CHAPTER 3

Meliponiculture – Stingless Bee Beekeeping in Thailand

3.1 Introduction

Stingless bees are highly eusocial insects belonging to the order Hymenoptera, and one of four tribes (Meliponini) in the family Apidae (Michener, 2000). They are pan-tropical in distribution being found in both the Paleo- and Neotropics. Worldwide there are over 500 described species in 32 genera with perhaps as many as 100 new species to be described (Michener, 2013). The richest species diversity is found in the Neotropics of Central and South America with 400 known species. The remaining species are found in Africa and the Indo-Australian regions (Cortopassi-Laurino *et al*., 2006; Michener, 2013; Pauly *et al*., 2013; Vit *et al*., 1994). Rasmussen (2008) has listed 89 species in 15 genera from the Indo/Australian region. Specifically for Thailand, 32 species in 10 genera have been described. In Thailand stingless bees are collectively known in the vernacular as "channarong", which is etymologically derived from "the factory that makes cerumen."

Stingless bee beekeeping is known as meliponiculture. The utilization of stingless bees by humans is an ancient undertaking albeit not overly well documented in the archeological record. The oldest evidence for human use of stingless bees is that of the pre-Columbian Mayans in meso-America (Ayala *et al*., 2013; Crane, 1992; Rosales, 2013), dating back several millennia, a pertinent historical review of the current state of Mayan stingless bee beekeeping (Villanueva-Gutierrez *et al*., 2013). Meliponiculture has been commonly undertaken in varying degrees by traditional communities throughout the equatorial range of stingless bees. Presently meliponiculture is most widely practiced in the Neotropics with numerous species of meliponines. Regarding stingless beekeeping in Asia, Cortopassi-Laurino, Imperatriz-Fonseca, Roubik, Dollin, Heard, Aguilar…Nogueira-Neto (2006) comment that "…nowhere (in Asia) is there a standard practice called meliponiculture." Our observations and documentation

regarding stingless bee beekeeping in Thailand strongly refute the misconception that Southeast Asia is bereft of a meliponiculture 'industry.'

Figure 3.1 The two main Thai provinces for meliponiculture (Chanthaburi and Trat) are highlight in the black

3.2 Stingless bee biology

Stingless bee colonies differ from those of honeybees (Apini) in that the honey is stored in pots as opposed to hexagonal combs. And while honeybee combs are composed solely of wax, stingless bee storage pots are varying mixtures of beeswax and plant resins, collectively known as cerumen. Individual pots are used to store nectar (honey) and pollen and can vary in size from very small (<5 mm in height) to large (>50 mm in height) dependent upon the bee species. The horizontal, single sided brood combs are separated from the food storage pots and depending on the stingless bee species can be well organized into stacked brood combs, or agglomerations of brood cells.

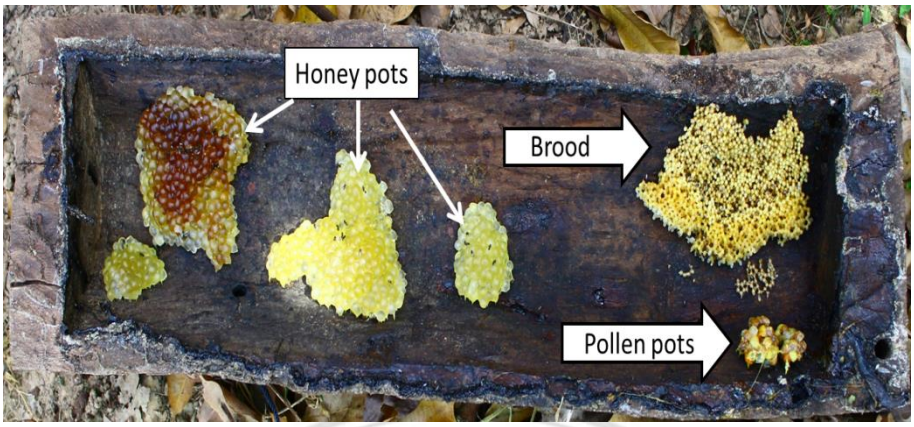

Figure 3.2 A newly established colony of *Lisotrigona furva.*
in a beekeeper modified log hive[1].

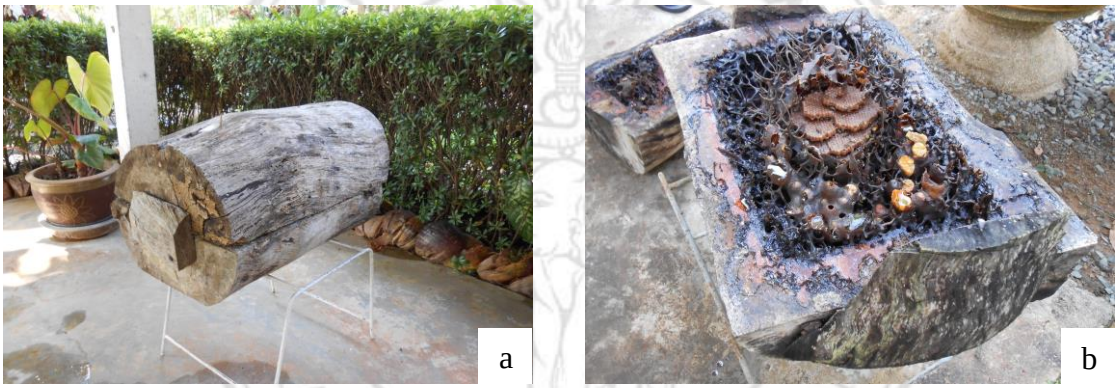

Figure 3.3 *Lepidotrigona terminata* in beekeeping modified log hive (a).
Top removed exposing the full nest matrix of *Lepidotrigona terminata* (b).

