Jurnal Biolokus: Jurnal Penelitian Pendidikan Biologi dan Biologi
Vol. 7, Issue 1, June 2024
Pages : 46 - 55

p-ISSN: 2621-3702
e-ISSN: 2621-7538

Identification of stinging bees (*Apis*) and stingless bees (*Meliponini*) in The Air Panas Hapanasan Springs Tourism Area, Rokan Hulu Regency

Jismi Mubarrak, Dahlia, Sonia*, Rena Lestari, Eti Meirina Brahmana
Department of Biology Education, Faculty of Teacher Training and Education, Universitas Pasir Pengaraian, Jl. Tuanku Tambusai, Kumu Rambah Hilir, Riau, 28557, Indonesia
*corresponding author: soniadaulay2020@gmail.com

ABSTRACT

Bees play a crucial role as pollinators, yet they still receive insufficient attention. This research aims to identify the species of stinging bees (Hymenoptera: Apidae: *Apis*) and stingless bees (Hymenoptera: Apidae: *Meliponini*) in the Hapanasan Hot Springs Tourism Area, Rambah Tengah Hulu Village, Rokan Hulu District. The study was conducted from January to June 2023 using a survey method with purposive sampling technique for sample collection. Bees collected were identified by describing their morphological characteristics. The stinging bee species identified include *Apis cerana*. The stingless bee species identified include *Tetrigona binghami, Heterotrigona itama, Geniontrigona thoracica, Lepidotrigona terminata, Lisotrigona carpenteri, Tetragonula testaceitersis, Tetragonula laeviceps, Tetragonula fuscobalteata, and Tetragonula clypearis.*

Keywords: *Apis,* bees, *Meliponini*, morphology, species

INTRODUCTION

Indonesia is a tropical country with thousands of islands situated between two continents and two oceans, making it incredibly biodiverse (Kemenhut, 2020). Insects, including bees, play a crucial role in biodiversity and the energy cycle in nature.

Bees are divided into three subfamilies: *Apinae* (honey bees), *Bombiinae* (bumblebees), and *Meliponinae* (stingless bees) (Supeno & Erwan, 2016). Honey bees can thrive in colder regions, whereas stingless bees are found in tropical and subtropical areas (Fadhila & Kiki, 2015). Bees have economic value due to their production of honey, propolis, and pollen. *Trigona* honey, for instance, is known for its high antioxidant content. Propolis also offers health benefits, such as wound healing and blood pressure reduction (Archyani & Dimas, 2019).

Rokan Hulu District, characterized by a tropical climate, boasts beautiful natural attractions, including the Hapanasan Hot Springs Tourism Area. This location features hot springs and a rich tropical forest teeming with biodiversity. Numerous bees nest in the large trees surrounding the area, benefiting from the abundant flowering plants that serve as their food source.

The Hapanasan Hot Springs Tourism Area also serves as a research and educational site, housing an Insectarium and a Butterfly Information Center used for educational tours and research activities. However, there is currently limited information available regarding the types of bees (*Apis* and *Meliponini*) present in this region. Therefore, research is needed to identify the bee species in this area, which could contribute valuable knowledge and serve as a foundation for bee-related studies in Rokan Hulu Regency.

METHOD

Location and time

This research was conducted from January to June 2023 in the Hapanasan Hot Springs Tourism Area, located in Rambah Tengah Hulu Village, Rambah District, Rokan Hulu Regency, Riau Province. The identification process was carried out at the Biology Education Laboratory, Faculty of Teacher Training and Education, Universitas Pasir Pengaraian.

The method used was a survey method employing purposive sampling technique.

Equipment and materials

The equipment used included a Global Positioning System (GPS), insect net, smartphone camera, writing materials, microscope, micrometer ruler, laptop, and the Image application. The materials used were latex gloves, 70% alcohol, plastic, and sample bottles.

