can co-exist with other stingless species - and *A. mellifera* - and still give a good honey yield (Flor de Mayo ranch, Table 5.2; and Section 5.4.6). However, when food plants become scarce, the specific behavioural characteristics of *M. beecheii* can put it at a considerable disadvantage.

To sum up so far: the practice of keeping the most cherished and non-competitive stingless species separately from other, less favoured species may have significantly increased its honey production per colony and the capacity of the immediate environment to sustain large numbers of its colonies. This is because *M. beecheii* was spared stiff competition from other species and its preference for sunlit spots was respected.

In many parts of Central America and Mexico, the traditional system of slash-and-burn agriculture came under intense pressure because the colonial regime depended upon rapid exploitation of the environment for short-term profit. Vast areas were deforested, especially in El Salvador. As the colonial authorities tightened their legislative restrictions on the use of land by indigenous farmers (including the abolition of the customary right to usufruct), the slash-and-burn system eventually collapsed. The new farming methods imposed did not automatically produce important *M. beecheii* food plants and nest sites; on the contrary they ravished the land. Before long, deforestation and the collapse of slash-and-burn agriculture had led to the virtual extinction of *M. beecheii* in the Sonsonate area of western El Salvador. Other stingless bees, such as *Tetragonisca angustula*, *Geotrigona* sp., *Trigona* spp. and *Plebeia* spp., do not depend solely on tree-hollows for nest sites and have therefore survived in severely deforested areas. Some of these species occur in the Sonsonate and Chalchuapa areas (La Criba lies in the latter), dwelling in underground and exposed nests, or, in the case of the smaller species, in any kind of natural or man-made cavity. This suggests that if meliponiculturalists in such areas were to use effective methods of colony multiplication, and provided there were adequate floral resources within foraging range, *M. beecheii* could be kept successfully, even though the original habitat of the species was destroyed long ago. In most parts of El Salvador, suitable nest sites and important food plants for *M. beecheii* have become so scarce that the environment can no longer sustain colonies of the species without a concerted effort by beekeepers.

Developments have been quite different on the Yucatan peninsula, where the colonial regime, rather than being geared to wholesale exploitation of the environment, depended heavily upon the indigenous people themselves. To support colonial society, tribute was demanded of the Maya, principally in the form of honey and wax - the area's most important commodities. Those Maya who could not or would not contribute to this colonial system fled into the dense forests of the southern part of the peninsula, where they managed to live in relative independence. It was among these Maya that the seeds of rebellion were sown, culminating in the anti-colonial uprising of the mid-19th century - the Caste War. Despite the eventual defeat of the rebels, until the mid-20th century, people in the Maya Zone of Quintana Roo continued to live quite independently of other Yucatecans, maintaining their traditional subsistence methods of slash-and-burn agriculture and meliponiculture. As a result of recent land reforms including the establishment of *ejidos* under the Cardenas government, the contemporary farmers in this area are still able to practice slash-and-burn agriculture and thereby continue to create favourable conditions for meliponiculture.

To conclude: in southern Mesoamerica and the Yucatan peninsula, traditional slash-and-burn agriculture sustained meliponiculture for centuries. However, the Yucatecan keepers of stingless bees were able to maintain much larger meliponaries and produce far more honey than their counterparts elsewhere, probably because the typical secondary vegetation complexes of the peninsula produced more abundant and consistent floral resources (i.e. copiously nectariferous and polliniferous plants throughout the year), than those in southern Mesoamerica. In the colonial area, however, the slash-and-burn system came under increasing pressure from massive deforestation and the changing relationship between humans and land. This pressure was far greater in El Salvador than Yucatan. The original success of meliponiculture resulted from a favourable interaction between ecological factors, a beneficial agricultural system, and special beekeeping methods with *M. beecheii*. The slash-and-burn system has survived in the Maya Zone of Quintana Roo, Yucatan, because of the area's relatively low population density and thanks to an enlightened and far-sighted political decision to make land freely available to peasant communities. In theory, therefore, meliponiculture can be sustained by the modern environment of the peninsular.

10.5 How apiculture and the Africanization of *A. mellifera* have affected meliponiculture

I argued in Section 1 that the history of an environment is the history of all its organisms. The introduction of the European honeybee *A. mellifera* and its subsequent Africanization have clearly made a profound impact on the environment of bees in Latin America. What exactly have the consequences been for meliponiculture?

It is beyond doubt that, since the introduction of *A. mellifera*, many people have chosen to breed the species for economic reasons. I sincerely hope that this dissertation has demonstrated that apiculture and meliponiculture can serve different, yet not incompatible goals. In Yucatan, apiculture gradually superseded meliponiculture as an important economic activity. Nonetheless, meliponiculture remains unchallenged in its cultural importance and as a provider of traditional medicines. (The numerous curative properties ascribed to *Melipona* honey can probably be explained by its high antibacterial activity). Whereas many people started breeding *A. mellifera* on a large scale with a view to making a considerable profit, many others continued to keep meliponine bees for quite different purposes. Therefore, as I have argued above, the serious decline of meliponiculture in recent decades cannot be attributed solely to a deliberate shift to apiculture.

The Africanization of honeybees has affected meliponiculture quite differently in El Salvador and Yucatan. In many Salvadoran communities, particularly the smaller and remoter villages, apiculturalists were not properly informed how to handle the more aggressive Africanized bees, so most of them abandoned the activity. Apiculture declined sharply - as it generally did in Latin America wherever public information campaigns were inadequate. With honeybees suddenly out of favour in such areas, the keeping of stinging bees came to be viewed in a new favourable light. Despite the lower productivity of such bees, Salvadoran households continuing to keep them, realizing that the harvesting and selling of *Melipona* honey could still be lucrative. This is because *Melipona* honey is 2.5 to 12.5 times more expensive than *A. mellifera* honey in local trading (1993 prices).

In contrast, Yucatecan apiculturalists were generally well informed about the implications of Africanization. Nonetheless, some of them had misgivings and abandoned the activity, whereas others took advantage of the high swarming frequency of the Africanized sub-species by capturing a swarm and starting to breed colonies. Official statistics for Mexico show that, following Africanization, the number of apiculturalists generally increased, while the average number of *A. mellifera* hives per beekeeper decreased. This was also the case in Tepich. Ironically, this shift to small-scale apiculture put increasing pressure on the domesticated meliponine bees, for people with less than five hives of *A. mellifera* were inclined to put them in the homestead (contravening *ejido* regulations). *M. beecheii* hives suddenly faced stiffer competition on their 'home ground'. Africanized honeybee colonies consist of far more individuals than meliponine colonies and therefore have a much greater foraging capacity. As the floral resources from which these two species forage largely overlap, and as *M. beecheii* generally avoids patches where other species are already foraging, the presence of just a few honeybee colonies in its flight-range can strongly reduce its average honey production per hive.

Africanization thus had opposite effects in Yucatan and El Salvador. The traditional Maya policy of keeping species strictly separate would have effectively minimized competition between *M. beecheii* and *A. mellifera*, even after Africanization had made the honeybees even more aggressive competitors. With all meliponaries inside the village and all apiaries outside, where would have been no clash.However, just as apiculture could not take on the cultural value of meliponiculture, certain concepts which apply to meliponiculture have not embraced apiculture (one possible exception being the relation between the death or swarming of bees and the death of one of their human beneficiaries, as discussed in Section 10.3). Competition becomes an increasingly important factor as the abundance of nectariferous and polliniferous plants decreases within the intensive foraging area of *M. beecheii*.

10.6 Contemporary Salvadoran and Yucatecan meliponiculture in comparison

As we have seen, widespread deforestation and commercially driven changes to the Mesoamerican agricultural system have led to a dramatic decline of food plants and nest sites for *M. beecheii*. In western El Salvador, meliponiculture has only survived in the Montecristo area and among isolated communities in the Chalchuapa area. The decline has been less severe on the Yucatan peninsula, where there are still a few small-scale meliponiculturalists in most rural communities, and where people in some villages and outlying ranches are even able to sustain reasonably large meliponaries. More specifically, the following similarities and distinctions between Salvadoran and Yucatecan meliponiculture have been noted:

a) The stingless species in the Salvadoran and Yucatecan environments do not completely coincide:[1]

  1) Six species occur in both El Salvador and Yucatan (i.e.: *M. beecheii*, *M. yucatanica*, *Trigona fulviventris*, *Scaptotrigona pectoralis*, *Partamona nigrior* and *Lestrimelitta limao*).
  2) Eight species occur only in El Salvador (*Tetragonisca angustula*, *Geotrigona acapulconis*, *Cephalotrigona* sp., *Scaptotrigona bipunctata*, *Trigona fuscipennis*, *Partamona* aff. *Cupira*, *Tetragona dorsalis* and *Oxytrigona* sp.)
  3) Four species occur only in Yucatan (*Frieseomelitta nigra*, *Nannotrigona* sp., *Trigonisca* sp. and *Trigona compresa*)

b) Honey-gathering in the forest (i.e. the harvesting of honey from wild colonies) is more important and better developed in El Salvador than in Yucatan. The techniques used by Salvadoran honey-gatherers are in accordance with specific behavioural characteristics of the meliponine species.

c) The honey of stingless bees has greater economic value in El Salvador than in Yucatan. The honeys of *Geotrigona acapulconis*, *Tetragonisca angustula* and *M. beecheii* are particularly expensive; the highest price per litre was equivalent to five days' labour (14.5 US dollars) in 1993. This factor is especially important in

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[1]As some *Plebeia* and *Trigona* species remain unidentified, it is impossible to determine the exact coincidence in these genera.

subsistence economies where cash is scarce. In the Maya Zone of Quintana Roo, *Melipona* honey is hardly ever sold.

d) The honey of stingless bees is important in domestic medicine, especially in El Salvador. Curative properties are ascribed to the honey(s) of: M. *beecheii* in El Salvador and Yucatan; *Tetragonisca angustula* and *Geotrigona acapulconis* in El Salvador; and *Partamona nigrior* in Yucatan.

e) Is there a significant difference in mean yields from *M. beecheii* hives in El Salvador and Yucatan? In the Salvadoran village of La Criba, no *M. beecheii* colonies have survived. This is because the capacity of the immediate environment to sustain colonies has decreased significantly in recent decades: nowadays, almost no 'wild' vegetation grows within this village. In El Brujo and El Limo in 1993, the mean production of *M. beecheii* hives was 1.6 litres of honey. This is significantly more than the mean production of such hives in the Yucatecan villages of Tepich, Kimbila, Epedz and Chan Chen Comandante; it is more or less equal to the figures for the villages of Yaxley, Tabi and Tusik; and it is significantly less than the figure for the outlying Flor de Mayo ranch. The data indicate that productivity is influenced by colony density (i.e. the number of competing colonies per unit area) and the availability of copiously nectariferous and polliniferous plants.

f) Harvesting methods in the two areas are practically identical. Salvadoran beekeepers do not multiply their meliponine colonies by splitting brood, whereas their Yucatecan Maya counterparts do (though not always successfully). However, the Salvadorans occasionally feed their stingless bees, which is rarely done in Yucatan. The bees are usually fed during the rainy season, probably because there is a shortage of food plants at that time and the frequent downpours make it difficult for the bees to go out foraging. Salvadoran beekeepers also appear to be more successful at capturing wild 'swarms' than their Maya counterparts. The Maya meliponiculturalists effectively reduce the tendency of their colonies to swarm by artificially creating daughter-colonies and thus reducing the number of bees per colony. However, many of them now say that their colonies have insufficient bees, honey and pollen to be multiplied. Whenever they open bee-logs, the Maya rub them inside with leaves of *Bursera simaruba*, a practice which is believed to reduce the risk of invasion by Phorid flies (if only a small number of these flies manage to get past the soldier bee in the nest-entrance and enter the hive, a weak colony is doomed). Strikingly, although *Bursera simaruba* occurs in El Salvador, beekeepers there have no use for it. Instead, they use salt to combat these deadly flies. Further research is necessary to determine the effectiveness of these repellents.

In other words, even in El Salvador, where meliponiculture is no longer part of a coherent cognitive system and has died out in most areas, it still has great importance to its practitioners and other members of the community. Neither in Yucatan nor in El Salvador was the decline of the practice solely caused by the more or less popular shift to apiculture, so why exactly did it happen sooner and have more dramatic consequences in the latter area? Generally speaking, the decline of meliponiculture must have been caused by massive deforestation and changes in land use, which drastically reduced the abundance of important *M. beecheii* food plants and nest sites. Even though this effect has been more pronounced in El Salvador, the contemporary meliponaries of El Brujo and El Limo are more productive than those in many parts of the Maya Zone. It therefore seems reasonable to conclude that one of the biggest problems facing the remaining Salvadoran keepers of stingless bees is their inability to multiply colonies. 'Lost' colonies (i.e. those that have died or fled) are rarely replaced, for the only source of new colonies is the forest. Because of habitat fragmentation and degradation, wild colonies are becoming increasingly hard to find. In addition, Salvadoran law prohibits the cutting or felling of trees in the forest, which is often the only way of obtaining wild nests of *M. beecheii*. Furthermore, most of the vegetation around village dwellings is quite young and therefore does not provide many tree-hollows. The bees therefore have little opportunity to migrate naturally. To conclude: the Montecristo area still provides sufficient food plants for the bees to be productive, but meliponiculture will only be sustained there if its practitioners can successfully multiply colonies.

10.7 Meliponiculture among the Maya

Another view I endorsed in Section 1 was that cultural concepts must be studied in relation to environmental aspects. Maya explanations of particular behavioural characteristics of *M. beecheii* are in accordance with their logical ordering of the environment, which in turn is partly based on the observed behaviour of the bees. Significantly in this context, many aspects of Maya culture are based on the principle of cyclical regeneration; for example, agricultural and ceremonial practices, concepts related to fertility, and time-reckoning, all of which are linked to Maya cosmology. It is not necessary to reiterate here the importance of meliponiculture to its practitioners, as made explicit through Maya culture, for this has been thoroughly discussed elsewhere in this dissertation (conclusions of 'emic' Sections 4 to 8). In addition, I have related the Maya methods of keeping stingless bees to their biological characteristics (Section 5.9). This final sub-section deals with the interaction between culture and environment; or more specifically, with the key issue of how Maya culture is responding to the current impoverishment of stingless bees in the context of sweeping environmental change.

