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Abstract. Southeast Asia is home for at least nine species of native honey bees one of them is Kelulut (stingless bee). The Kelulut is very valuable because it is a major pollinator for tropical plants. It provides significant income for some members of the local community, and it is an important component in the food network system. Besides, the Southeast Asian Dipterocarp forests, especially East and North Kalimantan, appear to be adapted to pollination by honeybees. Nowadays, global attention focuses on the threat of decreasing numbers of plants and pollination species, which have a direct impact on ecosystem function, especially to local and global bee biodiversity. Due to the current evidence of the decreasing number of bees accumulated in taxonomic and geographical scales, we decided to observe the role of Kelulut cultivation based on species and habitat approaches. Species biodiversity, population size, and growth rates are influenced by Spatio-temporal variations all of them have an important role in their vulnerability to extinction. Therefore, this will enhance our understanding of the factors and processes that are behind a decreasing number of bees and ensure the long-term survival of the bees and the important pollination services they provide.

1. Introduction

These bees are extremely valuable because they are key pollinators of crop species, provide significant income to some of the world's poorest people, and are prey items for some endemic vertebrates. Furthermore, Southeast Asian Dipterocarp forests appear to be adapted to pollination by honey bees. Thus, long-term decline in honey bee populations may lead to significant changes in the pollinator ecology of these forests, exacerbating the more direct effects of deforestation and wood harvesting on forest health. Although the complete extinction of any honey bee species is seen as unlikely, local extinction is likely to occur across extensive areas. The most significant threats to local honey bee populations are deforestation, and some of them are under threat of extinction due to the destruction of their natural habitat [1]. Like honey bees, stingless bees also can be used for pollination services of native or cultivated plants. Conservation of East Asian honey bees requires immediate action to determine what rate of colony harvesting by honey hunters is sustainable.

Stingless bees (Meliponini) are social bees confined to tropical and subtropical regions of the world [2]. Although stingless bees represent a small portion (2.5%) of more than 20,000 species of bees known worldwide, they are among the most ecologically, economically, and culturally important bees in the tropics and subtropics. They are the main pollinators of many native plants, which are

introduced and cultivated, and several species are managed to promote the pollination of various plants [3, 4]. Indigenous and non-Indigenous people in many regions of the world use honey, pollen, cerumen, and propolis from many species for a variety of purposes, including food, medicine, and crafts. In some cases, these bee products represent a unique or additional source of income or alternative medicines [5, 6]. Mayans and Aztecs used stingless bee in pre-Colombian times and that tradition survives in many regions of Mexico today [1, 5].

Despite the importance of stingless bees and many records about their nesting biology [2, 7], many basic aspects (for example, hive architecture) are still very poorly documented for most species, which is an obstacle to understand their evolution, ecology, and diversity [8]. Some of these nesting features are also useful in species recognition because many stingless bee species are very morphologically similar, and differences can be known based on the structure in the hive and the substrate of the hive [2]. Likewise, authentic and local knowledge about non-sting bees is still poorly documented and understood. Such knowledge is an invaluable component of our cultural capital but quickly disappears under the influence of globalization. It may not only inform us about alternative conservation practices to improve the health, abundance, and diversity of pollinators [5, 9] but also prove its usefulness in the introduction of new species [2].

Here, we documented the species of non-sting bee that was cultivated and the cultivation model. We also reported community knowledge in East and North Kalimantan about cultivation management techniques and practices. Based on biological and ecological information, we qualitatively assessed the cultivation interests of the stingless bee species and explored their relationship to their local abundance about conservation measures.

2. Materials and methods

A survey was conducted in terms of finding out species and cultivating techniques of stingless bee in East and North Kalimantan. Information related to the species and cultivating techniques was obtained by observing some stingless bee cultivation site from six locations which represent each research area. Sampling for East Kalimantan was conducted in Samarinda, Balikpapan, Penajam Paser Utara, Bontang, and Sangatta, while North Kalimantan samples were obtained from Tarakan (Figure 1). The survey was carried out from early January 2018 to March 2018.