Research procedure

In the field

The research was conducted by exploration; when nests were found, coordinates were determined using GPS. Exploration involved selecting points where trees with hollows and cracks in building walls around the tourist area served as nesting sites for bees. Latex gloves were worn before sampling. Sampling of honey bees (*Apis*) was performed using an insect net. Sampling of stingless bees (*Trigona*) involved covering the nest entrance with plastic and tapping the tree until the stingless bees entered the plastic. After obtaining the samples, they were placed in sample bottles and preserved with 70% alcohol.

In the laboratory

The collected samples were then dried by placing them on tissue paper in an open room. Once thoroughly dried, the samples were observed under a microscope for further analysis. Sample images were captured using a smartphone camera. Measurement of sample body parts was conducted using a micrometer ruler and ImageJ application on a laptop. Observations focused on the morphological characteristics of honey bees. Subsequently, honey bees were identified using reference books and journals.

Data analysis techniques

Data analysis in this research involved describing the morphological characteristics of the bees. Honey bees were identified and analyzed by describing the species using references such as "The Honey Bees (Hymenoptera: Apidae) of Bhutan with Key to the *Apis* Species" by Nidup and Dorji (2016) and "The Honey Bees of Indonesia" by Engel (2012).

Stingless bees were identified using references including "Pictorial Key to Indo-Malayan Stingless Bees" by Jalil and Ibrahim (2014), "A Key to the Genera and Subgenera of Stingless Bees in Indonesia (Hymenoptera: Apidae)" by Engel, Kahono, and Peggie (2018), "Natural History of Social Wasps and Bees in Equatorial Sumatra" by Roubik, Sakagami & Ohgushi (1990), and "*Tetragonula* Stingless Bees of the Continental Asia and Sri Lanka (Hymenoptera, Apidae)" by Sakagami (1978).

RESULTS AND DISCUSSION

Based on the conducted research, one species of stingless bee (Hymenoptera: Apidae: *Apis*) was identified, namely *Apis cerana*, found in 3 colonies. Additionally, nine species of stingless bees were found, namely *Tetrigona binghami*, *Heterotrigona itama*, *Geniontrigona thoracica*, *Lepidotrigona terminata*, *Lisotrigona carpenteri*, *Tetragonula testaceitersis*, *Tetragonula laeviceps*, *Tetragonula fuscobalteata*, and *Tetragonula clypearis*.

Table 1. The species of stinging bees found in the Air Panas Hapanasan Spring Tourist Area, Rokan Hulu Regency.

No	Species	Number of colonies
1	*Apis cerana*	3
	Total	3

Description of stinging bees

Figure 1. *Apis cerana.*

Apis cerana (Figure 1) has a body length of 11 mm. Its body is covered with brownish

hairs. The forewing measures 8.9 mm in length, while the hindwing measures 5.96 mm, with 17 hamuli present on the hindwing. The forewing of *Apis cerana* has dark-colored venation and a distinct vein M on the hindwing. The mandibles of *Apis cerana* are black at the base and brownish-yellow at the tips. The head consists of black scape antennae and a gray clypeus. In the thorax, the mesoscutellum is brownish-yellow. The propodeum of *Apis cerana* is bare and yellow in color. The hind tibia is dark brown to blackish.

This corresponds with Engel (2012), who states that *Apis cerana* has a vein M on the hindwing, a brownish-yellow mesoscutellum, forewing length of 7-9 mm, grayish clypeus, and dark brown to black scape. Nidup and Phurpa (2016) mention that *Apis cerana* resembles Apis mellifera but differs in having a vein M on the hindwing, whereas Apis mellifera lacks this feature, and *Apis cerana* measures approximately 9.52-12.67 mm. Nur'aini and Purwanto (2021) note that *Apis cerana* has a yellowish-brown propodeum without hairs, 17 hamuli on the hindwing, and black hind tibia.

Based on the observations during the research, *Apis cerana* nests in wood with crevices and in the walls of butterfly breeding buildings that also have crevices. In the second repetition, the species found in the wood crevices were blurred. In the third repetition, *Apis cerana* species were found on the floors of residents' wooden houses. This is in accordance with Supeno and Erwan's statement (2016) that in nature, these bees nest in tree cavities and stone crevices, as well as in wooden houses.