As befits a 'Lady bee', once domesticated, *M. beecheii* concerns under the jurisdiction of the senior male in the homestead. This is in accordance with the concept that God has placed *M. beecheii* under human protectorship. This is unique, for all other protectors of animal species are deities or collective spirits. A practical consequence of this concept is that *M. beecheii* is kept separately from all other bees: in other words, this species, which by virtue of its body colour has a natural preference for sunlit patches, is kept in the homestead where sunlit patches are indeed more common. Other stingless species, which are more susceptible to overheating, are left in the cooler forest, shaded by the canopy of trees. This practice absolves *M. beecheii* from the obligation to compete with other species (in theory), is in harmony with the natural tendency of the species to avoid foraging from floral patches where other bees are present, and increases the productivity of colonies. As long as the settlement and agricultural pattern in the Maya Zone of Quintana Roo remained relatively dispersed, the regime of separation was perfectly compatible with productive meliponiculture. The short flight-range of *M. beecheii* was not a problem: the bee-houses were located relatively close to the patches of secondary vegetation and, moreover, people let secondary vegetation grow virtually undisturbed in plots within the homestead. However, in the modern era, the slow but steady growth of the urbanized zone in the *ejidos* of the Maya Zone has posed a serious threat to the productivity of *M. beecheii*, because:

a) the abundance and diversity of food plants in the homestead has sharply decreased;
b) the typical distance from the meliponary to secondary vegetation with important *M. beecheii* food plants has exceeded the intensive foraging range of the species;
c) although apiaries are legally required to be kept outside the village perimeter, small-scale apiculturalists, usually with less than five hives, tend to put them in the homestead for easy access, inadvertently exposing *M. beecheii* colonies to

competition for floral resources with the far more efficient forager *A. mellifera*.

Before these changes took place, Maya concepts were well attuned to the circumstances and characteristics of *M. beecheii*. Now, though, some of these concepts appear to be counterproductive. The idea that the rightful place of *M. beecheii* is in the homestead is not often challenged, while the bees' immediate environment is changing rapidly. In Tepich, only a few meliponiculturalists (owning a total of nine colonies: see Table 5.1) have placed their *M. beecheii* hives amid the abundant food plants of the fallow *milpas* (forest cornfields). Traditional Maya culture gives scoop for such a relocation of hives, for land deemed 'wild' can be ritually 'tamed' (i.e. brought into the cultivable and habitable domain by means of ceremony). Surprisingly, however, even though most beekeepers are only too aware of how impoverished meliponine colonies generally are becoming, they are taking no decisions or actions in response. They relate their observations to a background of acquired knowledge, most of which, in the context of meliponiculture, has been handed down through cultural channels and, in the context of apiculture, has been learnt from fellow-practitioners or government trainers. Interpretations vary: traditional Maya culture accounts for the contemporary problems and proscribes an active response as follows:

a) the age-old system whereby vital substances are exchanged with the supernatural realm has gone out of balance as increasing numbers of people have stopped paying their dues (i.e. have stopped offering ritual food) to the gods;
b) the fates of humans and bees are inextricably linked, i.e. the historical subjection of the Maya by the Spaniards means that the native *M. beecheii* cannot avoid being dominated by the foreign *A. mellifera* for the time being;
c) the concept of cyclical regeneration - so deeply rooted in observed aspects of the environment, in agricultural practice and cosmology - implies that the past will inevitably be recapitulated; i.e. that the ancestors will awake from their slumber to re-establish the Maya hegemony over other ethnic groups and the supremacy of their most cherished stingless bee over other species, therefore it is neither humanly possible nor necessary to help *Xunan kab* ('Lady bee'), M. beecheii.

As these concepts appear to explain why meliponine colonies are currently impoverished and even proffer a vision of ultimate redemption, why should the Maya revise their thinking or practices, for example by relocating hives? Interestingly, though, attitudes *are* changing, as illustrated by the fact that increasing numbers of

Maya seem to be acknowledging that even the God-given *M. beecheii* needs flowers to survive. For the interpretation of celestial *Xmaben* is changing. The literal meaning is 'canoe' and the traditional concept was of a heavenly canoe filled with divine honey, a source of food exclusively for *Xunan kab*. However, as people have come to realize that this species collects from earthly flowers, the concept of *Xmaben* has changed to a divine field of flowers. Others have changed the substance that *M. beecheii* is supposed to collect from *Xmaben* into water, which is the life-blood of on the Yucatan peninsula.

Some traditional concepts that translate into meliponicultural strategies still have benefits for the Maya in some respects. While, on the one hand, the practice of keeping *M. beecheii* in logs stands in the way of a less destructive harvesting method; on the other hand, provided that the logs are in good condition and hermetically sealed at both ends, they are a very effective barrier to Phorid flies, an invasion by which is invariably fatal to all but the strongest colonies. The separation of *M. beecheii* from other species can only be regarded as a positive factor, for it increases the longevity and honey production of colonies. The productivity of meliponine hives has been reduced precisely because some people have broken with this Maya tradition (which harmonizes with an *ejido* regulation), bringing *A. mellifera* hives into the homestead. The concept of *k'inam* (a form of radiated energy that can be harmful to domesticated stingless bees) is linked to the preventative use of *Chakah* (*Bursera simaruba*) leaves, two positive effects of which may be their role in reducing the risk of:

a) invasion by Phorid flies (because the soldier bee may be unable to prevent a small percentage of the attacking flies from entering the hive, and rubbing the bee-log with the leaves may help to repel these enemies);
b) colony-members being ostracized or killed by their nest-mates (because, before touching the hive or handling bees, beekeepers rub their hands with the leaves, which probably masks foreign odours that the bees might response to as if there were enemies in the hive).

It is important to note that although this species of tree also occurs in El Salvador, beekeepers there do not use its leaves in meliponiculture.

In conclusion, there can be no doubt that Maya culture and farming supported meliponiculture for centuries and that the contemporary Maya still create potentially favourable conditions for the practice. However, domesticated *M. beecheii* can no longer benefit from the plants that flourish in fallow fields, as these now lie beyond the intensive foraging range of the meliponaries. Furthermore, only a few important meliponine food plants now grow in the homesteads of the Maya. As the stingless bees that are kept there cannot reach most of the important food plants in their environment, it is hardly surprising that their productivity has dropped dramatically.

Finally, the disturbance of the ancient interrelation between the environment for the beekeepers and the environment for the bees can thus largely explain the downfall of meliponiculture in both Yucatan and El Salvador. It appears that the traditional system of growing corn, i.e. shifting slash-and-burn cultivation, is highly compatible with the making of honey by stingless bees. However, because that traditional system has either disappeared (as in western El Salvador) or has been removed from the flight- range of the bees (as in Yucatan), what for centuries was a veritable 'Land of Corn and Honey' is now a far less sustainable and sustaining environment for hives of stingless bees, given contemporary meliponicultural techniques. Keepers of stingless bees lament the downfall of their practice, yet they see themselves as impotent to help their most cherished species.

All is not lost, however! I would like to propose a few practical steps that could be taken to improve the situation:

a) making beekeepers more aware of the importance of high-quality food plants within range of their stingless bees;
b) making effective methods of colony multiplication more widespread;
c) housing the bees in specially designed boxes (known as 'rational hives');
d) adopting less destructive methods of harvesting honey, such as the use of hypodermic syringes;
e) keeping *M. beecheii* separately from other bees.

I believe that, in the long term, these strategies would significantly increase the productivity and longevity of *M. beecheii* colonies fundamentally. Stingless bees are not only important from a cultural viewpoint, they also play a vital role in maintaining the bio-diversity of their environment, and if their productivity could be improved, they would help beekeeping families to increase their income and achieve greater self-reliance. Action must be taken immediately - time is running out for the Lady bee.

Appendix I: Biological characteristics of Meliponinae

The behavioural characteristics of bees which make them useful to beekeepers are, obviously, that they forage among flowering plants for nectar and pollen and store both these types of food in the nest. When the relationship between bees and humans is examined on a deeper level, it becomes clear that beekeepers deal with, and reap benefits from, a whole gamut of behavioural characteristics and survival strategies. The biological characteristics of meliponine bees have formed the frame of reference for this dissertation. Here, I briefly examine the following aspects of Meliponinae: classification, geographical distribution, morphology, social and defensive behaviour, threats to the colony (including natural enemies), preferred nesting sites, building materials and nest architecture, storage of honey and pollen, resource preference and foraging strategies, reproduction and swarming. For further reading, see:Biesmeijer 1997; de Bruijn & Sommeijer 1997; Sommeijer 1996, 1983; Sommeijer & de Bruijn 1994; Roubik 1989; and PEGONE, the newsletter for stingless bee research and meliponiculture, Utrecht University, Social Insects Department.

Classification

Despite being commonly referred to as 'stingless', the Meliponinae do in fact have a sting, though this apparatus is vestigial and without offensive or defensive function. While all the numerous meliponine species are similarly unable to sting their adversaries, in other respects they differ significantly from one another. Although two systems of classification are currently in use for stingless bees, they are not entirely contradictory (Sakagami 1981).[2] I use the system adopted by Michener (1994), whereby

[2]a) Family Apidae: sub-family Apinae: tribe Meliponini: genera *Melipona*, *Trigona*, *Lestrimelitta*, *Dactylurina* and *Meliponula* (Michener 1994 & 1974). b) Family Apidae: sub-family Meliponinae: tribe Meliponini comprising genus *Melipona*, and tribe Trigonini comprising numerous genera, two of which are *Trigona* and *Tetragonisca*.

all the stingless bees (Apidae and Meliponinae) of North and Central America are classified into the following genera: *Cephalotrigona*, *Lestrimelitta*, *Melipona*, *Nannotrigona*, *Oxytrigona*, *Paratrigona*, *Partamona*, *Plebeia*, *Scaptotrigona*, *Trigona* and *Trigonisca*. The genera *Plebeia* and *Trigona* are further divided into sub-genera including *Geotrigona*, *Tetragonisca* and *Frieseomelita* (ibid.).

Geographical distribution

Whereas the genus *Trigona* occurs throughout the tropics, the genus *Melipona* is confined to the tropical Americas, where it is nevertheless widespread. About twelve distinct *Melipona* species have been identified (ibid.), two of which are found in the areas on which this dissertation focuses. The first, *Melipona beecheii*, is endemic to Central America and southern parts of Mexico. Its range extends northwards from the Nicoya peninsula of Costa Rica into Mexico and includes the Yucatan peninsula, though the distribution of the species in other parts of southern Mexico (ibid.) has yet to be accurately determined. *M. beecheii* is certainly not found in northern Mexico. The second species, *M. yucatanica*, probably used to be widespread in Central America and Yucatan before the area was extensively deforested. It is still found in Mexico - on the Yucatan peninsula as well as in Oaxaca and Guerrero States -, in El Salvador and in Costa Rica (Camargo *et al.* 1988; collection of Bee Research Department, Utrecht University). The genus *Trigona* is distributed throughout the tropical region of the American continent. Eight species of this genus have been identified in Mexico and fifteen in Central America. The genera *Cephalotrigona*, *Lestrimelitta*, *Oxytrigona*, *Paratrigona* and *Trigonisca* are classified as uncommon or rare in North and Central America, while the genera *Nannotrigona*, *Partamona*, *Plebeia* and *Scaptotrigona* are classified as common (Michener 1994). The genera are further restricted in range by temperature variations. Generally speaking, stingless bees function optimally at ambient temperatures of around 30°C; they are somewhat sluggish at 25°C; their activity is dramatically curtailed below 20°C, and colonies are unlikely to survive sustained temperatures of below 10°C (Schwarz 1948: 166). Because air temperature varies not only seasonally and diurnally but also as a function of altitude, stingless bees are likely to be considerably less active at higher altitudes, such as in the Montecristo area of El Salvador (where temperatures of below 15°C are not uncommon), than they are at lower altitudes, such as on the Yucatan peninsula. In Mexico, however, one *Melipona* species defies Schwarz by surviving in high montane pine and pine-oak forest at up to 3000 metres above sea level (Ayala *et al.*: 1993: 194).

On a global scale, the greatest diversity of stingless species is found in the tropical Americas. Regionally, not Mexico but Central America has the greatest number of distinct species. In the former, for example, seventeen species have been reported in the Sian Ka'an nature reserve of Quintana Roo (Roubik *et al.* 1991), whereas some 60 species have been identified in Costa Rica (Dr. M.J. Sommeijer, personal communication). It has yet to be documented exactly how many species occur in El Salvador. I managed to collect bees of 16 distinct meliponine species in the western part of that country, where it can be assumed that there is significantly greater diversity than in Yucatan.

Morphology

In all the Meliponinae, the lack of a functional sting is compensated to some extent by mandibles which are more pronounced than those of bees capable of stinging and which are operated by stronger muscles. In other morphological aspects, there are remarkable differences between the genera. *M. beecheii* resembles the European honeybee (*Apis mellifera*) in size, colours and patterning. The numerous *Trigona* species are generally much smaller; indeed, many of them are smaller than a housefly. The body colours of stingless bees vary from black in *Trigona* species to lighter hues in *Melipona* spp. and *Tetragonisca angustula.* Workers vary in length from approximately one millimetre (*Trignonisca* sp.) to slightly larger than a European honeybee. Certain morphological characteristics of stingless bees can be considered as specializations for the collection of pollen and nectar. Most bees, for example, are hairy, the hairs facilitating the transport of pollen. Nectar is collected from flowers by means of specialised mouth parts and is transported in the honey stomach. Like the honeybees (*Apis* spp.), stingless bees have specialized corbiculae on their hind legs to enable them to carry compact masses of pollen grains back to the nest (Michener 1974).

