West Sumatran Stingless Bees (Hymenoptera: Apidae: Meliponini): What can be told from its Local Distribution

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Abstract. Research on stingless bee at several Meliponiculture (stingless beekeeping) sites in West Sumatra, including at Universitas Andalas Campus Complex, had been conducted from April to December 2019 by using direct survey and direct collection methods on stingless bee worker at their colony entrances. A total of 18 stingless bee species that belong to five genera were collected. Tetragonula was the genus with the highest in species number (8), followed by Homotrigona (5) and Lepidoptrigona (3). Meanwhile, Heterotrigona and Geniotrigona were only represent by a single species each despite their popularity among West Sumatra beekeepers. Universitas Andalas Campus Complex harbours the highest species number of stingless bee (10), followed by stingless beekeeping site in Lubuk Minturun (7). Only 2-4 stingless bee species bred elsewhere stingless beekeeping sites. We presume that the difference of species number recorded in various stingless beekeeping sites indicated the complexity of this bee species within the variety of habitats.

Keywords: distribution, meliponiculture, stingless bee, West Sumatra

1. Introduction

Stingless bees are the smallest among honey bee species, which belong to the family Apidae and subfamily Meliponinae. Nevertheless, stingless bee group contains the largest and most diverse species of highly eusocial bee. There have been between 500-600 stingless bee species described from all over the world [1, 2]. As a tropical country, Indonesia becomes home for a high species diversity of stingless bees, especially those that restricted to tropical and subtropical habitats [3].

Stingless bees are active throughout the year and serve as generalist insects that collect nectar and pollen from various plant species [4]. Their nests were commonly found in holes in tree bark or branch, in soil cavity, rock crevice, house-wall cavity, and wooden house [5]. As social insects, they need considerable amount of pollen and nectar to support their colonies. By sheer number of their worker
individuals, stingless bees can serve as potential pollinator for various flowering plants. Stingless bees have prospect in assisting pollination at agricultural lands [6]. Lately, stingless beekeeping (meliponiculture) has become popular in Indonesia, due to considerable advantages comparing to the rearing of honey bees. Increasing number of consumers use bee pollen, honey and propolis produced by stingless bees [7]. Even the indigenous people, with their traditional wisdom and knowledge in relation to natural resources, have long understood and taken benefits from local stingless bee faunas in sustainable way. In other words, local people can culturally and financially get benefit from keeping the stingless bee [8].

Stingless bees are cold-blooded insects and sensitive to the changes in environmental temperature [3]. Their flying activity is influenced by internal and external (environment) of the colony [9]. Environmental conditions significantly relate to the activities inside colony. Include in this environment factors are temperature, relative humidity, season, light intensity and rainfall [10].

Since human understood the benefits of stingless bees, meliponiculture system has been developed at various levels by indigenous and modern societies throughout the equatorial [11]. Meliponiculture became popular due to stingless bee products such as honey, pollen, wax and propolis or cerumen. In overall, honey is considered to the most valuable product as it was thought to have benefit to health condition, even since the ancient times. The honey from stingless bees contains important compounds such as tannin, flavonoids, coumarin, and carbohydrates; in contrary, it is lack of steroids and carotenoids [12]. Even though the benefits of stingless bees have become common knowledge since while ago, the practice of meliponiculture in Indonesia hit its significance around a decade ago in 2010 [13]. Its popularity in West Sumatra was also developed during the same time, however, there is only a scanty scientific information regarding stingless bee species and its distribution. This study aimed to know the total stingless bee species in West Sumatra as well as their distribution in beekeeping sites in this province.

2. Methods

2.1. Study Site and Sampling Method

This research had been conducted from April to December 2019 by using direct sampling method to collect stingless bee species from beekeeping sites in West Sumatra (Figure 1 and 2). The sampling sites were coded with number in Figure 1 as follow; 1 = Universitas Andalas Campus Complex (UACC), Padang, 2 = Sungai Lasi, Solok, 3 = Kelok Macan, Sawahlunto, 4 = Jorong Rumbai Lalan, Sijunjung, 5 = Dasawisma Lalan, Sijunjung, 6 = YF Farm, Sijunjung, 7 = Sungai Dareh, Dharmasraya, 8 = Sei Sariak, Padang Pariaman, 9 = Pasa Telang, Sicincin, 10 = Tabek, Batusangkar, 11 = Padang Panjang, 12 = Dinas Kehutanan, Payakumbuh, 13 = Sarilamak, 50 Kota, 14 = Sianok, Bukittinggi, 15 = Solok Selatan, 16 = Ngungun Saok, Lubuk Minturun Padang. The specimen collected with pincers at the nest entrance then kept in vial filled with 96% ethanol so they were preserved until the next steps commenced.