Table 2. The species of stingless bees found in the Hapanasan Hot Springs Tourism Area, Rokan Hulu District

No	Species	Number of colonies
1	*Tetrigona binghami*	1
2	*Heterotrigona itama*	2
3	*Geniontrigona thoracica*	1
4	*Lepidotrigona terminate*	5
5	*Lisotrigona carpenteri*	3
6	*Tetragonula testaceitersis*	2
7	*Tetragonula laeviceps*	4
8	*Tetragonula fuscobalteata*	1
9	*Tetragonula clypearis*	1
	Total	20

Description of stingless bees

Figure 2. *Tetrigona binghami*

Tetrigona binghami (Figure 2) has a body size of 7 mm. The length of its forewing is 7.35 mm and the hindwing is 5.18 mm. The hindwing has 7 hamuli, while the forewing exhibits two colors: dark at the base and white at the apex. The head of *Tetrigona binghami* is characterized by yellow hairs on the clypeus. Its antennae are brownish, with a yellow scape. The length of the malar space equals the diameter of the flagella. The thorax is covered with golden yellow hairs. The abdomen is dark black, while the propodeum lacks hairs. The hind tibia is blackish brown and densely hairy.

This aligns with Jalil and Ibrahim (2014), stating that *Tetrigona binghami* has 7 hamuli on the hindwing, with wing venation dark at the base and light or white at the apex, and the propodeum is glossy and hairless. According to Engel, Sih, and Djunijanti (2018), *Tetrigona binghami* has a smooth and hairless propodeum, a metabasitarsus area, and the malar space is equal to the flagella. Roubik, Sakagami, & Ohgushi (1990) describe *Tetrigona binghami* as having large teeth, forewings with two colors (dark brown at the basal and white at the apical part) with additional orange venation, a body size exceeding 5 mm, and forewing length over 6 mm.

Based on observations during the study, *Tetrigona binghami* was found only in one nest nesting in a large tree with cavities. Kerisna, Farah, and Raine (2019) also state that *Tetrigona binghami* nests in cavities naturally formed in tree trunks, which facilitates the stingless bees in nest construction.

Figure 3. *Heterotrigona itama*

Heterotrigona itama (Figure 3) has a black-colored body with a size of 6.2 mm. The length of its forewing is 6.71 mm and the hindwing is 4.53 mm. The hindwing has 7 hamuli, with wing venation in dark brown color. The head of *Heterotrigona itama* is characterized by a black clypeus. Its scape and flagella antennae are black. The width of the malar space equals the width of the flagella. The thorax has a short and hairy scutellum, with a black coloration. Its propodeum lacks hair, and its elliptical disc is blackish. The abdomen is black, while the scutellum is hairless. *Heterotrigona itama* has only one tooth on its mandible.

These characteristics are consistent with the description of *Heterotrigona itama* by Jalil and Ibrahim (2014), stating that it has a single small tooth on the mandible, 7 hamuli, a short and hairy mesoscutellum. According to Azizi, Priawandiputra, and Raffiudin (2020), *Heterotrigona itama* has black-colored flagella segments, a black clypeus, a short mesoscutellum, a hairless and glossy propodeum, and 7 hamuli. Suderajat, Riyanto, and Mulawarman (2021) mention that *Heterotrigona itama* has a black body, black scape and flagella, black clypeus, black mandible with a single tooth, black thorax, hairless propodeum, and brown-colored wings.

Based on observations during the study, *Heterotrigona itama* nests in trees with cavities. *Heterotrigona itama* was also found in cultivation boxes located at the research site. This is consistent with the statement by Febrianti, Iskandar, and Muflihati (2020) that *Heterotrigona itama* nests can be found within tree crevices. Similarly, Fadhilah, Dwi, and Yuliati (2022) found that *Heterotrigona itama* nests on tree trunks.