Social behaviour

Biologists classify the Meliponinae among the eusocial insects, i.e. those living in highly organized societies, along with honeybees of the genus *Apis* and certain species of wasps, ants and termites (Sommeijer 1983). In contrast to solitary bee-species, each individual of which must engage in all the tasks necessary for its survival - i.e. foraging, nest-building, reproduction, etc. - eusocial bees live in perennial colonies in which labour is strictly divided between castes. There are distinct morphs for different tasks: queens for egg-laying, drones for insemination, and workers for brood-care and other duties. A typical *Melipona* colony has 500 to 4000 individuals; for other stingless genera, numbers range from 300 to 80,000 individuals per colony (Wilson 1971). Easily recognizable by her hugely swollen abdomen, the fertilized queen devotes all her energy to ovipositing. The workers engage in a variety of activities. Newly emerged bees, characterized by their lack of pigmentation, remain in the nest until about three weeks old; adult workers embark on regular foraging expeditions. Individual *M. beecheii* workers specialize in foraging either nectar, pollen or nest-building materials, while a relatively small proportion of the total labour force switches to the food and other materials stored in the nest as soon as external resources fall below a critical level (Biesmeijer 1997: 235). The only known purpose of the drones is to inseminate the queens of other colonies. They leave the mother-colony at an age of 15 to 20 days, never to return (Veen *et al.* 1997)

Defensive behaviour

Although meliponine bees are equipped with a mere evolutionary vestige of a sting, they are perfectly capable of defending the colony against many of their enemies: in most cases by biting them with their powerful mandibles. Several species adopt other, no less effective strategies. When sensing danger, some of the smaller stingless species (e.g. *Nannotrigona* sp., *Geotrigona* - probably *acapulconis* -, *Plebeia* spp. and *Melipona yucatanica*) take refuge in the nest and suspend all activities that might otherwise betray their presence. For hours on end if necessary, all those colony members that are not out foraging will remain silent and motionless in the nest, and returning bees will neither closely approach nor enter it (personal observation in the field). Certain other small species (e.g. *Tetragonisca angustula*) defend the nest by frantically buzzing around the attacker in large numbers while attempting to bite him or her. This behaviour is not uncommon in many stingless species, including *M. beecheii*, but is particularly characteristic of, and vigorous in, the genera *Partamona* and the sub-genus *Scaptotrigona*. While such buzzing and biting may be an effective defence against marauding insects including other bees and certain ant species, it is generally ineffective against Phorid flies (*Pseudohypocera kerteszi*) and will not deter humans who are determined to rob the hive. The defending bees tend to concentrate on the attacker's hair. Even more irritatingly, they may sometimes enter his or her ears or nostrils. In *M. beecheii* colonies, a single sentinel bee always guards the entrance, checking every incoming insect. This bee has some back-up in the form of other soldier bees, on guard-duty directly behind her. As soon as the guards sense danger, they block the nest-entrance with their bodies and fight to the death to deny access to the hostile stranger(s). The wider the nest-entrance built by a species, the larger the guard squad. At least one *Oxytrigona* species has a defensive strategy that can be dangerous even to humans: when biting, they excrete a caustic liquid that produces skin 'burns'. In addition to these actively defensive strategies, the structure of the nest itself and the resins used to seal it may also help to protect the colony.

Threats to the colony

A successful colony of stingless bees may survive for many years; indeed, some colonies are reported to have existed for nearly one century. Colonies face many challenges, however; an ever-present one being the weather: strong wind and heavy rain can keep them confined to the nest or destroy the flowers on which they feed, while the intense tropical sunlight can overheat a bee at work (Biesmeijer 1997: 92-93). Several natural enemies pose an even greater threat to the longevity of the colony. Firstly, attacks may be launched by other bees, particularly *Lestrimelitta*, a pillage bee which lives by robbery alone. Species that normally forage may also pillage if food resources grow scarce and stocks in the nest are depleted. Secondly, ants of the genera *Eciton* often attack bee colonies to devour their stored food and the developing brood. If the ants manage to breach the colony's defences, they may totally destroy it. Parasitic Phorid flies are an even greater threat to bee colonies. During a mass attack, a few of these small flies may sneak past the soldier bees at the entrance and penetrate the nest. Colonies are particularly likely to be attacked by such flies when the stored pollen is exposed, spreading an attractive scent. This often happens when humans open the nest or hive to harvest honey or to multiply the colony by splitting the brood. Only the strongest colonies can survive penetration of the nest by Phorid flies, which lay their eggs in the stored pollen or the brood itself. Once these eggs hatch and the larvae start feeding at the expense of the bees and developing into adults, brood production ceases and the colony will soon die or abandon the nest (Tóth 1995). Certain birds and lizards also feed on bees. Anteaters are also partial to bee colonies, though a tree-hollow of wild stingless bees in the forest generally offers sufficient protection against these animals. Stingless bees are not attacked and have natural resistance to some of the (micro-)organisms which typically plague *A. mellifera*, such as the Varroa mite and various brood diseases.

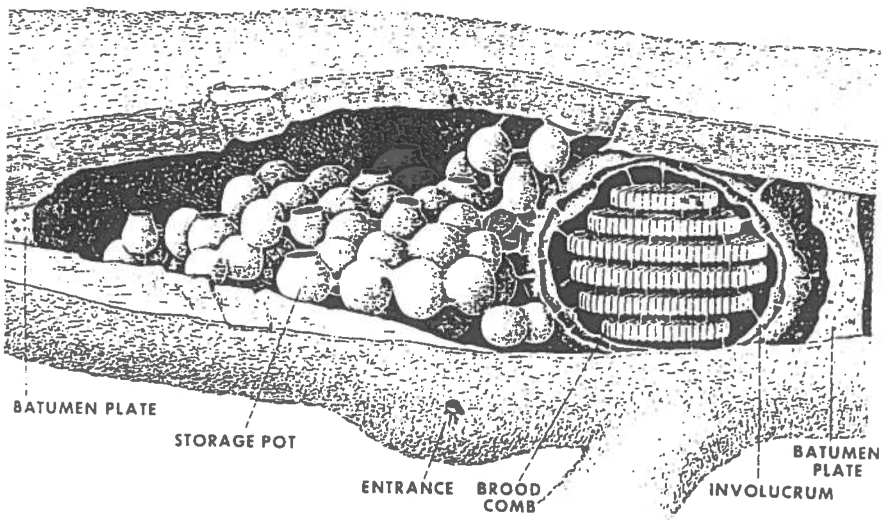
Preferred nesting sites

Most stingless species choose to build their nests in natural cavities which have a narrow opening or can be thus adapted to allow defence by a few soldier bees (Sommeijer & de Bruijn 1994). The only stingless bees to build fully-exposed aerial nests are some *Trigona* species. Most stingless species nest in tree-hollows; some take up residence in abandoned or partly occupied nests of ants, termites or parrots, which may be above or below ground. While certain species are equally at home in subterranean cavities and tree-hollows, others show a distinct preference: either for the aerial or the subterranean mode of dwelling (Martinez-Hernandez *et al.* 1993). Nests of several stingless species are often found in cavities in buildings (including the smaller bees such as *Plebeia*, *Tetragonisca angustula*, *Nannotrigona* sp. and *Trigonisca* sp., and a few of the larger ones such as *Partamona nigrior* and *Trigona compresa*). Certain species are less particular and have even been found nesting in discarded containers, for example an empty and still dirty oil-can or a child's piggy bank (*Tegragonisca angustula* in Costa Rica: personal observation). Despite this remarkable variety, one thing all stingless bees' nests have in common is that they are completely enclosed, apart from the entrance hole (Sakagami 1982). The size of the nest is characteristic for each species and depends on the size of the individual bees and the number in the colony.

Building materials and nest architecture

Characteristic structural elements of meliponine nests (see Figure 1) are: the entrance, batumen plates, food-storage pots, involucrum, a separate chamber for brood production in cells which, in most cases, are arranged in horizontal combs, pillars or ribs connecting these different elements (Sakagami 1982), and a special place for the processing of waste material (Sommeijer & de Bruijn 1994). However, not all stingless species build nests with each of these characteristics. Here, I first describe the building materials and then turn to the intra-nidal architecture of meliponine bees.

Figure 1: Typical nest architecture of stingless bees (from Michener 1974).



Meliponinae do not build nests of pure wax. The prime construction material is cerumen, a mixture of whitish wax excreted, and plant resins collected, by the bees. Some genera, including *Melipona*, also use masticated vegetal matter, animal and human faeces, and even artificial materials including tar. The colour of cerumen is caramel to dark brown. Freshly made, this material is soft and malleable, though it may harden and become brittle. The plant resins, collectively called propolis, are particularly used to seal cracks in the outer nest-wall. The bees build the nest enclosure and protective layers of batumen, i.e. a mixture of cerumen and propolis which often contains some mud as well (Michener 1974).

The intra-nidal architecture of meliponine bees is substantially different from that of *Apis* species. Among the stingless species, there is considerable variation in the style of entrance. Genera including *Melipona*, *Frieseomellita* and *Cephalotrigona* construct an entrance so narrow that only one bee can pass at a time. The nests of other genera including *Oxytrigona* and *Partamona* have a somewhat larger opening, several square centimetres in cross-section. Many species construct an entrance tube, which may be just a few centimetres long and one or two centimetres in diameter (e.g. *Tetragonisca angustula*, *Nannotrigona* sp. and *Geotrigona* - probably *acapulconis*) or very large and highly elaborate (*Lestrimelitta* sp.). Some of the smaller species close the tube at dusk and re-open it at dawn (e.g. *Tetragonisca angustula*, *Nannotrigona* sp.). In some species, the nest openings and tubes are coated with a sticky resin to trap or repel intruders. *M. beecheii* and *M. yucatanica* often construct a characteristic star-shaped figure at the entrance, probably for the purpose of orientation.

In the nests of most species, the brood chamber is a clearly distinguishable volume at the heart of the structure. In many cases, it is enclosed in thin layers of cerumen, i.e. the involucrum. The brood is reared in a concentric array of horizontal combs consisting of cells for individual bees. Stingless bees do not re-use the brood cells. As each larva develops into an adult bee, workers scrape cerumen from the outer surface of its cell, which thus gradually becomes more translucent: lighter brood cells contain bees of greater maturity than darker ones. The cerumen is re-cycled to construct new cells.

Unlike *Apis* species, meliponine bees store honey and pollen in special storage pots, which are relatively large egg-shaped vessels made of soft cerumen and arranged in clusters. Some species do not differentiate the positions of pots when storing honey and pollen; others keep the two types of food in separate parts of the nest. *M. beecheii*, for example, stores pollen in pots around the brood chamber and honey in pots more towards the nest walls or hive stoppers. Some species use more mud and propolis (and possibly other materials) in their storage pots than other species, which tends to make them more brittle.

Meliponinae deposit their waste in a specially reserved part of the nest, where the workers defecate and dump used cocoons and dead bees (Sommeijer & de Bruijn 1994). However, *M. beecheii* use their mandibles to carry dead bees out of the nest for disposal (personal observation in the field).

Honey and pollen storage

Bees collect pollen to feed their offspring (larvae) and young adults; they gather nectar for larvae and mature adults, as well as for wax production and thermoregulation (Biesmeijer 1997: 237). They store nectar and pollen when they are abundant in order to survive periods of scarcity. Because of its relatively high water-content (typically 23.7%), meliponine honey tends to ferment. In the nest, however, the honey can be stored for a long time without fermenting, probably because of the presence of certain micro-organisms (*Bacillus* spp.). The nest is an ideal environment for these bacteria, for it is usually humid inside and the bees defecate and deposit waste materials near areas where food is stored. Some bacteria are known to secrete enzymes and other substances which have an antibiotic effect, killing other micro-organisms which would otherwise cause fermentation. The bees inadvertently transfer a variety of micro-organisms to the honey while the storage pots are still open. Probably as a result, the antibiotic activity of *Melipona* honey is significantly higher than that of *A. mellifera* honey. Before being stored as honey in sealed pots, nectar passes through the honey stomachs of several individual bees. Foragers pass their load of nectar to 'house bees' (i.e. workers that do not leave the nest), which in turn pass the nectar to the workers which dehydrate it, the resulting product being called honey. Honey not only has a lower water-content than nectar, it also contains certain enzymes produced by the bees (de Bruijn & Sommeijer 1997; Sommeijer & de Bruijn 1994).

Unlike nectar, pollen is transferred virtually unchanged from flowering plant to storage pot; all the house bees do is release a drop of clear liquid onto the lumps of pollen and masticate them with their mandibles to mould the pollen into a more compact mass. In the storage pots, the pollen mass ferments, producing an acidic odour when exposed. Only fermented pollen is suitable for rearing brood (Sommeijer & de Bruijn 1994).

Resource preference and foraging strategies

The composition (and hence taste and odour) of stored honey and pollen varies from species to species and reflects the preferred floral resources. Some species are clearly attracted to the more concentrated nectars: *M. beecheii*, for example, has been shown to have a strong preference for nectar of high sugar-content in Quintana Roo (Roubik *et al.* 1995) and in other parts of its range (Biesmeijer 1997: 74). Some bees collect from flowers which are toxic to humans. Resource preferences influence the composition of honey and pollen, either directly through selective foraging, or indirectly through the composition of the pots in which these foods are stored. By which criteria do particular bee species select resources? Some general remarks may serve to clarify this complex issue somewhat. Experimental and field observations indicate that the perceived colour, odour, size and shape of flowers are factors in their attractiveness. Bees are believed to see ultraviolet light as a distinct colour, whereas they appear to be unable to distinguish the red end of the spectrum (Roubik 1989: 143). Nonetheless, a wide range of flowers have colours which fall within the spectrum visible to bees.

Anatomical features also determine the range of exploitable resources. For example, the smaller bee species can more easily collect from small flowers, whereas the larger bees have the strength to force apart or depress petals to gain acces hidden anthers which other species cannot reach (Roubik 1989: 107). Some larger species can also collect from small flowers by perforating their petals. Such destructive behaviour has been noted in certain *Trigona* species, including *T. fulviventris* and *T. fuscipennis* (ibid.: 156). Foraging is also influenced by the shape of the proboscis with which bees extract nectar. A long or narrow proboscis restricts the extraction of viscous solutions. In addition, body colour and size influence thermoregulation in a bee. Small pale bees can tolerate more direct exposure to sunlight than large dark bees. This is particularly important in the tropics, where overheating may seriously constrain mobility and hence foraging range. The larger and darker species clearly prefer to forage in shady niches, while smaller and lighter coloured species stick to sunlit patches (Biesmeijer 1997: 80). Exposure of flowers to sunlight also leads to evaporation of water from their nectar, effectively raising the sugar content. *M. beecheii* is known to collect more concentrated nectars than darker *Melipona* species such as *M. fasciata* (Biesmeijer 1997: 234).

Niches are also differentiated according to the place of the flowering plants (i.e. preference for flowers in tree canopies or those much closer to the ground) and the times of day or night at which they release attractive scents. *Melipona* foragers mainly collect pollen in the morning[3] and nectar later in the day, when the sugar content of the nectar tends to be higher (Biesmeijer 1997: 49, 55-56; Sommeijer *et al.* 1983).

Some *Trigona* species jealously guard the floral resources from which they are collecting, the defensive strategy ranging from threatening behaviour to mortal combat (Biesmeijer 1997: 81; Roubik 1989: 104-5, 109-10), whereas *M. beecheii* warily avoids any spot where another species is present in large number, irrespective of its aggressiveness (Biesmeijer 1997: 88-89). As the black *Trigona* species are not suited to collecting from the sunlit patches preferred by *M. beecheii*, this kind of direct competition only rarely occurs in the wild (ibid.: 94). However, in beekeeping systems where *M. beecheii* is kept in proximity to other species such as *A. mellifera* (which closely resembles *M. beecheii* in colour) or other stingless bees (of similar or much darker hue) this non-competitive behaviour of *M. beecheii* can result in lower productivity of the colony, even more so as individuals of *M. beecheii* do not normally switch to other floral resources during their foraging careers (see below).