In stingless bee colonies monogyny is the usual condition. New queens are developed repeatedly, however most of them are killed. Replacement of the egg-laying queen does not happen every year and some queens may live as long as 3-7 years (Bradbear, 2009). All stingless bees follow a mass-provisioning strategy in caring for their brood. Brood cells are constructed and then provisioned with honey and pollen by the worker bees prior to oviposition by the queen. The cells are sealed soon after egg-laying and remain sealed until the adult bees emerge.

[1] This is an uncommon species in Thai meliponiculture as it is reported to be difficult to divide established colonies and individual colonies possess small populations of workers. (H. Banziger, personal communication, February 2014)

Stingless bee colonies multiply by swarming. When a colony has reached a certain size and an appropriate new nest site is discovered, a group of worker bees will begin transporting building materials from the parent colony to the new nest site. More and more bees will fly to the new nest over the next few days, and in the end, a virgin or newly mated queen from the parent colony will transfer to the new nest and begin producing eggs. In most species, mating between a new queen and drones takes place outside the nest (Bradbear, 2009; Hartfelder *et al*., 2006). Individual colonies are perennial and can remain continuously occupied for decades (Roubik, 2006).

As pointed out previously stingless bees store honey in pots, not in combs *as per* honeybees (Oddo *et al*., 2008). Even though the amount of honey from a stingless bee colony cannot compete with honeybees on a per colony basis, stingless bee honey is of higher value due to its relative scarcity. Ferrufino & Vit (2013) provide production data of 1 to 3 kg of honey per annum for six stingless bee species in Bolivia. Honey produced by stingless bees is often marketed as a putative medicinal remedy for a variety of ailments. This specific market niche also increases the value of stingless bee honey, which is often 20 times the value of *A. mellifera* honey (Vit *et al.*, 1998).

Stingless bee honey, as compared to the western honeybee (*A. mellifera*) 'standard', possesses more water, is more acidic, and undergoes a natural *in situ* fermentation process. While most reports on the chemical composition of stingless bee honey are from studies in the Neotropics, some investigations of Thai stingless bee honey have been done on a few of the most common species used in stingless beekeeping. Vit, Pedro & Roubik (2013) provide a useful summary of past meliponine honey studies.

3.3 Meliponiculture in Thailand

Meliponiculture in Thailand could be characterized as in an incipient stage but expanding. We have observed in northern and central Thailand numerous cases of rural agriculturalists possessing one to a few stingless bee colonies, usually in log sections, but they are not in any sense managed or kept for economic gain. It was not until the past few decades that stingless bees have been managed as an economic enterprise on a scale significantly beyond the possession of a few colonies collected *in situ* from the

forests. Currently, larger scale stingless bee beekeeping is practiced in the Southeast region of Thailand centering around the provinces of Chanthaburi and Trat. This particular area in Thailand has a well-developed commercial fruit industry. Several decades ago orchardists began experimenting with the use stingless bees as supplemental pollinators for enhanced fruit production. Pollinated crops include rambutan (*Nephelium lappaceum*), mangosteen (*Garcinia mangostana*) and durian (*Durio zibethinus*). These tree fruit species represent major nectar and/or pollen resources as well as resin *i.e*., mangosteen. Following the successful development of colony management, especially protocols for the multiplication of colonies by divisions, it was obvious to the meliponiculturists that marketing honey and cerumen would provide additional gain to supplement the inherent economic value of pollination.

Not all stingless bee species are amenable for meliponiculture due to the nature of their mature tree cavity nesting habitats. However, several species are adaptable to human-made domiciles. In Southeast Asia the foremost among these are species in the *Tetragonula laeviceps* and *T. pagdeni* species complex which are very opportunistic in nest cavity selection and readily accept human-made domiciles. Other species presently being managed in Thailand include *Lepidotrigona flavibasis, L. doipaensis, L. terminata* and *Tetragonula testaceitarsis.* Hive architectures vary widely and include hive boxes of varying volumes, tree trunks and split logs which are then hollowed out by the beekeeper. There is not a standard size for stingless bee hives, and domiciles presently used can vary depending upon beekeeper preference.

Figure 3.4 *Lepidotrigona flavibasis* in a standard box hive design (a). Commercial meliponiary in a shade house (b).