Figure 4. *Geniontrigona thoracica*

Geniotrigona thoracica (Figure 4) is a species that has the largest body size compared to other species found. Its body is reddish-black with a length reaching 8 mm. The length of its forewings is 8.64 mm and the hind wings are 5.97 mm long. The hind wings have 9 hamuli. The head of *Geniotrigona thoracica* is marked by a reddish-brown clypeus. The malar space is wider than the flagella. The thorax has a short scutellum. *Geniotrigona thoracica* has one large tooth and two small teeth on its mandibles. Its forewings have two colors, dark yellowish at the base and clear at the wingtips. The propodeum of *Geniotrigona thoracica* has a smooth and shiny texture.

This corresponds to the characteristics of *Geniontrigona thoracica* according to Jalil and Ibrahim (2014), stating that *Geniontrigona thoracica* has 2 membrane colors on the forewings, 9 hamuli, a short scutellum, malar space wider than flagella, smooth and shiny propodeum, and a body length of 8-9 mm.

Roubik, Sakagami, & Ohgushi (1990) mention that *Geniontrigona thoracica* has a smooth and shiny propodeum, inconspicuous mesoscutellum, elongated malar space, and a body that is black but very reddish.

Based on observations during the study, *Geniontrigona thoracica* was only found in cultivation boxes. Around the entrance, sticky resin was found. *Geniontrigona thoracica* has a large and round entrance. This is consistent with the statement by Sanjaya, Dwi, and Lolyta (2019) that *Geniontrigona thoracica* has a large entrance measuring 4 cm, which is due to its larger body size compared to other stingless bees.

Figure 5. *Lepidotrigona terminate*

Lepidotrigona terminata (Figure 5) has a body size of 6 mm. The length of its forewings is 5.5 mm and the hind wings are 3.33 mm long. The hind wings have 6 hamuli, with the forewings showing slightly transparent venation. The head of *Lepidotrigona terminata* is marked by a black clypeus covered with white hair. Its mandibles are yellowish-brown at the tips. The malar space is nearly equal to the diameter of the flagella. In the thorax, the mesoscutum and mesoscutellum have distinct yellow marginal lines. The scutellum is short. *Lepidotrigona terminata* has one large and coarse tooth and two small teeth on its mandibles. Its hind tibia is covered with fine hair.

These characteristics align with the features of *Lepidotrigona terminata* as described by Jalil and Ibrahim (2014), stating that it has distinct yellow marginal lines on the dorsal part, 6-8 hamuli, malar space nearly equal to the diameter of flagella, and fine hair on the hind tibia. Roubik, Sakagami, & Ohgushi (1990) mention that *Lepidotrigona terminata* has simple hair on the hind tibia, reduced wing venation, and body and forewing lengths of 5.5-6 mm respectively. Rachmawati et al., (2022) also state that *Lepidotrigona terminata* worker bees are predominantly black and yellow, with a black head and clypeus covered in white hair, and malar space equal to the flagella in size.

Based on observations during the study, *Lepidotrigona terminata* was found in cracks in the walls of Wisatamandala tourist buildings, hollow trees, and cultivation boxes at the research site. *Lepidotrigona terminata* has a long and soft entrance tube. The base of the tube is dark-colored while the tip is lighter in color. Iqbal, Defri, and Evi (2016) state that *Lepidotrigona terminata* lives colonially by building nests on tree trunks, bamboo, buildings, and in rock crevices.

Figure 6. *Lisotrigona carpenteri*

Lisotrigona carpenteri (Figure 6) has a body size of 4 mm. The length of its forewings is 2.7 mm and the hind wings are 1.9 mm long. The hind wings have 5 hamuli, with wing venation that is light in color. The head of *Lisotrigona carpenteri* is characterized by a yellow clypeus. Its scape antenna is yellow. The mandibles are brownish-yellow. The malar space is very short. Its hind tibia is covered with simple hair. The abdomen of *Lisotrigona carpenteri* is transparent.