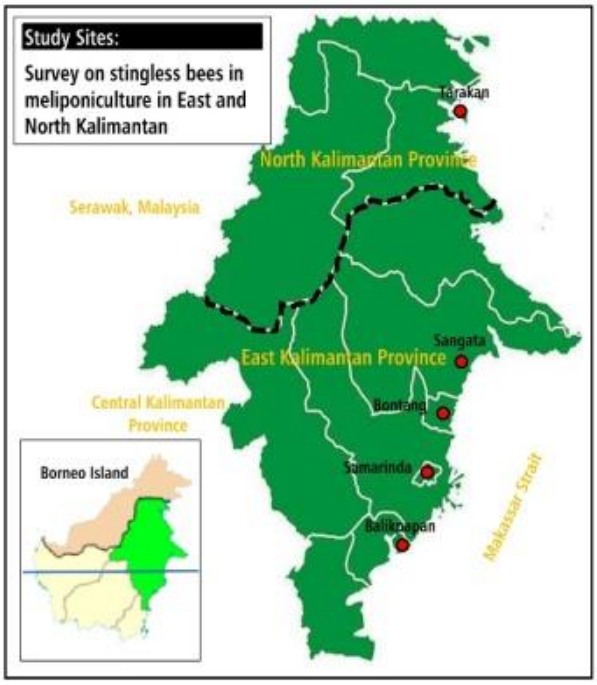

Figure 1. Map of study sites.

In this study, specimens were taken to Biology Labs of Universitas Mulawarman from cultivated species to inventory stingless bee species. Specimens were identified based on their morphological characteristics and identified using the taxonomic key from a former study about stingless bees [7, 10-14]. Morphometric characteristics were observed using the Nikon C-LEDS stereo microscope, which was equipped with a camera and Optilab Viewer. This study used interviews, direct observations, and documentation at the cultivations site to get the information about the methods and techniques of cultivating used by the beekeepers at each location. Also, the interviews were recorded on a notebook and voice recorder to document the names of species, uses of the bees, and their products.

3. Results and discussion

Natural stingless bee nests are built on tree trunks, wood, wall cracks, and under the roof of the houses. The nests are made of natural resin and wax, including the nest entrance to protect it from their enemies, such as ants and wasps. Stingless bees prefer hardwood trees such as Ulin (*Eusideroxylon zwageri* Teijsm & Binn.) when they want to make their nest. It can maintain the nest's temperature and humidity optimally. Stingless bee nests are so unique. They have some rooms arranged in a pollen storage room, honey storage room, and egg-laying room and interconnected with each other. The combs are built-in horizontal or vertical inside the tree. The nests also only have a single hole entrance and each nest only has a colony that consists of a queen, males, and workers.

Beekeepers and farmers in East and North Kalimantan recognize stingless bees by the name of Kelulut. Honey Kelulut has a unique taste that is a mix of sweet, sour, and bitter. Recently, many people pay attention to stingless bee honey. Therefore, people try to culture this bee. During the survey, we identified 12 stingless bee species and found two main species that are very good for Meliponiculture in East and North Kalimantan (Table 1), namely *Heterotrigona itama* and *Tetragonula laeviceps*. In cultivating stingless bees, communities use natural and artificial cultivation. For natural cultivation, cultivators just take the hive in the log by cutting down the tree or cultivators just take the nest from inside of the tree. There is a chance to meet a new species of stingless bee, but the colonies' life span becomes shorter because the stress levels get higher. Also, the taste of its honey is unpredictable. While artificial cultivation is an advanced process of natural cultivation and takes the hive from the tree as first stock, then split it into two different nests. In some cases, cultivators also make boxes and put them in the cultivation area.

Table 1. Kelulut (stingless bees) species and colonies (Melipononiculture).

No	Species	Site Area						Colony (n)	Percentage (%)
		SMD	BPN	PPU	BTG	SGT	TRK		
1	*Geniotrigona thoracica* Smith.	0	0	0	0	0	1	1	0.28
2	*Heterotrigona bakeri* Cockerell.	10	0	0	0	0	1	1	0.28
3	***Heterotrigona itama* Cockerell.**	**36**	**40**	**2**	**50**	**10**	**5**	**143**	**40.39**
4	*Lepidotrigona terminata* Smith.	0	0	2	0	2	0	4	1.13
5	*Homotrigona fimbriata* Smith.	1	0	0	0	0	0	1	0.28
6	*Tetragonula biroii* Friese.	0	20	0	0	5	0	25	7.06
7	*Tetragonula fuscobalteata* Cameron.	14	0	0	10	0	10	34	9.06
8	*Tetragonula iridipensis* Smith.	5	0	0	0	0	0	5	1.41
9	***Tetragonula laeviceps* Smith.**	**20**	**0**	**4**	**20**	**5**	**60**	**109**	**30.79**
10	*Tetragonula reepeni* Friese.	6	0	0	0	0	0	6	1.69
11	*Tetragonula sarawakensis* Schwan.	6	0	0	0	0	0	6	1.69
12	*Tetragonula testaceitarcis* Cameron.	10	0	2	0	5	2	19	5.37
	Total	98	60	10	80	27	79	354	

The table is about the number of stingless bee species and colonies which have been cultivated in East and North Kalimantan. *Heterotrigonaitama* Cockerell and *Tetragonulalaeviceps* Smith are the most cultivated species in those cities. Some endemic species just live in North Kalimantan, such as *Geniotrigona thoracica* Smith.