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[3]Polliniferous food-plants visited by *Melipona* spp. tend to produce the greatest quantities of pollen in the morning before about 10:00 hours (Dr. M.J. Sommeijer, personal communication).

Each stingless species has its own characteristic foraging technique, the most obvious distinction being solitary as opposed to group foraging. A solitary forager is, of course, not influenced in its choice of floral resource by the behaviour of its sister-workers. Group foragers either leave the nest in 'squadrons' and arrive together at the flower patch, or search individually and having found attractive flowers, quickly recruit as many nest-mates as possible to reap the maximum benefit from the patch. *Scaptotrigona*, *Partamona* and *Trigona* are group foragers of the first kind, while *Melipona* and *Apis* are of the second (Roubik 1989: 109). The *Melipona* recruiting system is not yet fully understood. Biesmeijer (1997: 234) reports that returning bees emit sound pulses in addition to using odours in the field (i.e. floral scents, local ambients, body odours and pheromones) and visual cues (guiding flights and the visible presence of bees on flowers) to locate food resources. Furthermore, bees may forage either liberally, i.e. collecting extensively from as many different plant species as possible, or conservatively, i.e. collecting intensively from only a few plant species (Roubik 1989: 109). Once an individual of *M. beecheii* has located a favourable source of food, it usually continues foraging there for as long as possible, i.e. until its career is terminated by death or the pollen or nectar flow seriously decreases or ceases altogether. Even if the quality of the source diminishes significantly and other bees return with information on a better source, the *M. beecheii* forager continues regardless. Newly discovered sources are exploited by new bees. Only if the source suddenly fails will the forager switch to another patch (Biesmeijer 1997: 237-238).

Another crucial factor limiting foraging behaviour is the restricted flight-range of meliponine bees. In general, the maximum operating radius from the nest seems to be directly related to body size and morphological features.[4] The maximum flight-range of *M. beecheii* is approximately 1000 m; that of the smaller *Tetragonisca angustula* is 680 m; *Partamona cupira*, 520 m; *Trigona corvina*, 320 m; and the tiny *Nannatrigona* sp. can venture no further than 120 m from home. Furthermore, the further the resource is located from the nest, the fewer the bees that reach it. Typically, 75% of the foraging work is done within 40% of the maximum flight-range. *M. beecheii* thus forages intensively on food resources within a radius of only 400 m from the nest or hive; *Tetragonisca angustula* within 272 m; *Partamona cupira*, 208 m; *Trigona corvina*, 128 m; and *Nannotrigona* within a range of only 50 m (Nieuwstadt & Ruano Iraheta 1996). This fact implies that the distance between neighbouring colonies strongly influences

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[4]The foraging range of meliponine species has been shown to be directly proportional to body size, indicated by typical head-width (Nieuwstadt & Ruano Iraheta 1996).

the intensity of competition. During the rainy season, when pollen and nectar resources are likely to be less readily available and accessible, intraspecific and interspecific competition for food may well increase (Biesmeijer 1997: 55).

Conditions of the local ecosystem further determine whether a particular plant is important to a bee species. Corn, for example, seems to be visited by *Melipona* bees more often in El Salvador than in Yucatan, probably because high-quality resources are only available in limited quantities in the former area. This factor means that the composition of pollen and honey may differ significantly within the range of each species. In addition to such spacial variation, the fact that different plant species flower at different times of the year leads to temporal variations in the composition of honey and pollen stored by particular bee species.

The foraging strategy of *M. beecheii* can be summarised as follows: individual bees forage intensively in a range of approximately 400 metres from the nest, with a pronounced tendency to continue foraging from the same plants if possible, and a clear preference for sunny spots. In connection with the latter factor, they also have a preference for nectars with high sugar-content. However, as *M. beecheii* evades competitors, this natural behaviour is easily disturbed by the presence of other species on the same spot (experiments with *M. beecheii* and *M. fasciata*: Biesmeijer 1997). Beneath the forest canopy, overheating is less of a problem than in open spaces. Many *Trigona* species are black and therefore better adapted to the forest, while the paler *M. beecheii* is suited to foraging on cleared land in and around villages, where it is difficult to avoid direct sunlight. More research is needed to determine the foraging strategies of many other stingless species and the basic principles underlying observed variations.

Overlap of *M. beecheii* and *A. mellifera* food resources

There is little available information on the overlap in floral resources exploited by *M. beecheii* and *A. mellifera* on the Yucatan peninsula. Chemas & Rico-Gray (1991) list *A. mellifera* food-plants on the Yucatan peninsula. Comparing this data to the information on *M. beecheii* food-plants included in the main body of this dissertation indicates that the following plants are visited by both species: *Gymnopodium floribundum*, *Viguiera dentata*, *Bursera simaruba*, *Croton glabellus*, *Mimosa bahamensis*, *Neomillspaughia emarginata*, *Piscidia piscipula* and *Vitex guameri*.

Reproduction and swarming

Bees swarm to establish new colonies, a queen leaving with part of the colony to build a new nest elsewhere. Stingless bees rarely swarm in the wild, which is probably one of the reasons why there are few detailed descriptions of such behaviour in the literature. Nevertheless, some remarkable aspects of meliponine swarming have been discovered, which may have a number of important implications for practical meliponiculture and forest management.

In *Melipona* species, all castes of bees - including queens - are reared in identical cells. This is in contrast to many other species (especially *Trigona* spp.), in which royal cells are larger and constructed at the edge of the comb. An important feature of *M. beecheii* is that new queens are produced all year round. (Other stingless species, e.g. *Tetragonisca angustula*, only sporadically produce new queens). The fate of a newly emerged queen is determined by the condition of the colony and the 'ruling' queen at the time. If there is no opportunity for the new queen to succeed the old queen or to start a new colony, she will be assassinated by workers. If there is an opportunity for swarming, the virgin queen leaves the hive with a part of the colony. The 'nuptial' or mating flight occurs after swarming to a new site: probably triggered by chemical communication, drones of another nest congregate within royal flight-range of the new colony. The workers having stimulated the queen to leave the nest, she heads for the waiting drones. After mating, parts of the successful male's genitals remain attached to those of the queen. She is then ready to oviposit and fertilize the eggs. Before swarming, groups of worker bees prepare the new nest, transferring materials from the mother- to the daughter-nest. The daughter-colony remains dependent on the mother-colony for several weeks after swarming, food and building materials continuing to be transferred. Research has yet to determine the maximum distance between mother- and daughter- colony, though it can be safely assumed that this cannot exceed the maximum flight-range of individuals in the mother colony. This makes the bees extremely vulnerable to fragmentation of their natural habitat. This vulnerability is aggravated by a scarcity of nesting sites as a result of deforestation: if no suitable cavities (man-made or otherwise) are to be found in the vicinity of the colony, it will be impossible for the bees to swarm and reproduce naturally.

Appendix II

AGAVACEAE
Agave sp.

ANACARDIACEAE
Mangifera indica L.
Spondias sp.
Metopium brownei (Jacq.) Urb.

ANNONACEAE
Annona purpurea L.
Annona squamosa L.

APOCYNACEAE
Plumeria sp.

BETULACEAE
Alnus ferruginea Kunth

BIGNONIACEAE
Crescentia cujete L.

BIXACEAE
Bixa orellana L.

BOMBACACEAE
Ceiba aesculifolia Kunth
Ceiba pentandra (L.). Gaertn.
Ceiba sp.

BORAGINACEAE
Cordia alliodora (Ruiz & Parón) Oken
Cordia dodecandra DC.
Ehretia tinifolia DC.

BURSERACEAE
Bursera simaruba (L.) Sarg.
Bursera graveolens (Kunth) Triana & Planch

CARICACEAE
Carica papaya L.

CEASALPINOIDEAE
Caesalpinia gaumeri Greenm.
Senna racemosa L.
Tamarindus indica L.

CLETHRACEAE
Clethra suaveolens Turcz
Clethra lanata Mart. & Galeotti

COMBRETACEAE
Combretum erianthum Benth.
Terminalia catappa L.

COMPOSITAE
Verbesina sp.
Vernonia patens Kunth
Vernonia canescens Kunth
Viguiera dentata (Cav.) Spreng. (var. helanthoides (Kunth) Blake)
Perymenium grande Hemsley

CONVOLVULACEAE
Ipomoa sp.
Turbina corymbosa (L.) Raf.

CUCURBITACEAE
Cucurbita sp.
Mormodica charantia L.

CUPRESSACEAE
Juniperus standleyi Steyerm.

DILLENIACEAE
Curatella americana L.

STERCULIACEAE
Guazuma ulmifolia Lam.
Theobroma cacao L.

EUPHORBIACEAE
Acalypha sp.
Croton glabellus L.
Croton niveus Jacq.

GRAMINEAE
Zea mays L.

FABACEAE
Indigofera suffruticosa Mill.
Lonchocarpus michelianus Pittier
Lonchocarpus yucatenensis Pittier
Myroxylon balsamum (L.) Harms (var. pereirae (Royle) Harms)
Phaseolus vulgaris L.
Piscidia piscipula (L.) Sarg.

FAGACEAE
Quercus grandis Liebm.
Quercus vicentensis Trel.

HAMAMELIDACEAE
Liquidambar styraciflua L.

JUGLANDACEAE
Juglans pyriformis Liebm.

LABIATAE
Ocimum micranthum Willd.

LEGUMINOSAE
Leguminosae spp.

MIMOSOIDEAE
Acacia sp.
Acacia gaumeri Blake
Enterolobium cyclocarpum (Jacq.) Griseb.
Inga sp.
Lysiloma bahamense Benth.
Mimosa bahamensis Benth.

LAURACEAE
Litsea glaucescens Kunth
Nectandra sp.
Persea americana Mill.

LOGANIACEAE
Buddleja cordata Kunth

MALPIGHACEAE
Malpighia glabra L.
Byrsonima crassifolia (L.) Kunth

MELIACEAE
Cedrela odorata L.
Swietenia cirhata Blake

MORACEAE
Brosimum alicastrum Swartz subsp. alicastrum
Ficus glabrata Kunth

MUSACEAE
Musa sp.

MYRTACEAE
Eugenia sp.
Pimenta dioica (L.) Merr.
Psidium guajava L.

PALMAE
Acrocomia aculeata (Jacq.) Lodd.
Sabal yapa (Becc.) Wright

PINACEAE
Abies guatemalensis Rehder
Pinus oocarpa (Schlechtenda) Schiede

POLEMONIACEAE
Cobaea villosa Standl.

POLYGONACEAE
Coccoloba spicata Lundell
Gymnopodium floribundum Rolfe (var. antrogonoides (Robinson) Standl. & Steyerm.)
Neomillspaughia emarginata Blake

ROSACEAE
Prunus guatemalense I.M. Johnson
Prunus persica (L.) Sieber & Zucc.

RUBIACEAE
Chiococca alba (L.) Hitch.

RUTACEAE
Casimiroa edulis La LLave & Lex.
Casimiroa tetrameria Millsp.
Citrus aurantifolia (Christm.) Swingle
Citrus reticulata Blanco
Citrus sp.
Murraya paniculata (L.). Jacq.
Ruta graveolens L.
Zanthoxylum microcarpum Griseb.
Zanthoxylum sp.

SALICACEAE
Salix humboldtiana Willd.

SAPINDACEAE
Talisia olivaeformis (Kunth.) Radkl.

SAPOTACEAE
Chrysophyllum cainito L.
Manilkara zapota (L.) van Royen
Pouteria sapota (Jacq.) H. E. Moore & Stearn

VERBENACEAE
Vitex gaumeri Greenm.

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Resumen

En la presente tesis describo la meliponicultura dentro del sistema etno-ecológico de los meliponicultores de El Salvador (capitulo 3) y Yucatán (capitulo 4 -8) dentro del contexto de las características biológicas de las Meliponinae (capitulo 5 y 9) y dentro del marco histórico (capitulo 2). Se enfatiza el relato de los meliponicultores Mayas de Yucatán, del pueblo y ejido del mismo nombre 'Tepich', donde la meliponicultura forma parte integral del sistema etno-ecológico.

Características de las abejas sin aguijón (Apidae, Meliponinae)

Las abejas sin aguijón (Apidae, Meliponinae) son nativas de América tropical. Gracias a un proceso coevolutivo entre las abejas y las flores que data del Cretáceo, ciertas plantas originarias de dicha región se volvieron dependientes de las Meliponideas para su polinización. Las Meliponideas son las abejas más comunes en los ecosistemas tropicales del continente Americano. Las diferentes especies en su conjunto juegan un papel crucial en la polinización de la vegetación oriunda. Las especies varían en talla, de aproximadamente un milímetro hasta un poquito más largo que la abeja Europea (*Apis mellifera*). La especie más apreciada en Centro América y México es la *Melipona beecheii*, la cual además es endémica en esta región. Se parece en su aspecto y color a la *A. mellifera*. Algunas especies del género *Trigonini* son negras y pueden parecerse mucho a una mosca casera. Los Meliponidos tienen un aguijón degenerado el cual no utilizan. Estas abejas sociales viven en colonias permanentes. Para los meliponicultores son interesantes porque almacenan miel y polen en vejigas de cerumen (una mezcla de cera y resina) que tiene la forma de una nuez de leche (vease dibujo 1 apéndice 1). La cámara de las crías se encuentra separada en el nido y tiene la forma de un pastel de bodas. Está compuesta de pequeñas celdas verticales, cada una contiene una larva, y están ordenadas formando capas horizontales concéntricas. Algunos Meliponidos construyen nidos en huecos en árboles, otros ocupan huecos en la tierra o un nido abandonado de termitas o pericos, otros construyen su propio nido externo.

Los Meliponidos coleccionan miel y polen dentro de un radio limitado alrededor del nido. El setenta y cinco porciento del suministro de la *M. beecheii* ocurre dentro de un radio de 400 metros (Nieuwstadt & Ihareta). Por consecuencia, las plantas alimenticias en la proximidad del nido son imprescindibles para una producción abundante de miel y polen en la colonia. El radio máximo de vuelo de la *M. beecheii* es un kilometro, de modo que para la enjambración natural de las abejas, es importante que hayan nidos vacantes (i.e. huecos en árboles) dentro de dicho radio.