These characteristics are consistent with Engel, Sih, and Djunijanti (2018), who state

that *Lisotrigona carpenteri* has forewing length less than 3 mm, greatly reduced wing venation, and malar space shorter than the diameter of the flagella. Jalil and Ibrahim (2014) mention that *Lisotrigona carpenteri* has 5 hamuli on the hind wings, a very small malar space, simple hair on the hind tibia, a yellow clypeus, and a body length of 4-4.2 mm. Roubik, Sakagami, & Ohgushi (1990) state that *Lisotrigona carpenteri* has a malar space smaller than the flagella.

Based on observations during the study, *Lisotrigona carpenteri* was found in cracks in the walls of butterfly breeding buildings located in the tourist area. This is consistent with Chinh et al. (2004) who stated that *Lisotrigona carpenteri* is found in brick walls, stone crevices, and elsewhere.

Figure 7. *Tetragonula testaceitarsis*

Tetragonula testaceitersis (Figure 7) has a body size of 4.35 mm. The length of its forewing is 4.37 mm and hind wing is 3 mm. The hind wing has 5 hamuli, with wing veins that are light-colored. The head of *Tetragonula testaceitersis* has a small malar space. Its antenna is dark brown and scape is brown. The mandibles have two large dark brown teeth. The head, thorax, and abdomen are entirely black. In the thorax, the scutellum protrudes backwards. There are white hairs around the propodeum. The hind tibia is black.

This corresponds with Jalil and Ibrahim (2014) stating that *Tetragonula testaceitersis* has 5 hamuli, a protruding scutellum extending far backwards, and a very short malar space. According to Samsudin, Mohd, and Izfa (2017), the body length of *Tetragonula testaceitersis* ranges from 4.30 to 4.90 mm, its wing veins are weak, it has 5 hamuli, two large teeth, a black head, a brown clypeus covered with white hairs, brown scape, black mandibles, black mesoscutum, black hind tibia and basitarsus, and a dark brown scutellum.

Based on observations during the study, *Tetragonula testaceitersis* was only found in cracks in walls. *Tetragonula testaceitersis* has a unique entrance tube that differs from other *Tetragonula* species. Sanjaya, Dwi, and Lolyta (2019) mentioned that *Tetragonula testaceitarsis*, also known as sun stingless bee, has an entrance tube that resembles the sun, extending in and out.

Figure 8. *Tetragonula laeviceps*

Tetragonula laeviceps (Figure 8) has a shiny body with a size of 4.4 mm. The length of its forewing is 5 mm and hind wing is 2.64 mm. The hind wing has 5 hamuli, with light-colored wing veins. The head of *Tetragonula laeviceps* is characterized by a black clypeus covered with white hairs. Its scape is brownish-yellow. The compound eyes are brownish. The malar space is very short. *Tetragonula laeviceps* antenna has the first flagellomere brown, while the second to last are dark brown. The abdomen is brownish. *Tetragonula laeviceps* has two small teeth.

This aligns with the characteristics of the genus *Tetragonula* as described by Jalil and Ibrahim (2014) stating that *Tetragonula laeviceps* has 5 hamuli, a scutellum that protrudes long backwards, and a very short

malar space. Roubik, Sakagami, & Ohgushi (1990) mention that *Tetragonula laeviceps* is small-sized with a predominantly dark body. Rachmawati et al. (2022) state that overall, *Tetragonula laeviceps* is dark brownish-black in color, has a very short malar space, a black clypeus covered with white hairs, brownish-black compound eyes, 5 hamuli, and 2 teeth on the mandibles. Sakagami (1978) also notes that *Tetragonula laeviceps* typically has a body size less than 4.6 mm, forewing length of 4.8 mm, and a metasoma that is partly dark to brown.

Based on observations during the study, *Tetragonula laeviceps* nests in trees with cavities. Supratman (2018) also states that trees are the most common type of nesting site for *Tetragonula laeviceps*.

Figure 9. *Tetragonula fuscobalteata*

Tetragonula fuscobalteata (Figure 9) has a body size of 3.33 mm. The length of its forewing is 3 mm and hind wing is 2 mm. The hind wing has 5 hamuli, with light-colored wing veins. The head of *Tetragonula fuscobalteata* is characterized by a brown clypeus covered with whitish-silver hairs. The malar space is short. *Tetragonula fuscobalteata* has one large tooth and one small tooth on its mandibles. In the thorax region, its propodeum is smooth. The hind tibia has branched hairs, and there are fine hairs on its basitarsus. The abdomen of *Tetragonula fuscobalteata* has two colors, brown at the base and at the tip.