During the past 20 years the number of stingless bee beekeepers in Thailand has been expanding. The sale of honey and wax (cerumen) now supports an industry of an estimated 700 beekeepers (DOAE, personal communication, February 2014). Most meliponiculturists have fewer than 3 years' experience, and own *ca*. 20-50 hives, however a smaller cadre have in excess of 10-15 years of experience and are individually managing more than 200 colonies. The collective number of colonies in the two provinces of Chanthaburi and Trat, where commercial meliponiculture is most developed in Thailand, is approximately 5,000 hives (DOAE, personal communication, February 2014)

Thai stingless bee honey retails for 1,200 – 1,500 THB ($37 - $47 USD) per kilogram, which is 10 times the price received for Thai produced *Apis mellifera* honey. While well documented colony honey production records are non-existent, our interviews with meliponiculturists in 2013 and 2014 suggest an average production of 500 grams per hive/year, which translates to a national honey production of *ca*. 2.5 - 3 metric tons per year, with a farm-gate value of 3,760,000 THB ($117,500 USD).

In addition to honey as a commodity, there is an active economic market for the wax (cerumen) with per kilogram returns of 1,500 – 2,000 THB ($47 - $62 USD). A reasonable average cerumen production is 200 gram/ hive / year, which represent a national farm-gate, value of *ca*. 2 million THB ($61,600 USD). Collectively honey and cerumen generate 5.76 million THB ($177,500 USD) to the regional economy. The primary marketing for both honey and cerumen is done in-country but a newly developed international market exports primarily to other Asian countries such as Malaysia, Brunei, Taiwan and Japan.

Honey and cerumen harvesting

Product harvesting is done twice a year, with the first extraction taking place in mid-March to mid-April. This marks the end of the dry season and follows the major blooming period of rubber (*Hevea brasiliensis*), mango (*Mangifera indica*) and rambutan. A second harvest occurs in November following the bloom of durian which is nearing the end of the wet season. Harvesting is done by removing the top cover of the hive, thus exposing the interior of the colony. A scraping tool or spoon is used to

remove the aggregate honey pots. This material is placed in plastic containers for later processing. The post-harvest separation of honey from the pots is done by allowing the honey pots to drain over a larger container that is covered by a fine nylon mesh. Following this gravity separation, the honey pots are hand compressed to recover the residual honey. The recovered honey is strained at least one additional time and left to settle in another container for as long as 30 to 45 days prior to bottling. Following honey drainage the cerumen is compressed into spheres and placed into plastic bags to be stored at ambient temperature until sold. Honey is normally retailed by weight in glass or plastic containers. Commonly used sales units are 300 g, 500 g and 1 kg. Home sales account for eighty to ninety percent of all honey and cerumen marketing.

Figure 3.5 In apiary *Tetragonula laeviceps*-pagdeni honey pot removal (a). Extracted honey pot of *Tetragonula laeviceps-pagdeni* (b).

Figure 3.6 Stingless bee honeys in settling containers following straining.

Figure 3.7 Bottled and labelled stingless bee honey for retail sale

Training and research programs

Numerous organizations are presently, or have in the past, been involved with stingless bee beekeeper training. First and foremost is the Thai Ministry of Agriculture's Department of Agricultural and Extension (DOAE) with a center located in the Chanthaburi province. In recent years this facility has focused primarily on meliponiculture. The stated objectives include training programs for those interested in becoming meliponiculturists and the existing stingless beekeeper cadre. Activities involve training in management techniques for dividing colonies, honey and cerumen collecting and processing, and the use of stingless bees as managed pollinators for the regional fruit production industry. The national Royal Project also is involved in meliponiculture training at their Kung Krabaen Bay Royal Development Study Center in the Chanthaburi province. This beekeeper training program is executed in collaboration with the Ministry of Agriculture.

An early academic program in the development of a viable stingless beekeeping industry was the work of Dr. Somnuk Boongird from Ramkhamhaeng University in Bangkok. He has conducted numerous workshops and training programs. Additionally he has authored a stingless bee beekeeping manual (Boongird, no date). There are currently numerous academic programs at Thai universities involved in a variety of stingless bee research programs; these include the Rajamankala University of Technology Thanyaburi located in Pathum Thani province with a program studying

stingless bee pollination and honey quality. Burapha University in Chonburi province investigates stingless bee propolis and cerumen. Additional work on the bioactivity of stingless bee propolis and honey is on-going at Chulalongkorn University in Bangkok. In northern Thailand stingless bee research programs occur at Chiang Mai University (stingless bee taxonomy and honey physicochemistry), Maejo University (stingless bee colony biology and management) and the University of Phayao (stingless bee biology).

We have witnessed the development of a small but thriving commercial use of stingless bees in Thailand over the past two decades. While the industry is still limited in geographical scope there are efforts to expand this specialized form of beekeeping to other areas of Thailand. This effort is fueled by academics at several institutions, the government through extension programs, and practicing stingless bee beekeepers. We anticipate the continued expansion of meliponiculture in future years *via* their use as managed pollinators as well as the economic benefits from the sale of honey and cerumen.