Ángulo teórico y objetivo de la investigación

Desde hace siglos los pueblos indígenas de Centro América y México crían estas abejas para obtener miel y cera. En la época pre-colombina y durante el período colonial, los Maya-Yucatecos criaban estas abejas en gran escala. Hoy por hoy, la meliponicultura ha disminuido significativamente. Científicos sociales atribuyen esta caída en la producción principalmente al florecimiento de la apicultura que resultó de la introducción de la abeja Europea. Analizando el proceso desde una perspectiva económica concluyen (con la excepción de Merrill-Sands 1984) que la caída de la meliponicultura sobre todo es consecuencia de la libre elección de los abejeros quienes optaron por la abeja europea (*A. mellifera*), que es mucho más productiva que las abejas nativas sin aguijón. La misma conclusión extraen aquellos que parten de la idea que la cultura determina la relación humana con el medio-ambiente. Estos científicos degradan la meliponicultura a un 'hobby' de los meliponicultores. En esta tesis afirmo que estas teorías contradicen la práctica: los meliponicultores hacen todo lo que está en su poder por conservar las colonias que les quedan. Sirviendome la descripción y análisis de la meliponicultura de los Maya-Yucatecos muestro que la condición actual de la meliponicultura es el resultado de las interacciones entre: 1) las abejas con sus características especiales; 2) conceptos culturales de las comunidades que las crían y; 3) las características del medio-ambiente de las áreas donde se crían los Meliponidos. Es en éste contexto que nace la pregunta: ¿Por qué disminuye la meliponicultura? Y, ¿Por qué disminuye más rápido en El Salvador que en Yucatán? A continuación afirmo que la caída de la meliponicultura no se puede atribuir unilateralmente a la deforestación o a dimensiones culturales de la sociedad maya. Propongo, en cambio, que la disminución de la meliponicultura se debe sobre todo a la interacción de los tres agentes mencionados. Este ángulo teórico se basa en un reciente debate que ha tenido lugar entre antropólogos ocupados en el campo de la ecología humana y la antropología ecológica, una de las conclusiones del debate sugiere que la cultura, la sociedad y medio-ambiente están en una relación de interacción refutando la idea de que uno de estos elementos (cualquiera que sea) determine a los otros.

Una vez rechazada la idea de la existencia de una dicotomía entre la cultura y la naturaleza al nivel de la relaciones ecológicas humanas y por consecuencia la idea de que uno de los términos determine al otro, se puede avanzar una nueva visión sobre el papel de la cultura en la relación de la sociedad humana con el medio-ambiente (Ingold 1992; Hornborn 1996). El modelo ecológico general propone que un organismo modela su medio-ambiente de acuerdo a parámetros que le permiten subsistir, entregándole a este ambiente las características propias de la especie. De esta manera el medio-ambiente es un concepto complejo, que solamente existe en relación con una determinada especie o individuo y, de esta manera, forma parte integral de la especie misma. Por ende, el medio-ambiente se puede definir solamente en relación directa con el organismo. El concepto anterior es diferente a la definición corriente de naturaleza, compuesta ésta, de objetos neutros en relación a un individuo inconexo que la contempla desde afuera sin formar parte de ella. Las siguientes proposiciones se encuentran en la base de este punto de vista: a) los seres humanos forman parte del medio-ambiente por el hecho de actuar dentro de éste. En la producción de alimentos, por ejemplo, el proceso de producción transforma el medio-ambiente y, b) en este nivel la cultura no es indispensable para actuar o para percibir, en cambio la cultura nos permite interpretar acciones y percepciones y hacerlas explícitas a otros. Los meliponicultores prueban sus acciones y percepciones de la meliponicultura en base a su conocimiento y lógica (cultural). De ésta forma se confirman, se rechazan o se transforman los conceptos culturales y las conclusiones que resultan de esta interacción forman la base para la acción siguiente. ¿Cómo es, entonces, que la cultura influye en la meliponicultura? En la presente tesis describo la meliponicultura tal y como los meliponicultores Salvadoreños y Maya-Yucatecos la explican en el contexto de su cultura. Luego relaciono este concepto Maya-Yucatecos y Salvadoreños de la meliponicultura con las características de los Meliponidos y su medio-ambiente tal como las explican los biólogos. Esta perspectiva corresponde con las llamadas aproximaciones '*emic*' y '*etic*', sin embargo el *emic* y el *etic* son explicables solamente dentro de sus propios contextos. La teoría del medio-ambiente concatenada directamente a los organismos, permite sobre montar la barrera paradigmática impuesta por la distinción '*emic*' / '*etic*', y hace posible relacionar los conceptos culturales a los aspectos biológicos de los Meliponidos, en forma tal que ambos se entrelazan en la meliponicultura. A su vez éste enfoque permite incorporar en el análisis elementos que aunque forman parte del complejo de la meliponicultura quedan sistematica y alternativamente fuera de la descripcion *emic* o *etic*.

Cambios en el medio-ambiente desde el siglo 16 y las consecuencias para la meliponicultura

Antes de la conquista Española, los Maya-Yucatecos criaban las abejas indígenas a gran escala y exportaban la miel a otras partes de Mesoamérica. En los anales (Oviedo 1959; Casas 1951; Landa [1566] 1959&1992) se describe la meliponicultura como: 'la única riqueza de Yucatán'. Independientemente a esta exportación, también en otras partes de Mesoamérica se criaban estas abejas. Durante la época colonial, los llamados vecinos (los colonizadores) exigían tributo de cera y miel a los Maya-Yucatecos. Estos productos eran exportados subsecuentemente a Europa. Algunos Maya-Yucatecos huyeron al sur de la península para escapar a este oneroso sistema tributario. Allí los Españoles los dejaron relativamente en paz. Los Maya-Yucatecos contemporáneos comparan este episodio de su propia historia con la conducta que observan en las abejas sin aguijón, éstas, según ellos, huyen al bosque cuando las abejas extranjeras (*A. mellifera*) las molestan. Los Maya-Yucatecos que viven en el centro de la península (entre la costa al norte, donde la gobernación española estaba firmemente establecida en el poder, y la parte sur, donde ésta casi no tenía influencia) se sublevaron primero. Esto condujo a la llamada 'Guerra de Castas'. En otras partes de Mesoamérica la población indígena no pudo escaparse al régimen español. Esta diferencia resultó ser un factor importante que marcó el curso de la historia regional y las relaciones entre el ser humano y el medio-ambiente en la región. Uno de los fenómenos efectados fue, evidentemente, la meliponicultura.

El sistema agrícola tradicional consistía, y consiste hasta hoy en día, en talar una pequeña área de bosque, secar y quemar la vegetación cortada para que los nutrientes se introduzcan en el suelo, y luego proceder a la siembra de maíz, frijol y calabaza. Después de dos o tres resiembras, los milperos dejan el terreno sin cultivar por varios años (el cultivo de la rosa). Diversas plantas colonizan el terreno en barbecho y finalmente, aproximadamente después de cuarenta años la vegetación llega a convertirse en bosque maduro. Por medio de este sistema de cultivo el ser humano produce un paisaje en el cual se alterna el bosque maduro y la vegetación secundaria en diferentes fases de desarrollo. Este sistema era viable en la medida que la gente solamente tenía la tierra en usufructo y no en propiedad y cuando la densidad de la población permitía la rotación holgada de las tierras en cultivo y en barbecho. El tipo de asentamiento, fuera de los centros urbanos, era relativamente disperso y reducido. Las casas estaban ubicadas cerca de los terrenos ocupados para cultivos y por ende cerca de los terrenos en barbecho colonizados por vegetación secundaria. Los meliponicultores tenían las colonias en sus solares cerca de los terrenos de cultivo y por consecuencia podemos suponer que, a pesar del radio de vuelo limitado de los Meliponidos, estas abejas podían llegar a la vegetación secundaria y al bosque maduro para coleccionar néctar y polen. En los bosques algunos árboles maduros desarrollan huecos, en los que las abejas pueden construir sus nidos cuando enjambran. A esto se agrega que, cuando los milperos talan con el fin de abrir un terreno de cultivo, talan selectivamente dispensando determinados árboles maduros, entre los cuales algunos llegan a desarrollar huecos.

Durante el período colonial la población foránea deforestó rápidamente las tierras bajas en América Central y Yucatán con el fin de abrir terreno para desarrollar actividades ganaderas y agrícolas comerciales. Sobre todo en El Salvador esta deforestación tomó características dramáticas. Los derechos de la población indígena sobre la tierra se limitaron cada vez más y por fin se llegó a una privatización total de las tierras salvadoreñas. Con esto la práctica tradicional del cultivo de la rosa desapareció. En Yucatán la historia tomó otro rumbo. Durante la Guerra de Castas los Maya-Yucatecos se levantaron contra la opresión española. Después de la guerra, una parte de la población Maya retornó a vivir a la región que hoy se conoce como la Zona Maya de Quintana Roo. La reforma agraria de los años '30 estableció el oficialmente el derecho colectivo sobre la tierra, derecho que aún tiene vigencia en esta zona. De acuerdo a la reforma se formaron ejidos en los cuales se asigna una cierta extensión de tierra a un pequeño número de titulares. Estos titulares tienen la gobernación común sobre el ejido y dentro de éste tienen libre acceso a la tierra. Este tipo de propiedad colectiva ha posibilitado la mantención de la forma tradicional de cultivo y dentro de esta forma de explotación agrícola se ha conservado el hábitat de los Meliponidos.

La apicultura y la africanización de *A. mellifera*

En el siglo 18, principalmente cafetaleros foráneos importaron por primera vez la abeja Europea (*A. mellifera*) a Centro América y México. En primera instancia, la apicultura era practicada en su mayoría por este grupo de personas y se extendió lentamente entre la población indígena. En Yucatán la situación es diferente, la introducción de la *A. mellifera* no tuvo sino éxito hasta mediados del siglo 20. En esta área, la apicultura fue iniciada como una actividad de capital intensivo en manos de un reducido grupo de empresarios adinerados. Es un hecho llamativo que los Maya-Yucatecos lograran adueñarse con éxito de la apicultura. Siendo los Maya-Yucatecos expertos en la cría de *M. beecheii*, los empresarios creyeron conveniente hacer uso de sus conocimientos en beneficio de la apicultura. En ese proceso los Maya adquirieron la experiencia necesaria para dedicarse ellos también a la crianza de la *A. mellifera* y eventualmente se apropiaron de la práctica. Al mismo tiempo lograron limitar los derechos de los empresarios sobre la tierra ejidal, estableciendo de este modo el control sobre la apicultura en su territorio. Hoy por hoy, Yucatán es una de las regiones productoras de miel más grandes del mundo. En su mayoría esta miel proviene de pequeños apiarios de milperos Mayas. Para muchos apicultores el rubro más importante de sus ingresos monetarios proviene de la apicultura. Aunque en Centro América la producción de miel no es tan alta como en Yucatán, allí también tiene un alto valor económico entre los agricultores quienes practican una economía de subsistencia.

En los años ochenta la apicultura se vio afectada por la invasión de las llamadas 'Abejas Asesinas', o sea las abejas africanizadas. Estas abejas se dispersaron desde Brasil en el año de 1957 produciendo la hibridación de los apiarios de las abejas europeas a su paso. En un principio, la africanización causó graves problemas a los apicultores y a sus vecinos. Muchos apicultores renunciaron a esta actividad, perdiendo así una fuente importante de sus ingresos. Entre los agricultores que producían principalmente para la subsistencia, el descenso de la apicultura tuvo consecuencias dramáticas. Lo que sucedió en los pueblos el Brujo, el Limo y la Criba de El Salvador, está en marcado contraste con la situación en Yucatán, dónde el gobierno se ha preocupado de informar a los apicultores sobre la africanización y las consecuencias para la producción de miel. Es importante aclarar que las abejas Africanizadas no se entrecruzan con las abejas Meliponidas. Así y todo, la intensidad de competencia por las plantas alimenticias y por los nidos silvestres entre estos dos tipos de abejas ha aumentado debido a que (en contraste a las abejas Europeas) las abejas Africanizadas se internan más profundo en el bosque .

La meliponicultura en El Salvador

En la zona occidental de El Salvador, la meliponicultura se encuentra reducida al área periférica de la reserva forestal de Montecristo. Aparte de este núcleo, en cada pueblo del área de Chalchuapa, uno o dos abejeros crían las abejas sin aguijón. La especie *M. beecheii* es la preferida para la crianza. Los meliponicultores mantienen las colonias en troncos huecos colgados del techo de las casas, mayor parte de los meliponicultores crían además otras especies, tal como la *Melipona yucatanica*, *Tetragonisca angustula*, *Trigona fulviventris*, *Trigona nigerrima*, *Cephalotrigona capitata*, *Plebeia* sp. y *Scapto-*

trigona sp. También extraen la miel y la cera de nidos silvestres entre otras, de una abeja del genero *Geotrigona*. Basándose en su conocimiento del comportamiento y hábitat de las abejas, los meliponicultores comparten la convicción de que solamente se puede criar ciertas especies. Por esta razón las abejas agresivas o las que viven en la tierra no son llevadas a las casas. Los meliponicultores alimentan a las abejas cuando se produce una escasez de plantas alimenticias, lo que generalmente sucede durante la temporada de lluvias. Carecen de conocimiento sobre métodos para reproducir las colonias, por consiguiente, dependen del bosque para conseguir nuevas colonias. Debido al avanzado estado de deforestación, los Meliponidos se han vuelto escasos en el bosque. La prohibición de la tala de arboles, dificulta aún más el acceso a nuevas colonias. Los meliponicultores cosechan la miel principalmente en los últimos meses de la época seca (marzo y abril) durante luna llena. La miel es ocupada frecuentemente con fines curativos. La investigación de de Bruijn y Sommeijer (1997) probó que la miel de los Meliponidos tiene un alto valor bactericida. Debido a la escasez de miel de Meliponidos y a causa del concedido valor curativo, en El Salvador el precio de esta miel es muy elevado. En 1993, la miel de la *Geotrigona* sp., la más cara entre los Meliponideos, llego a cotizarse a un equivalente de 5 días de trabajo de campo por litro. Esto es, doce veces más alto comparado con el valor pagado por la miel de la *A. mellifera*. Por consecuencia, en algunos hogares donde se practica la economía de subsistencia, la miel de los Meliponidos juega un papel económico más importante que la miel de *A. mellifera*. Con todo, debido a la composición cultural heterogénea de la población salvadoreña, a la influencia del protestantismo y la disminución considerable de la meliponicultura, en El Salvador no se puede hablar de un sistema cultural coherente dentro del cual la meliponicultura forme parte integral.