This corresponds with the characteristics of the genus Tetragonula as described by Jalil and Ibrahim (2014), stating that Tetragonula fuscobalteata has 5 hamuli, a scutellum that protrudes long backwards, and a very short malar space. Sakagami (1978) mentions that Tetragonula fuscobalteata is very small, with a body size less than 3.9 mm and forewing less than 3.9 mm. Azizi, Priawandiputra, and Raffiudin (2020) state that *Tetragonula fuscobalteata* is smaller in size compared to *Tetragonula laeviceps*, has 5 hamuli, a brown clypeus covered with white hairs, a prominent mesoscutellum that extends backwards, and a smooth and shiny propodeum.

Based on observations during the study, *Tetragonula fuscobalteata* nests in wooden huts with cavities around the tourist area. This corresponds to the findings of Fadhilah, Dwi, and Yuliati (2022) that *Tetragonula fuscobalteata* builds nests in crevices of wooden structures.

Figure 10. *Tetragonula clypearis.*

Tetragonula clypearis (Figure 10) has a body size of 3.27 mm. The length of its forewing is 3.44 mm and hind wing is 3.2 mm. The hind wing has 5 hamuli, with light-colored wing veins. The head of *Tetragonula clypearis* is characterized by a malar space shorter than the antenna. Its scape is yellowish-brown. The thorax of *Tetragonula clypearis* is black. The central part of its propodeum lacks hair and is shiny. The abdomen is dark brownish-black in color. Its flagellum is dark brown.

This description aligns with the characteristics of the genus *Tetragonula* as described by Jalil and Ibrahim (2014), stating that *Tetragonula clypearis* has 5 hamuli, a scutellum that protrudes long backwards, and a very short malar space.

Dollin, Leslie, Shoichi (1997) state that workers of *Tetragonula clypearis* measure 3.2-3.7 mm in length, with forewing lengths of 3.4-3.7 mm, black heads and mesosomas, and orange to brown scapes and flagella. Lamerkabel et al. (2021) mention the morphological characteristics of the genus *Tetragonula*, including having 2 small teeth, a malar space shorter than the antenna segment, a shiny and hairless propodeum, and 5 hamuli. Lamerkabel et al. (2021) describe *Tetragonula clypearis* as having a black coloration, body sizes ranging from 2.81-3.38 mm, black thoraxes, transparent wings, and dark brownish-black abdomens.

Based on observations during the study, *Tetragonula clypearis* nests in tree trunks with cavities around the tourist area. Erwan, Munaris, Muhammad (2022) state that *Tetragonula clypearis* typically builds nests in tree cavities.

The Hapanasan Hot Springs Recreational Area is located in Rambah Tengah Hulu Village, Rambah District, Rokan Hulu Regency, approximately 9 km from Pasir Pengaraian City Park, Rokan Hulu Regency, Riau Province. In the context of bee bioecology, the presence of this area can serve as a potential habitat for various bee species sensitive to the environment. The preserved biodiversity of the area provides optimal conditions for bees to perform pollination processes and maintain a balanced ecosystem cycle. Further studies on bee bioecology in this area can provide profound insights into the interaction of bees with local flora and their role in environmental sustainability.

To support this discussion, references from relevant research can serve as a strong foundation. Previous studies that have addressed bee bioecology and tropical ecosystems can provide a deeper understanding of the importance of preserving recreational areas such as Hapanasan Hot Springs as natural habitats for bees and other ecosystems.

The surroundings of the Hapanasan Hot Springs Recreational Area encompass various ecosystem types such as rivers, forests, and plantations. Large hollow trees around the Hapanasan Hot Springs Recreational Area are used as nesting sites by bees. There are also numerous flowering plants around the recreational area that serve as food sources for bees, such as guava trees, coconut trees, oil palm trees, jackfruit trees, mango trees, rubber trees, and other flowering plants.