2.2. Data Analysis

The stingless bee samples were sorted, photographed and identified at Laboratory of Taxonomy, Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Andalas, West Sumatra, Indonesia. Preserved specimens were then stored in the lab’s repository for future references. Identification key used proper reference for West Sumatra [14]. The data was tabulated with specific concern given to species inventory and their distribution across sites. The results were then thoroughly discussed.
3. Results and Discussion

In overall, the study recorded 18 stingless bee species from 15 stingless beekeeping sites and a natural habitat in UACC. There were observed variety of species number at every site, however, the sites with
proximity to dense vegetation, such as stingless beekeeping in Lubuk Minturun or UACC, tend to have more species (7 and 10 species, accordingly). While only 2 to 4 stingless bee species were recorded from stingless beekeeping sites, especially those located in urban or human affected environment (Table 1).

**Table 1. Information about locations and stingless bee species recorded at each sampling site in West Sumatra**

| No | Locations | Sites status and elevation | # Species recorded |
|----|-----------|---------------------------|-------------------|
| 1  | Universitas Andalas Campus Complex, Padang | Campus area and secondary forest, 200 m | 10 |
| 2  | Taruang Taruang, Sungai Lasi, Solok | Stingless beekeeping near settlement, 549 m | 3 |
| 3  | Karangayar, Kelok Macan, Desa Santur, Sawahlunto, Jorong Rumbai, Nagari Lalan, Sijunjung | Stingless beekeeping near settlement, 378 m | 3 |
| 4  | Dasawisma Taratak Bukik, Nagari Lalan, Sijunjung | Stingless beekeeping near settlement, 302 m | 2 |
| 5  | YF Farm, Nagari Lalan, Sijunjung | Stingless beekeeping at a farm, 187 m | 3 |
| 6  | Dharmasraya Lurah Ampalu, Sungai Sariak, Padang | Stingless beekeeping near settlement, 124 m | 2 |
| 7  | Pariaman | Stingless beekeeping near settlement, 77 m | 3 |
| 8  | Jorong Jambu, Nagari Tabek, Pariangan, Batusangkar | Stingless beekeeping near settlement, 670 m | 2 |
| 9  | Padang Panjang | Stingless beekeeping in Dena Farm, 848 m | 2 |
| 10 | Dinas Kehutanan Kota Payakumbuh | Stingless beekeeping in an office area, 500 m | 2 |
| 11 | Solok Selatan | Stingless beekeeping near house, 763 m | 4 |
| 12 | Jorong Lambah, Nagari Sianok, Bukittinggi | Stingless beekeeping near house, 810 m | 2 |
| 13 | Lubuk Minturun, Padang | Stingless beekeeping in adjacent to Secondary Forest, 340 m | 7 |

The number of stingless bee species in a certain location may correlate with plant diversity which provide food source (e.g. nectar, extrafloral nectarines, pollen or resin). Woody plants, such as tree, may provide nesting spots through natural hollow formed in it. Stingless beekeeping in Lubuk Minturun site (pointed with number 16 in Figure 1 and Table 1) had a mix between fruit plantation (e.g. *Durio zibethinus*, *Nephelium lapaceum*, and *Artocarpus heterophyllus*) with the remnant of wild flower and vegetation such as *Melastoma malabatricum*, *Piper auckland*, *Eupatorium odoratum* and *Sida*...
rhombifolia. Meanwhile, UACC that located 14 km eastern Padang City, the capital of West Sumatra, has 150-hectare, of total 500-hectare location, allocated for forested site which divided into three functional areas; Biology Educational and research Forest, Medicinal Plant Garden and Arboretum. In addition to that, the campus building also possessed potential for being habitat to stingless bees. Its surrounding was decorated with garden, greneries and shading trees such as Acasia mangium, A. auriculiformis, Terminalia catapa, Swietenia mahogany, Pinus mercusii, Morus macroura. These trees were mixed with ground vegetation such as Melastoma malabaricum, Glibadium surinamense, Hibiscus rosasinensis, Sida rhombifolia and Nyphaea sp. All of these plants provide nectar, pollen and resin whenever they bloom. There were 67 flowering plants from 31 families recorded and presumed to be food sources for stingless bees in UACC area (Herwina, unpub.). The more abundance flowering plants supply food resources, the more stingless bees stimulated to produce honey and other bee products [11]. Hence, the diversity of food recourses for stingless bees in UACC area could reasonably explain the high diversity of stingless bees at UACC and similar condition also observed at beekeeping site in Lubuk Mintrun.