La meliponicultura en la cosmovisión de los Maya-Yucatecos en Quintana Roo

Según los Maya-Yucatecos el mundo animal y material es animado y está organizado en forma jerárquica. Distinguen la tierra cultivada y habitada, que está ritualmente demarcada del mundo exterior, de la tierra no cultivada y no habitada, que rodea los poblados. Esta distinción coincide más o menos con la distinción entre: 'los animales domésticos', que viven con la gente en el solar, y 'los animales silvestres', que viven en el bosque y que son cazados por los Maya. Este sistema está basado en la concepción de que existe una integración armoniosa entre todos los componentes que forman el medio-ambiente. En el concepto de los Maya-Yucatecos tanto la gente, como los animales y las plantas forman parte del medio-ambiente. No obstante, a pesar de esta base armónica la estabilidad del sistema es repetidamente perturbada. Debido a que la gente y los animales deben comer para subsistir y con este fin matan y consumen a otras especies, las acciones de la gente desequilibran constantemente el sistema. Para restablecer el balance primordial, los Maya mantienen una relación ceremonial de trueque con los espíritus protectores de los animales, los llamados *ah kanulob*. Ingold (1986) tipificó el espíritu protector de los animales como 'la esencia espiritual' de una especie de animal, dentro de este complejo los animales mismos corresponden a la carne y sangre del *ah kanul*.

La *M. beecheii* ocupa un lugar notorio en la cosmología Maya ya que es estrictamente separada de los Meliponidos que viven en el bosque (*Melipona yucatanica*; *Frieseomellita nigra*; *Trigona fulviventris*; *Scaptotrigona pectoralis*, *Plebeia sp*; *Nannotrigona sp.*; *Trigonisca sp.*; *Partamona nigrior*; *Lestrimelitta limao* y unas especies no determinadas del genero *Trigona*). La *M. beecheii* es la única abeja domesticada y por consecuencia debe vivir entre la gente. La llaman *Xunan kab*, o sea Señora abeja. Las colonias son mantenidas en troncos huecos en casas especiales para abejas construidas en el solar. Mientras los Maya mantienen una relación de intercambio recíproco con los *ah kanulob* de los animales a través del cual pretenden compensarlos por los animales muertos en la cacería, no existen rituales dirigidos a compensar el uso que los mayas hacen de las *Xunan kab*. De acuerdo al sistema de representación Dios dispuso que el ser humano fuera el protector de *Xunan kab,* por lo tanto los meliponicultores son los compañeros humanos de los seres espirituales *ah kanulob*. En otras palabras: el meliponicultor Maya-Yucateco comparte la esencia espiritual con *Xunan kab*. Por consiguiente, ellos cuidan la abejas lo mejor posible y cuando las abejas no tienen suficiente alimento almacenado en el nido, el meliponicultor renuncia a la cosecha. El meliponicultor crea nuevas colonias por medio de la división de la cría y a su vez limpia los troncos con hojas especiales para contrarrestar las moscas forideas y otras fuerzas que se supone son malignas para las abejas. El meliponicultor realiza ceremonias dirigidas a los dioses de la lluvia y a los espíritus del bosque y a Dios mismo, como retribución por la producción de miel en los nidos, estas ofrendas son equivalentes al pago que hace él agricultor hace por el uso de la tierra de cultivo. De esta forma *Xunan kab,* para solventar su propia cuenta con el mundo espiritual, necesita del meliponicultor.

El meliponicultor también necesita de *Xunan kab*. La sociedad Maya está organizada en base a la distribución de las tareas económicas, sociales y rituales de acuerdo al '*género*'. El hombre cultiva el maíz en la milpa, que está ubicada fuera del pueblo, mientras que la mayoría de las ocupaciones de la mujer se cumplen dentro del solar. Allí la mujer cuida de los niños, de las plantas y de los animales domésticos. Cuando el maíz entra en el solar, lugar ritualmente delimitado del área circunvecina, la mujer lo procesa para transformarlo en alimento. *Xunan kab* constituye una excepción a esta división de las tareas domésticas. Aunque las abejas habitan en el solar y por consiguiente deberían pertenecer al campo laboral de la mujer, son los hombres quienes cosechan la miel y cuidan de las *Xunan kab*. Los hombres producen la miel y las mujeres la necesitan para regular su fertilidad. Así, las mujeres solamente tienen acceso a la miel por mediación de un hombre, por lo general, su esposo. En este contexto es el hombre que, por medio de la miel de *Xunan kab*, hace posible la reproducción de su familia. A un nivel cosmológico más alto el hombre logra que -a través de ofrendas de maíz y miel-, las substancias vitales fluyan simbólicamente hacia el mundo espiritual. Desde allí los dioses devuelven estas substancias vitales en forma de nueva vida y nueva cosecha. Haciendo uso de la miel el hombre regula la fertilidad de la mujer y de la tierra en cultivo. El círculo se completa de este modo ya que lo que el cazador toma de los *ah kanulob* en carne y sangre cuando mata a un animal para alimentar a su familia, lo devuelve simbólicamente en maíz -el equivalente ritual de la carne-, y en miel de *Xunan kab* -el equivalente ritual del semen y la sangre.

Por ser considerada caliente, solamente la miel de esta abeja 'femenina', la *Xunan kab*, es apta para ser usada en prácticas ceremoniales y para regular la fertilidad de las mujeres y de los plantíos. En contraste, las abejas 'masculinas', las del bosque, producen una miel considerada fría, y por lo tanto dañina para la fertilidad. Este complejo simbólico se puede explicar coherentemente dentro de la cosmología Maya. De hecho, el tronco hueco, en el cual se cría la *Xunan kab*, es una 'tierra' poblada por el meliponicultor. Los mismos principios cosmológicos que regulan la 'tierra' en que viven los humanos, son válidos para la 'tierra' en que viven las abejas. De la misma manera en que durante el día el sol calienta la tierra de los humanos, el sol calienta el *hobon* de las abejas, calentando así la miel. Para los Maya existe una relación homológica entre la 'tierra' de las abejas y la 'tierra' de la gente debido a que el meliponicultor comparte su 'esencia espiritual' con *Xunan kab*. El destino de la familia humana es compartido con la familia de abejas y permanecen ligadas la una a la otra hasta la muerte. Sin embargo, es un hecho que las colonias de *Xunan kab* cada vez producen menos e incluso mueren. Los meliponicultores arguyen que ellos no pueden hacer nada para influir favorablemente la producción de sus abejas, o para poner un alto a la pérdida de las colonias. Según algunos, la causa del problema es que los mayas ya no brindan tributo ceremonial a sus dioses y por ello éstos ya no están dispuestos a prestar servicios o hacer favores a la gente. Según otros, el destino de las abejas es determinado por la historia: tal como los Maya están vinculados a sus *Xunan kab*, los conquistadores extranjeros están vinculados a la abeja importada, el *Americano kab* (*Apis mellifera*). En tiempo de la conquista y luego durante el período colonial, los Españoles 'llevaron la delantera matando a los Maya u obligandolos a huir al bosque'. Ahora, el mismo proceso se puede constatar entre las abejas. Es una opinión extendida, sin embargo, que en el futuro, los poderosos ancestros Mayas (que se pueden ver en Chichen Itza en forma petrificada) resurgirán devolviendo a los Maya su poder. A partir de ese momento, los *Xunan kab* volverán a producir en forma optima.Hasta aquí los Mayas.

La interacción entre el medio-ambiente, la cultura y prácticas de crianza de abejas

Si se parte de las características de las abejas para explicar el descenso de la meliponicultura, son viables otras teorías que no son aparentes ni interpretables dentro de la cosmología Maya. Como factores generales en la caída de la meliponicultura se pueden mencionar: la vasta deforestación, la desaparición de la vegetación secundaria y de nidos vacantes para *M. beecheii* y la consecuente transformación de los métodos de cultivo relacionados a la meliponicultura y, como último factor, la introducción de *A. mellifera*. En comparación con Yucatán, la deforestación en El Salvador fue más drástica. En El Salvador, el sistema agrícola tradicional desapareció, importandose la abeja *mellifera* mucho antes que en Yucatán. A la vez, los meliponicultores en El Salvador carecen de métodos para reproducir las colonias Meliponidas. Como consecuencia, en grandes áreas de El Salvador la meliponicultura ha desaparecido, mientras que en Yucatán se continua criando estas abejas en casí toda la península. Lo que no quita que esta práctica en Yucatán se haya reducido significativamente en relación a su estado pre-colombino.

La decadencia de la meliponicultura en Tepich se puede explicar por una interacción entre conceptos culturales y los cambios que han ocurrido en el medio-ambiente. La meliponicultura Yucateca se basa en las características biológicas de los Meliponidos. Por el hecho que esta 'abeja Dama' está incorporada en la sociedad Maya en base de su presumido sexo, los meliponicultores las tienen en el solar. De esta manera, los Maya separan la *M. beecheii*, que evita competencia con otras abejas y prefiere coleccionar miel y polen en lugares soleados, de las abejas que prefieren lugares de forraje sombreados. Otro criterio importante es que la *M. beecheii* evita la competencia con otras abejas, mientras que las otras especies actúan ahuyentando sus competidoras. El uso de hojas de *Bursera simaruba* contra el *k'inam* (un tipo de energía que puede causar la muerte en la abeja) posiblemente es una defensa efectiva contra las moscas forideas. A pesar de que esta planta también se encuentra en El Salvador, allí no es ocupada. Por medio del sistema agrícola tradicional, los Maya crean campos abiertos para sus abejas (iluminados directamente por el sol) en los que crecen plantas melíferas y poliníferas en forma abundante. Los Maya ocupan ciertos métodos para la multiplicación de sus colonias y estos no parecen haber cambiado sustancialmente durante siglos. Anteriormente, el sistema agrícola fue de gran importancia en la producción de las colonias. Ciertas plantas alimenticias importantes para los Meliponidos son endémicas en Yucatán, así que la situación ecológica especial de esta península, posiblemente ha contribuido a una mayor productividad, y una mayor capacidad de soporte para la mantención de las colonias de *M. beecheii*. Ahora la relación entre meliponicultura y agricultura se encuentra perturbada: importantes plantas alimenticias quedan fuera del área de forraje intensivo de las abejas. En los terrenos en barbecho con vegetación secundaria crecen plantas alimenticias de gran importancia para la *M. beecheii*. En los diferentes grados de desarrollo de la vegetación predominan diferentes plantas melíferas y poliníferas valiosas para esta especie (sucesivamente: ± 1 año: *Bauhinia divaricata*, *Ocimum micranthum*, *Viguiera dentata*; ± 5 años: *Neomillspaughia emarginata*, *Eugenia* sp.; 5-6 años: *Neomillspaughia emarginata*, *Gymnopodium floribundum* y varias especies de Leguminosae ; ± 10 años: *Gymnopodium floribundum* y Leguminosae; 10-15 años: *Bursera simaruba*, *Piscidia piscipula*, *Turbina corymbosa*, *Vitex gaumeri*). En su conjunto esta vegetación, a lo largo de las diferentes etapas de desarrollo, produce durante el ciclo anual, plantas de las cuales las abejas pueden coleccionar polen y miel. Pero, las zonas urbanas siguen aumentando, como consecuencia importante vegetación -que resultaba del ciclo de regeneración del bosque dentro del sistema agrícola- ya no se encuentra dentro del radio de forraje intensivo de las abejas. Al mismo tiempo la vegetación del solar, donde se encuentra la *M. beecheii*, ha disminuido en cantidad y en calidad; y ya que la *M. beecheii* evita la competencia por fuentes alimenticias con otras especies, basta con la presencia de unas treinta colonias de *A. mellifera* para reducir considerablemente la producción de *M. beecheii*. A pesar de que los Maya conservan su sistema agrícola tradicional, los Meliponidos ya no pueden explotar su medio-ambiente en forma optima. En contraste, la *A. mellifera* se encuentra principalmente en la milpa, en medio de plantas alimenticias importantes, y tienen un radio de vuelo mucho más amplio. Hoy en día, las plantas alimenticias valiosas que crecen en los terrenos en barbecho, posiblemente contribuyen a elevar la producción de *A. mellifera* en Yucatán.

En resumidas cuentas, por un lado se puede atribuir el anterior éxito de la meliponicultura en Yucatán a los conceptos culturales y al conocimiento Maya de los Meliponidos, por otro lado los problemas actuales de la meliponicultura también se puede atribuir a que los Maya parcialmente conservan aún sus conceptos culturales. Esta contradicción se puede explicar tomando en cuenta las transformaciones que tuvieron lugar en el medio-ambiente de las colonias. La separación estricta de la *M. beecheii* de otras especies contribuye a una mejor producción. Sin embargo, por la prescripción Maya que la abeja 'femenina' se debe de tener en el solar, importantes plantas alimenticias se encuentran demasiado lejos de los meliponarios, a su vez las zonas urbanas han crecido dejando los campos de cultivos fuera del área de forraje de la *M. beecheii*. Además, los Maya ya no separan estrictamente la *M. beecheii* de la *A. mellifera*. Esta última puede ser considerada como el principal competidor de la *M. beecheii*. A pesar del gran valor que los Maya-Yucatecos atribuyen a la *M. beecheii*, algunos de los conceptos culturales son contra-productivos ya que el medio ambiente de las abejas ha cambiado y ahora estos conceptos ejercen una influencia negativa sobre la producción de la abeja. El medio ambiente cambió, mientras los conceptos culturales no han cambiado al mismo ritmo. Actualmente, la meliponicultura Maya es improductiva.

Samenvatting

In dit proefschrift beschrijf ik de meliponicultuur binnen het etno-ecologische systeem van imkers uit El Salvador (hoofdstuk 3) en Yucatán (hoofdstuk 4 tot en met 8) tegen de achtergrond van biologische karakteristieken van de Meliponinae (hoofdstuk 5 en 9) en binnen een historisch perspectief (hoofdstuk 2). De nadruk ligt op de Maya imkers in Yucatán in het dorp en gelijknamige *ejido* Tepich, waar de angelloze bijenteelt nog een grotendeels geïntegreerd onderdeel vormt van het grotere etno-ecologische systeem.

Achtergrond: de angelloze bijen (Apidae, Meliponinae)

Angelloze bijen (Apidae, Meliponinae) zijn inheems in tropisch Amerika. Door een proces van co-evolutie tussen bijen en bloemen sinds het Krijt tijdperk zijn bepaalde inheemse planten grotendeels afhankelijk geworden van angelloze bijen voor hun bestuiving. Meliponinae zijn de meest voorkomende bijen in de tropische ecosystemen van het Amerikaanse continent. Met zijn allen spelen ze een cruciale rol in de bestuiving van de inheemse vegetatie. In grootte variëren de soorten van ongeveer 1 millimeter tot net iets groter dan de Europese honingbij (*Apis mellifera*). De meest gewaardeerde en bovendien endemische soort in Midden Amerika en México, de *Melipona beecheii,* lijkt qua vorm en kleur veel op de *A. mellifera.* Sommige andere soorten van het geslacht *Trigonini* zijn zwart en kunnen op een huisvlieg lijken. Angelloze bijen hebben een gedegenereerde angel en steken niet. Deze sociale bijen leven in permanente kolonies. Voor imkers zijn ze vooral interessant omdat ze honing en stuifmeel opslaan in het nest in voedselpotten van cerumen (een mengsel van was en hars) in de vorm van een walnoot (zie plaatje 1 bijlage 1). De broedkamer is een apart deel in het nest en heeft de vorm van een bruidstaart: de horizontale lagen bestaan uit kleine rechtopstaande broedcellen die ieder één larve bevatten. Sommige van de Meliponinae maken nesten in holle boomstammen, anderen gebruiken holtes in de grond of een verlaten nest van termieten of parkieten, of bouwen zelf een extern nest.