CONCLUSION

The research identified stingless bee species (Hymenoptera: Apidae: *Meliponini*) and honeybee species (Hymenoptera: Apidae: *Apis*) in the Hapanasan Hot Springs Recreational Area, Rambah Tengah Hulu Village, Rokan Hulu Regency. The honeybee species found include *Apis cerana.* The stingless bee species found include *Tetrigona binghami, Heterotrigona itama, Geniontrigona thoracica, Lepidotrigona terminata, Lisotrigona carpenteri, Tetragonula testaceitersis, Tetragonula laeviceps, Tetragonula fuscobalteata, and Tetragonula clypearis.*

Further research is recommended on the morphometrics of honeybees (Hymenoptera: Apidae: *Apis*) and stingless bees (Hymenoptera: Apidae: *Meliponini*). It is also suggested to conduct studies in different villages and districts to identify the species, habitats, and morphometric characteristics of honeybees and stingless bees that have not yet been discovered.

REFERENCES

Archyani & Dimas, W. (2019). *Kiat Praktis Budi Daya Lebah Trigona* (*Heterotrigona itama*). Laduny.

Azizi, M.G., W.P., & R.R. (2020). Morphological identification of stingless bees from Belitung. *The 3rd International Conference on Biosciences.* 1-8.

Chinh, T.X., Marinus, S.J., Willem, J.B., & Charles, D.M. (2004). Nest architecture and colony characteristics of three stingless bees in North Vietnam with the first description of the nest of Lisotrigona carpenteri Engel

(*Hymenoptera: Apidae, Meliponini*). *Journal of the Kansas Entomological Society*, *80*(2), 130-135.

Dollin, A.E., Leslie J.D., & Shoichi, F.S. (1997). Australian Stingless Bees of the Genus Trigona (*Hymenoptera: Apidae*). *Jurnal Biosystematics Invertebrate Taxonomy*, *11*, 861-896.

Engel, M.S. (2012). The Honey Bees of Indonesia (*Hymnoptera: Apidae*). *Jurnal Treubia*, *39*, 41-49.

Engel, M.S., Kahono, S., & Peggie, D. (2018). A Key to The Genera And Subgenera of Stingless Bees In Indonesia (*Hymenoptera: Apidae*). *Jurnal Treubia, 45*, 65-84.

Erwan, Munaris, & Muhammad, M. (2022). Study of Morphological and Morphometric Characteristics of Worker Bees *Tetragonula clypearis* in North Lombok Regency, West Nusa Tenggara Province, Indonesia. *Jurnal Biologi Tropis, 22*(3), 989 – 998.

Fadhilah, A., Dwi, A., & Yuliati, I. (2022). Inventarisasi Potensi Sarang Kelulut (*Trigona Spp*) Dan Deskripsi Habitatnya Dikawasan RTH Kampus Universitas Tanjungpura Pontianak. *Jurnal Hutan Lestari, 10*(4), 949 – 961.

Febrianti, Iskandar, A., & Muflihati. (2020). Bentuk Pintu Masuk Sarang *Trigona Spp* Di Kawasan Hutan Mangrove Surya Perdana Mandiri Kelurahan Setapuk Besar Singkawang Utara. *Jurnal Hutan Lestari*, *8*(3), 620 – 627.

Fadhila, R. & Kiki, R. (2015). *Laba Lebah Tanpa Sengat, My Trubus Potential Business.* Trubus Swadaya.

Iqbal, M., Defri, Y.D., & Evi, S.B. (2016). Karakteristik Habitat *Trigona* spp. Di Hutan Larangan Adat Desa Rumbio Kabupaten Kampar. *Jurnal Faperta*, *3*(2), 1-5.

Jalil, A. H. & Ibrahim, S. (2014). Pictorial Key to Indo-Malayan Stingless Bees. *17th Congress of the International Union for the Study of Social Insects (IUSSI)*, Cairns, Australia.