Table 2. Distribution of stingless bee species across 16 sites in West Sumatra. Locations number refer to location remarks in Figure 1. Number 1 under location columns indicate species presence at that location.

| Species                              | Locations | Total |
|--------------------------------------|-----------|-------|
|                                      | 1  2  3  4  5  6  7  8  9  10  11  12  13  14  15  16 |       |
| Tetragonula reepeni                  |           | 1     |
| Tetragonula fuscobalteata            | 1  1  1   | 4     |
| Tetragonula testaceitarsis           |           |       |
| Tetragonula laeviceps                | 1  1  1  1  1  1  1  1  1  1  1  9     |
| Tetragonula minangkabau              | 1  1  1   | 3     |
| Tetragonula geissleri                | 1         |       |
| Tetragonula biroi                    |           | 1     |
| Tetragonula collina                  |           |       |
| Lepidotrigona nitidiventris          |           | 1     |
| Lepidotrigona ventralis              | 1         | 1     |
| Lepidoptrigona terminata             |           | 1     |
| Homotrigona (Tetrigona) apicalis     |           | 1     |
| Homotrigona (Tetrigona) binghami     |           | 1     |
| Homotrigona (Homotrigona) fimbriata  |           | 1  2  |
| Homotrigona (Sundatrigona) moorei    | 1         | 2     |
| Homotrigona (Lophotrigona) canifrons |           |       |
|                                      | 1  1  1  1  1  1  1  1  1  1  1  8     |
Geniotrigona thoracica

| Heterotrigona itama | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 12 |
|---------------------|---|---|---|---|---|---|---|---|---|---|----|
| Total               | 10| 3 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 4 | 7  |

*Heterotrigona itama* was recorded at 12 locations from 16 sites surveyed in this study (78%). This black and medium size stingless bee possesses considerable size honey pot and given bred within resourceful surrounding, a colony is able to produce 200-500 ml honey with additional propolis and bee bread monthly (Herwina, pers. obs.). Recall this significant potency, *H. itama* has been prioritized by most beekeepers, as seen in Table 2 above. On the other hand, *Geniotrigona thoracica* also create large honey pot, and produce sizeable honey volume per colony per month. This species also produces considerable amount propolis if their colony properly maintained (Herwina, pers. obs.). Additionally, it is also friendly and tranquil during the harvest of honey, bee pollen and propolis. It became the third most selected stingless bee (43%) for beekeeping in West Sumatra according to the finding of this study. In Malaysia, *G. thoracica* is bred in association with fruit plantation as it serves well as pollinator therein [15]. *Tetragonula laeviceps* that was recorded at 9 locations (50%) was actually the second favourite species in beekeeping. Albeit being common species in many sites in West Sumatra and easy to rear, the size and its relation to production volume may slightly decrease its potential as top choice for breeding.

Other 14 beekeeping sites were observed to have 2-4 stingless bee species. Beekeepers seemed to focus their attention on species like *H. itama* and *G. thoracica* as their more prominent potential as described above. The limitation of vegetation and other resources that may be unique for certain site were also thought to be determinant for number of species and colonies existing therein. *Tetragonula fuscobaeltata* and *T. minangkabau* favour parts of building or tree hollow to build their colonies, hence limit their existence to possible area with buildings and vegetation. On the other hand, some species were observed only from specific location. *Lepidotrigona terminata* was only recorded from Pariaman, similarly with *T. biroi* that observed only at Sijunjung. The UACC area remarkably hold five unique stingless bee species, the most single locality in this study. They were *Tetragonula repeeni*, *T. geissleri*, *Lepidotrigona nidiventris*, *L. ventarlis* and *Heterotrigona apicalis* (Table 2). Recently, the unique species *T. geissleri* and *L. nidiventris* were observed foraging, and possibly nesting, at area outside of UACC borders, emphasizing their prospect for colony expansion and possible domestication.

4. Conclusion
There were 18 stingless bee species recorded from various beekeeping and natural sites in West Sumatra. The observation indicated that beekeeping sites only maintained 2 to 4 stingless bee species, while beekeeping located in adjacent to secondary forest (Lubuk Minturun) or possessing forested area (UACC site) tend to have more stingless bee species, 7-10 species. Stingless bee *H. itama* was presumably the most favourite species for beekeeping in West Sumatra, as it was recorded at 78% of surveyed sites, followed by *T. laeviceps* (at 50% of sites) and *G. thoracica* (43% of sites).

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