Meliponinae verzamelen slechts binnen een beperkte omtrek van het nest honing en stuifmeel. Vijfenzeventig procent van de foerageer activiteit van de *M. beecheii* vindt plaats binnen een straal van 400 meter (Nieuwstadt & Iraheta 1996). Daarom zijn voedselplanten in de directe nabijheid van het nest onontbeerlijk voor een goede produktiviteit van de kolonie. De maximale rijkwijdte van de *M. beecheii* is 1 kilometer, bijgevolg is het voor het natuurlijke zwerm gedrag van de bijen van belang dat er nestplaatsen zijn (holtes in bomen) binnen deze straal.

Theoretische invalshoek en doel van het onderzoek

Sinds mensenheugenis houden inheemse bevolkingsgroepen van Midden Amerika en México deze angelloze bijen voor hun honing en was. In de precolumbiaanse tijd en tijdens de koloniale periode hielden de Yucateekse Maya de *M. beecheii* zelfs op grote schaal. Tegenwoordig is de meliponicultuur sterk achteruitgegaan. Sociale en ruimtelijke wetenschappers wijten deze terugval vooral aan de succesvolle introductie van de Europese honingbij en de opkomst van de apicultuur. Omdat zij de bijenteelt vanuit een economische invalshoek benaderen, komen zij (met uitzondering van Merrill-Sands 1984) tot de conclusie dat de achter uit gang van de meliponicultuur vooral een vrije keuze is van de imkers die overgaan op de veel produktievere *A. mellifera*. Dezelfde conclusie trekken zij die uitgaan van de idee dat de cultuur de menselijke relatie met de omgeving determineert. Deze onderzoekers degradereb de meliponicultuur tot een hobby van de imkers. In dit proefschrift stel ik dat dit in strijd is met de praktijk: imkers van angelloze bijen doen hun best de waardevolle en inmiddels schaarse kolonies te behouden. Via de beschrijving en analyse van de meliponicultuur bij de Maya laat ik zien dat de huidige gesteldheid van de meliponicultuur het resutlaat is van de interactie tussen: 1) de angelloze bijen met hun specifieke karakteristieken; 2) culturele aspecten van de groeperingen die angelloze bijen houden; 3) omgevingsaspecten van de gebieden waar de angelloze bijen worden gehouden. In deze context probeer ik een antwoord te vinden op de vraag: Waarom neemt de angelloze bijenteelt af? Waarom neemt het sneller af in El Salvador dan in Yucatán? Vervolgens stel ik dat dit niet eenzijdig toe is te schrijven aan ontbossing of aan culturele dimensies van de samenleving, in plaats hiervan kijk ik vooral naar het proces dat ontstaat door de interactie tussen beide. Deze invalshoek is ontleent aan een recent debat dat heeft plaatsgevonden tussen antropologen die werkzaam zijn op het gebied van de ecologie en antropologische ecologie. Zij stellen dat de samenleving, cultuur en omgeving met elkaar in wisselwerking staan in plaats van dat één van deze de anderen zou bepalen.

Nu de idee wordt verworpen dat er een dichotomie zou bestaan tussen cultuur en natuur waarin de een de ander zou determineren, ontstaat er een nieuwe visie op de rol van de cultuur en de relatie tot de omgeving (Hornborg 1996; Ingold 1992). Het algemene ecologische model stelt dat een organisme de omgeving in een coherent systeem organiseert door er in te leven op een manier die de soort eigen is. Omgeving is een complex begrip dat alleen bestaat in relatie tot het organisme of de persoon wiens omgeving het is. Daarom kan de omgeving alleen in relatie tot het organisme gedefinieerd worden. Dit is in tegenstelling tot het begrip 'natuur', welke uit neutrale objecten bestaat in relatie tot een objectief individu dat naar de natuur kan kijken zonder daar zelf deel van uit te maken. Mensen maken deel uit van de omgeving door er in te handelen, door bijvoorbeeld het produceren van voedsel, en veranderen de omgeving in dit proces. Cultuur is niet nodig om handelingen te verrichten of om waar te nemen, in plaats hiervan stelt cultuur ons in staat acties en waarnemingen te interpreteren en expliciet te maken aan anderen. De angelloze bijenhouders testen hun waarnemingen en handelingen in de bijenteelt praktijken tegen de reeds verworven kennis en (culturele) logica. Culturele concepten worden zodoende bevestigd, aangepast of verworpen en gaan weer vooraf aan een volgende actie. Hoe beïnvloedt cultuur dan de angelloze bijenteelt? In dit proefschrift beschrijf ik de meliponicultuur binnen de omgeving voor de Maya en de Salvadoraanse imkers zoals zij dit expliciet maken in hun cultuur. De Maya en Salvadoraanse concepten betreffende de meliponicultuur relateer ik aan de kenmerken van de Meliponinae en hun omgeving zoals biologen die expliciet maken. Dit stemt overeen met de zogeheten '*emic*' en '*etic*' visie. Maar terwijl de *emic* and de *etic* visie in principe alleen verklaarbaar zijn binnen zichzelf, biedt het uitgangspunt van de verschillende organismen het voordeel dat culturele concepten kunnen worden gerelateerd aan biologische aspecten van Meliponinae zoals deze in feite ook in de meliponicultuur samenkomen. Bovendien biedt deze benadering het voordeel dat elementen in de analyse op te nemen die onderdeel vormen van het meliponicultuur complex, maar die niet in de *etic* of in de *emic* visie geïncorporeerd zijn.

Veranderingen in de omgeving sinds 16de eeuw en het effect op de meliponicultuur

Voor de Spaanse verovering telen de Yucateekse Maya op grote schaal de inheemse angelloze bijen en verhandelen de honing naar andere gebieden in Mesoamerika. Angelloze bijenhoning wordt in de koloniale annalen (Oviedo 1959; Casas 1951; Landa

[1566] 1959&1992) beschreven als 'de enige rijkdom van Yucatán'. Hoewel Yucateekse imkers honing exporteren naar andere delen van Mesoamerika, worden de bijen in de hele regio gehouden. Tijdens de koloniale periode eisen de *vecinos* (de spaanse kolonisten) tribuut van de Maya in de vorm van honing en was en exporteren deze produkten naar Europa. Sommige Maya vluchten naar het zuidelijke deel van het schiereiland om dit tribuut systeem te ontlopen. Hier worden ze relatief ongemoeid gelaten door de Spaanse koloniale regering. De huidige Maya vergelijken deze episode uit de geschiedenis met de angelloze bijen zelf, die volgens hun ook naar het bos zouden vluchten als de geïmporteerde bijen (*A. mellifera)* te veel last veroorzaken. De Maya die in het midden van het schiereiland wonen (tussen de noordelijke kuststreek waar de Spaanse koloniale regering de touwtjes stevig in handen heeft en het zuidelijke deel landinwaarts waar ze nauwelijks controle over kunnen uitoefenen) komen het eerst in opstand. Dit leidt tot de zogeheten Kaste oorlog. In andere delen van Mesoamerika kan de inheemse bevolking niet ontsnappen aan de last van het Spaanse koloniale bewind. Dit blijkt een belangrijk gegeven in het verdere verloop van de geschiedenis en de relatie tussen de inheemse bevolkingsgroepen en hun omgeving. Bovendien heeft dit belangrijke gevolgen voor de meliponicultuur.

De traditionele Mesoamerikaanse landbouwmethode bestaat, tot op vandaag de dag, uit het kappen van een stuk bos, het drogen en verbranden van de gekapte vegetatie zodat de benodigde voedingsstoffen in de bodem komen en het zaaien van maïs, bonen en pompoen. Na twee of drie jaar gebruik laten de boeren het land verschillende jaren braak liggen (*swidden cultivation*). Verschillende planten soorten koloniseren het braak liggende land en ontwikkelen zich in zo'n veertig jaar tot volgroeid bos. Door dit landbouwsysteem creëert de mens een landschap waarin bos afgewisseld wordt met secundaire vegetatie in verschillende stadia van ontwikkeling. Dit systeem is mede mogelijk omdat mensen alleen het vruchtgebruik hebben over de grond, de bevolkingsdruk beperkt is en er genoeg grond beschikbaar is om landbouwgronden af te wisselen met braakland. Het Mesoamerikaanse vestigingspatroon buiten de stedelijke centra is relatief verspreid. Huizen liggen in de directe nabijheid van landbouwgronden waarvan een deel braak ligt en waar de vegetatie snel terugkeert. De imkers houden hun kolonies bij de huizen en landbouwgronden en daarom kunnen we ondanks de beperkte vliegwijdte van de bijen aannemen dat de bijen de secundaire vegetatie en het bos kunnen bereiken om nectar en stuifmeel te verzamelen. Sommige oudere bomen in het bos verschaffen holtes waarin de bijen hun nest kunnen bouwen als ze zwermen. Bovendien sparen de boeren een deel van de volgroeide bomen (die holtes ontwikkelen) als zij het bos kappen voor landbouw.

Tijdens de koloniale periode wordt het land in Midden Amerika en Yucatán snel ontbost om plaats te maken voor commerciële veeteelt en landbouwactiviteiten van de allochtone bevolking. Vooral in El Salvador neemt dit drastische vormen aan. De rechten van de inheemse bevolking op het land worden steeds verder beperkt en uiteindelijk wordt in El Salvador al het land geprivatiseerd. *Swidden cultivation* is daardoor niet langer mogelijk. In Yucatán neemt de geschiedenis een andere wending. Tijdens de Kaste oorlog komen de Maya in opstand tegen de buitenlandse overheersing. Na de oorlog vestigt een deel van de Maya bevolking zich in de huidige Staat Quintana Roo. Door de landhervorming van de jaren '30 behouden zij (tot op heden) officieel het gemeenschappelijk recht op grond. Er worden *ejidos* gesticht waarin een bepaalde hoeveel grond aan een kleine gemeenschap van rechthebbenden wordt toebedeeld. Deze mensen hebben het gemeenschappelijke bestuur over hun *ejido* en hebben binnen de *ejido* vrije toegang tot het land. Door deze vorm van collectief landbezit blijft de traditionele landbouwvorm bestaan en blijft voorlopig ook de habitat van de angelloze bijen in stand.

De apicultuur en de afrikanisatie van *A. mellifera*

In de 18e eeuw importeren allochtone koffieplanters en andere geïnteresseerden voor het eerst Europese honingbijen (*A. mellifera*) in Midden-Amerika en México. De teelt blijft in eerste instantie grotendeels beperkt tot deze groep mensen en verspreidt zich langzaam onder de inheemse bevolking. Echter, in Yucatán wordt deze soort pas halverwege de twintigste eeuw succesvol geïntroduceerd. Apicultuur begint hier als een commerciële, kapitaal-intensieve activiteit in handen van rijke ondernemers. Het is een opmerkelijk feit dat de Maya erin slagen de apicultuur over te nemen. Omdat de Maya ervaren telers zijn van de angelloze bij *M. beecheii*, stellen de ondernemers hen in dienst. Aldoende raken de Maya ook snel bedreven met de apicultuur en slagen erin de Europese honingbijen zelf te telen. Langzamerhand weten de Maya de rechten van de rijke ondernemers op de *ejido* gronden te beperken en krijgen de teelt steeds verder in handen. Tegenwoordig is Yucatán één van de grootste honing producerende regio's ter wereld. Deze honing is merendeels afkomstig uit de kleine bijenstallen van de Maya boeren. Voor veel apiculturalisten is honing de belangrijkste inkomstenbron. Hoewel in Midden-Amerika de honing produktie niet zo hoog is als in Yucatán, heeft de apicultuur hier ook een grote economische waarde voor de, grotendeels zelfvoorzienende, boeren.

In de jaren tachtig wordt de apicultuur verstoord door de invasie van de zogeheten 'Killer Bees', oftewel de geafrikaniseerde honingbijen. Vanaf 1957 verspreiden deze bijen zich vanaf Brazilië en hybridiseren met Europese honingbij kolonies in de bijenstallen van de imkers. Agressieve gehybridiseerde kolonies vormen in eerste instantie grote problemen voor de imkers en hun omgeving. Dit leidt ertoe dat in grote gebieden de imkers afzien van apicultuur en een belangrijke inkomstenbron moeten ontberen. De afname vindt vooral plaats onder de zelfvoorzienende boeren. Deze situatie, zoals in de dorpen el Brujo, el Limo en la Criba in El Salvador, contrasteert scherp met de situatie in Yucatán waar de boeren voorlichting krijgen over de africanisatie. Het is een belangrijk feit dat geafrikaniseerde honingbijen niet hybridiseren met angelloze bijen. De competitie over voedselbronnen en nest plaatsen intensiveert wel ten gevolge van de afrikanisatie omdat Geafrikaniseerde honingbijen (in tegenstelling tot de Europese honingbijen) tot diep in het tropisch bos dringen.