Kementrian Lingkungan Hidup dan Kehutanan. (2020). *Status Hutan & Kehutanan Indonesia 2020 : XXVII*.

Kerisna, V., Farah, D., & Raine, S.W. (2019). Identifikasi Jenis Lebah *Trigona spp*. Pada Zona Pemanfaatan Hutan Desa Menua Sadap Kecamatan Embaloh Hulu Kabupaten Kapuas Hulu. *Jurna Tengkawang, 9* (2)**,** 82-91.

Koetz, A. (2013). *The Asian Honey Bee (Apis cerana) and Its Strains - with Special Focus on Apis cerana Java Genotype.* Queensland Government.

Kwapong, S.P., Kwame, A., Rofela, C., & Afia, K. (2010). *Stingles Bees Importance, Managenent And Utilisation A Training Manual For Stingless Beekeeping.* Unimax Macmillan LTD.

Lamerkabel, J.S.A., Victor, G.S., Wulandari, S., Anang, L., Mochammad, J., Erwan, Jati, B., Firman, J., & Dewi, M. (2021). Karakteristik Morfologi dan Morfometrik Lebah Madu Tak Bersengat (*Apidae; Melliponinae*) pada Koloni di Daerah Pesisir Pulau Ambon. *Jurnal Budidaya Pertanian, 17*(1), 28-35.

Nidup, T. & Dorji, P. (2016). The Honey Bees (*Hymenoptera: Apidae)* of Bhutan with Key to the Apis Species*. Jurnal Bio Bulletin, 2*(2), 01-07.

Nur'aini & Purwanto, H. (2021). Morphology, morphometrik, and molecular characteristic of *Apis cerana* and *Apis nigrocincta* from central Sulawesi, Indonesia*. Jurnal Biologi Tropis, 21*(2), 368-382.

Rachmawati, R.D., Ali, A., Nafiatul U., Agussalim, & Hari P. (2022). Diversity, distribution, and nest characteristics of stingless bees (*Hymenoptera*: *Meliponini*) in Baluran National Park, East Java, Indonesia*. Jurnal Biodiversitas*, *23*(8), 3890-3901.

Roubik, D., Sakagami, S.F., & Ohgushi, R.

(1990). *Natural History of Social Wasps And Bees In Equatorial Sumatra*. Hokkaido University Press.

Sakagami, S.F. (1978). Tetragonula Stingless Bees of the Continental Asia and Sri Lanka (*Hymenoptera, Apidae*). *Jurnal Zoology, 21*(2), 165–247.

Samsudin, S.F., Mohd, R.M., & Izfa, R.H. (2017). Taxonomic Study on Selected Species of Stingless Bee (*Hymenoptera: Apidae*: Meliponini) in Peninsular Malaysia. *Serangga, 23*(2), 203-258.

Suderajat, A., Riyanto., & Mulawarman. (2021). The Types of Trigona Bee (*Apidae: Meliponinae)* in Three Different Habitat in South Sumatra. *Jurnal Biologi Tropis, 21*(1), 206-2012.

Sanjaya, V., Dwi, A., & Lolyta, S. (2019). Studi Habitat Dan Sumber Pakan Lebah Kelulut Di Kawasan Cagar Alam Gunung Nyiut Desa Pisak Kabupaten Bengkayang. *Jurnal Hutan Lestari*, *7*(2), 786-798.

Supeno & Erwan. (2016). *Pengenalan pembelajaran tentang lebah madu* (*Honey Bees*). Arga Puji Press.

Supratman. (2018). *Karakteristik Habitat Tempat Bersarang Lebah (Trigona sp) Di Desa Pelat Kecamatan Untir Iwes Kabupaten Sumbawa Provinsi Nusa Tenggara Barat* [Skripsi]. Universitas Muhammadiyah Makasar.

Syafrizal, A.A., Bratawinata, M., Sila, D., & Marji. (2012). Jenis Lebah Kelulut (*Trigona* spp.) Di Hutan Pendidikan Lempake. *Jurnal FMIPA Mulawarman Scientifie*, *11*(1), 11-18.