Throughout the world, bees are the most important pollinators, and their value to science and society is undeniable. They play an important role in ecosystem health and plant reproduction and, as a consequence, in general, food security. Among arthropods, they are famous for their high social and cultural values [13, 14]. The recent decline in bee populations and species diversity throughout the world has raised global environmental and economic problems because the loss of pollinators will negatively impact the global human diet and health and crop market economies, as well as the livelihoods of farmers and beekeepers [14, 15].

Stingless bees have populated Earth's tropical regions for over 65 million years, which is longer than *Apis* spp. (the stinging honey bees) have existed [2]. Both honey bees and stingless bees make honey in perennial nests founded by a swarm of sterile female workers and a queen. Colonies maintain workers at all times and also males during certain times of the year. However, stingless bees are 50 times more diverse than the honey bees and differ from them in many biologically significant ways [8]. Within the Family Apidae, stingless bees belong to the Tribe Meliponini. Considered eusocial non-Apis bees, meliponines have extremely diverse morphology, nest building (nidification) habits, behavior, and ecology. They are small to medium-sized bees (2–13 mm in length) (Figure 2) with considerable variation in colony population size (from several hundred up to more than 10,000 workers per colony). They also exhibit a high rate of brood production and require substantial pollen intake [8].

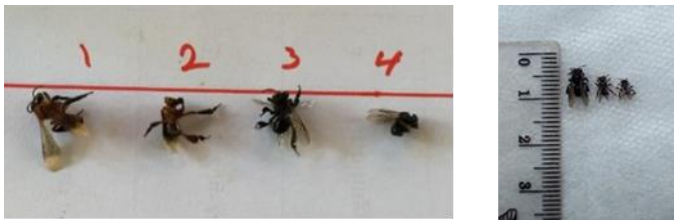

Figure 2. Species and sizes of Kelulut (stingless bees); 1. *Homotrigona fimbriata;* 2. *Geniotrigona thoracica;* 3. *Heterotrigona itama;* 4. *Tetragonula laeviceps.*

Figure 3. Meliponiculture in East and North Kalimantan.

Beekeeping and meliponiculture not only positively contribute to income gain, but also plays a role in increasing food security. Some communities in North and East Kalimantan already cultivate it with various methods, packing the honey, sell it to the local markets, and they also share their knowledges to other communities (Figure 3). However, beekeeping activity and its potential receive only subordinate attention within the Indonesian government and the public. According to scientists from Padjadjaran University (Dr. Mahani SP., M.Si., UNPAD, Bandung, Indonesia), bee businesses are mostly considered as a part-time farming activity. Not only parts of the local community, but also

people from every social class are not aware of the bees' benefits [3]. Those range from insufficient profitability, to fear of bee stings, to a lack of knowledge on the importance of bees as pollinators. Meliponines are a very promising social insect to be used as a commercial pollinator [16]. Because they do not have a sting, they are suitable as pollinators in greenhouses and residential environments. Also, their flying range is shorter than honeybees, which promote local foraging and can make it more efficient for closed or semi-closed pollination (e.g., greenhouses, hoop houses, and tunnels [4].

Based on field surveys with cultivators, the price of its honey is about 20 times more expensive than honey produced by other bees and also has great market demand. Therefore, in this research, efforts have been made to develop technology used by the people of East and North Kalimantan to increase honey production and quality. The resulting honey has a different color, smell, and taste. The components of honey are different from honey obtained from other bees. This honey is very nutritious and has good market demand. Stingless bees also act as important pollinators.

4. Conclusiont

From this study, twelve species of stingless bees were identified. The species were *Geniotrigona thoracica*, *Heterotrigona bakeri*, *H. itama*, *Lepidotrigona terminata*, *Homotrigona fimbriata*, *Tetragonula biroii*, *T. fuscobalteata*, *T. iridipennis*, *T. laeviceps*, *T. sapiens*, *T. sarawakensis*, and *T. testaceitarcis*. Meliponiculture in East and North Kalimantan is dominant to two species of stingless bees, namely *Tetragonula laeviceps* and *Heterotrigona itama*. The source of bee colonies is from nature. Then the colony propagation is done by the cultivation technique of the parent colonies. Cultivation as Meliponiculture can save species from extinction because there are many types of insects in nature that can provide welfare for humans. Meliponiculture is an ecological perspective. Kelulut cultivation is the livestock of hope. Kelulut has the advantage, such as no sting, easy on cattle, no need to be herded, adaptive, resistant to pests and diseases, easy to develop the colonies. Besides, it produces honey, beebread, and propolis.

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