Meliponicultuur in El Salvador

In west El Salvador is de meliponicultuur teruggedrongen tot het gebied rondom het Montecristo natuurreservaat. Hiernaast houden in de Chalchuapa regio nog een of twee imkers per dorp angelloze bijen. De soort *M. beecheii* wordt het meest geteeld. Imkers houden de kolonies in holle boomstammen onder de dakrand van de huizen. Verder houden zij ook de soorten *Melipona yucatanica*, *Tetragonsica angustula*, *Trigona fulviventris*, *Trigona nigerrima*, *Cephalotrigona capitata*, *Plebeia* sp. en *Scaptotrigona* sp. Andere soorten worden in het bos van hun honing en was beroofd, waaronder een bij van het geslacht *Geotrigona*. Imkers onderscheiden bijen die je volgens hun kunt houden van bijen die je volgens hun niet kunt houden op basis van het gedrag en de habitat van de bijen: agressieve soorten of soorten die in de grond leven, worden niet mee naar huis genomen. De imkers voeden de bijen als er een schaarste is aan voedselplanten, hetgeen hoofdzakelijk voor komt in het regenseizoen. Ze kennen geen methodes om de kolonies te reproduceren en zijn voor het verkrijgen van nieuwe kolonies voornamelijk afhankelijk van wilde bijennesten in het bos. Door grootschalige ontbossing zijn de Meliponinae in het bos schaars geworden. Bovendien is het verboden om bomen te kappen. De imkers oogsten de honing merendeels in de laatste maanden van het droge seizoen (maart, april) tijdens volle maan. De honing van Meliponinae gebruiken ze meestal voor medicinale doeleinden. Onderzoek heeft uitgewezen dat honing van angelloze bijen een hoge antibiotische waarde heeft (de

Bruijn & Sommeijer 1997). Door de relatieve schaarste van angelloze bijenhoning in El Salvador en de hoge medicinale waarde die de mensen aan deze honing toeschrijven is deze honing duur. De prijs voor een liter van de duurste honing soort (*Geotrigona* sp.) stond in 1993 gelijk aan het loon dat betaald wordt voor vijf dagen landarbeid. Dit is ruim twaalf maal meer dan voor de honing van *A. mellifera* wordt betaald. Na de afrikanisatie is de apicultuur in het westen van El Salvador onder de zelfvoorzienende boeren sterk afgenomen. Daarom speelt de angelloze bijenhoning in sommige zelfvoorzienende huishoudens in El Salvador een grotere economische rol dan de honing van de *A. mellifera*. Door de heterogene culturele achtergrond van de bevolking, de invloed van het protestantisme en de sterke daling van de meliponicultuur is er geen sprake meer van een coherent cultureel systeem waarvan de meliponicultuur deel uit maakt.

Angelloze bijenteelt in de kosmovisie van de Maya in Quintana Roo

Volgens de Maya is de biotische en abiotische wereld om hen heen bezield en bovendien hiërarchisch geordend. De Maya maken een onderscheid tussen gecultiveerd en bewoond land, dat ritueel is afgescheiden van de buitenwereld, en ongecultiveerd en onbewoond land, dat de dorpen omringt. Dit onderscheid valt grofweg samen met de classificatie van dieren in gedomesticeerde dieren, die bij de mensen op het erf rondom het huis wonen, en de wilde dieren die in het bos leven en waarop de Maya jagen. Het systeem is gebaseerd op een harmonieuze integratie van mensen, dieren en planten die deel uitmaken van de omgeving. Toch wordt dit systeem herhaaldelijk verstoord omdat mens en dier moeten eten en daartoe andere soorten doden en consumeren. Om dit oorspronkelijk evenwicht te herstellen gaan de Maya een ceremoniële ruil-relatie aan met de geesten van de dieren, de zogeheten *ah kanulob*. Een geestelijke beschermer van de dieren is wat Ingold (1986) heeft getypeerd als de 'spirituele essentie' van een diersoort terwijl de dieren zelf zijn vlees en bloed zijn.

De angelloze bij *M. beecheii* neemt een opmerkelijke plaats in in de Maya samenleving daar zij strikt gescheiden wordt gehouden van de Meliponinae die in het bos leven (i.e.: *Melipona yucatanica*; *Frieseomellita nigra*; *Trigona fulviventris*; *Scaptotrigona pectoralis*, *Plebeia sp*; *Nannotrigona sp.*; *Trigonisca sp.*; *Partamona nigrior*; *Lestrimelitta limao en* een aantal niet gedetermineerde *Trigona* soorten). De *M. beecheii* is de enige gedomesticeerde soort en leeft daarom bij de mens. De Maya noemen deze gedomesticeerde bij *Xunan kab* oftewel 'Dame bij'. Ze worden in speciale huizen in holle boomstammmen gehuisvest. Maar terwijl de mens voor het gebruik en de jacht op andere dieren een ruil-relatie aangaat met de *ah kanul* van de soort om gedoodde dieren te compenseren, gebeurt dit niet voor het gebruik van *Xunan kab.* God heeft bepaald dat de mens de beschermer is van *Xunan kab.* Imkers die angelloze bijen houden zijn dus menselijke collega's van de niet menselijke *ah kanulob.* Met andere woorden: de mens deelt zijn spirituele essentie met zijn angelloze bijen. Ze worden dan ook zo goed mogelijk verzorgd en als ze te weinig honing hebben opgeslagen in de bijenstam slaat de imker de oogst over. De imker creëert zelf nieuwe kolonies door de splisting van het broed en hij maakt zijn bijenstammen schoon met speciale bladeren om Foride vliegen en krachten die schadelijk zouden zijn voor bijen af te weren. Hij houdt ceremonieën voor de regengoden en de geesten van het bos en aan God zelf, net zoals hij de rekening presenteert voor zijn gebruik van het land. In zekere zin heeft *Xunan kab* de imker nodig om de rekening met de goddelijke wereld te vereffenen.

De imker zelf heeft zijn *Xunan kab* ook nodig. De Maya samenleving is georganiseerd volgens gender principes. De man verbouwt maïs op het akkerland buiten het dorp en de vrouw heeft haar belangrijkste taken in en rondom het huis. Hier verzorgt zij de kinderen, planten en dieren. Als de maïs van het land het ritueel afgebakende erf binnenkomt, verwerkt de vrouw dit verder tot voedsel. *Xunan kab* vormt een uitzondering op deze werkverdeling. Hoewel de bij op het erf wordt gehouden en daarom volgens de regels tot het werkdomein van de vrouw behoort, zijn het uitsluitend mannen die *Xunan kab* oogsten en verzorgen. De mannen produceren de honing terwijl de vrouwen de honing nodig hebben voor hun vruchtbaarheid. Vrouwen hebben dus alleen toegang tot de honing via een man, in de regel hun echtgenoot. Met de *Xunan kab* honing zorgt de man in feite voor de voortplanting van zijn familie en op een hoger niveau zorgt hij ervoor dat door middel van honing en maïs symbolisch levensvatbare vloeistoffen naar de boven wereld stromen, die hij in de vorm van nieuw leven en nieuwe oogst weer terug krijgt. Met de honing regelt de man de vruchtbaarheid van vrouw en land. Wat hij van de *ah kanulob* neemt aan vlees en bloed door het doden van een dier, geeft hij symbolisch weer terug in de vorm van maïs (vlees) en *Xunan kab* honing (semen/bloed).

Alleen de honing van de vrouwelijke bij *Xunan kab* is geschikt voor ceremoniële praktijken en voor het reguleren van vruchtbaarheid omdat deze honing als 'warm' wordt beschouwd. Mannelijke bosbijen daarentegen produceren alleen 'koude' honing welke slecht is voor vruchtbaarheid. Dit gegeven kan binnen de Maya kosmologie worden verklaard. De holle boomstam waarin *Xunan kab* wordt gehouden is feitelijk een door de imker bevolkte 'aarde'. Voor deze bijen-aarde gelden dezelfde kosmologische principes als voor de aarde waarop de mensen leven. Netzoals de zon overdag de aarde verwarmt waarop de mensen leven, zo verwarmt hij ook de 'aarde' waarin de bijen leven en de honing die zij in deze 'aarde' opslaan. De Maya leggen dan ook een homologe relatie tussen de bijen-aarde en de mensen-aarde. En aangezien de imker zijn 'spirituele essentie' deelt met de *Xunan kab,* valt de bijenfamilie en de familie van de imker hetzelfde lot ten deel, tot in de dood. Het is echter een feit dat de *Xunan kab* kolonies steeds minder produceren en zelfs sterven. De imkers zeggen dat zij niets kunnen doen om hun bijen weer produktief te maken en het verlies aan kolonies tegen te gaan. Volgens sommigen is de oorzaak van het probleem dat mensen de goden niet meer respecteren met rituelen waardoor de goden niet langer bereid zijn hun diensten en gunsten te verlenen. Volgens anderen ligt het lot van de bijen besloten in de geschiedenis: net zoals de Maya verbonden zijn aan hun *Xunan kab*, zo zijn de buitenlandse veroveraars verbonden aan de geïmporteerde bijensoort *Americano kab*. Toen, tijdens de verovering en de koloniale periode, bleken de Spanjaarden aan de winnende hand en doodden zij de Maya of dreven de Maya ver het bos in. Een zelfde relatie bestaat nu tussen de bijen. Echter, in de toekomst zullen de machtige voorouders van de Maya (die nu in versteende vorm zichtbaar zijn in Chichen Itza) herleven en de Maya hun macht teruggeven. Als gevolg hiervan zal ook *Xunan kab* weer goed produceren. Tot zover de Maya.

Wisselwerking tussen omgeving, cultuur en bijenteelt praktijken

Uitgaande van karakteristieken van de Meliponinae, zijn er verklaringen denkbaar voor de afname van de meliponicultuur die niet direct zichtbaar zijn in de Maya kosmologische visie. Als algemene factoren in de achteruitgang van de meliponicultuur kunnen worden genoemd: de grootschalige ontbossing, het verdwijnen van secundaire vegetatie en nest plaatsen voor *M. beecheii* door veranderde landbouwmethoden in samenhang met de bijenteeltmethoden en de introductie van *A. mellifera*. In vergelijking tot Yucatán nam de ontbossing in El Salvador drastischere vormen aan. Het traditionele landbouw systeem kwam er eerder onder druk te staan, *A. mellifera* werd er eerder geïmporteerd en bovendien kennen de imkers er geen methodes om de angelloze bijen kolonies te vermeerderen. Als gevolg hiervan kwam de meliponicultuur in El Salvador eerder onder druk te staan dan in Yucatán. In grote delen van El Salvador is de meliponicultuur verdwenen, terwijl in het grootste deel van Yucatán nog steeds angelloze bijen worden gehouden. Niettemin is ook de Yucateekse praktijk in vergelijking tot de pre-columbiaanse tijd in belangrijke mate afgenomen.

De achteruitgang van de meliponicultuur in Tepich is te verklaren door een wisselwerking van culturele concepten in een veranderende omgeving. De Yucateekse meliponicultuur ondersteunt een aantal biologische karakteristieken van *M. beecheii*. Omdat deze 'Dame-bij' op basis van haar verondersteld e geslacht is opgenomen in de maatschappij, houden de imkers deze bij op het erf. De Maya scheiden hierdoor de bijen die competitie vermijden en de voorkeur geven aan het verzamelen van nectar en stuifmeel op zonnige plaatsen van bijen die geen competitie vermijden en vaak een voorkeur hebben voor de schaduw. Het gebruik van *Bursera simaruba* bladeren tegen *k'inam* is mogelijk ook een effectief verweer tegen de Foride vliegen. Deze plant komt ook voor in El Salvador, maar wordt daar niet gebruikt. Door het landbouwsysteem creëren de Maya open plaatsen voor hun bijen (direct beschenen door zonlicht) waarin hoogwaardige voedselplanten groeien. De Maya kennen methodes om kolonies te vermeerderen. Deze praktijken lijken ten opzichte van vroeger nauwelijks te zijn veranderd. In het verleden droeg het landbouwsysteem van de Maya bij aan de produktiviteit van de kolonies. De specifieke ecologische situatie in Yucatán, zoals het voorkomen van een aantal hoogwaardige endemische voedselplanten, heeft mogelijk bijgedragen aan de hogere produktiviteit van, en grotere een draagkracht voor, *M. beecheii* kolonies. Nu is de relatie tussen meliponicultuur en landbouw verstoord: belangrijke voedselplanten staan buiten het actieve foerageergebied van de angelloze bijen. In de secundaire vegetatie op het braakliggend land groeien belangrijke voedselplanten voor de *M. beecheii.* In de verschillende stadia van ontwikkeling van de vegetatie domineren verschillende voedselplanten die belangrijk zijn voor deze bijensoort (successievelijk: ± 1 jaar: *Bauhinia divaricata*, *Ocimum micranthum*, *Viguiera dentata*; ± 5 jaar: *Neomillspaughia emarginata*, *Eugenia* sp.; 5-6 jaar: *Neomillspaughia emarginata*, *Gymnopodium floribundum* en verschillende soorten Leguminosae ; ± 10 jaar: *Gymnopodium floribundum* en Leguminosae; 10-15 jaar: *Bursera simaruba*, *Piscidia piscipula*, *Turbina corymbosa*, *Vitex gaumeri*). Gezamenlijk zorgen deze planten ervoor dat de bijen gedurende het merendeel van het jaar honing en stuifmeel kunnen verzamelen. Echter, de dorpen zijn gegroeid waardoor deze belangrijke vegetatie, die ontstaat ten gevolge van het landbouwsysteem, niet langer binnen het actieve foerageer gebied ligt van de bijen. Bovendien is de vegetatie op het erf, waar de *M. beecheii* wordt gehouden, verminderd in aantal en diversiteit en competeren de angellozen met een dertigtal kolonies *A. mellifera*. Aangezien *M. beecheii* competitie over voedselbronnen vermijdt, verlaagt dit de produktie van de kolonies in een toch al qua vegetatie verarmde omgeving. Ondanks dat de Maya in dit gebied niet zijn afgeweken van het traditionele landbouwsysteem kunnen de angelloze bijen de omgeving niet langer maximaal benutten. De *A. mellifera* daarintegen, staan merendeels in het akkerland temidden van de belangrijke voedselplanten. Bovendien hebben deze honingbijen een veel groter bereik. De belangrijke voedselplanten die op het braakliggend land groeien dragen nu mogelijk bij aan de huidige hoge produktie van deze bijensoort in Yucatán.

Kortom, enerzijds is het vroegere succes van de meliponicultuur in Yucatan mede te wijten aan de culturele concepten en de kennis van de Maya van de Meliponinae, anderzijds worden de huidige problemen van de meliponicultuur mede veroorzaakt doordat de Maya gedeeltelijk vasthouden aan deze culturele concepten. Deze contradictie is te verklaren door de veranderde omgeving. De strikte scheiding van *M. beecheii* van andere soorten bijen draagt bij aan de produktie van de *M. beecheii*. Maar, door het voorschrift dat de 'vrouwelijke bij' op het erf moet worden gehouden, staan belangrijke voedselplanten te ver van het nest omdat de dorpen zijn gegroeid en de landbouwgronden buiten het foerageer gebied liggen van de bijen. Bovendien wordt de *M. beecheii* niet langer strikt gescheiden gehouden van zijn grootste concurent *A. mellifera*. Hoeveel waarde de Maya de *M. beecheii* ook toeschrijven, sommigen van de culturele concepten werken, nu de omgeving veranderd is, een effectieve produktie van de bijen tegen. De omgeving is veranderd terwijl de culturele concepten niet zo snel mee veranderen. Momenteel is de meliponicultuur bij de Maya niet meer produktief.