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Inventory of Stingless Bees in Customary Forest of Imbo Putui, Kampar Regency, Indonesia

Yana Yunisa Marsya[1], Novia Gesriantuti[1], Yeeri Badrun[1], Nuskan Syarif[2], Said Faizan Tas'ad[3]

[1]Department of Biology, Faculty of Mathematics, Natural Sciences and Health, Universitas Muhammadiyah Riau, Pekanbaru, Indonesia
[2]Civil Alliance of Adat Nusantara, Siak Hulu District, Kampar Regency, Indonesia
[3]Management Institution of Customary Forest of Imbo Putui, Kampar Regency, Indonesia

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Abstract. Information on stingless bee diversity in customary forest of Imbo Putui is still lacking so there is no data of stingless bees in the forest. The purpose of this study was to identify the species of stingless bees found in Imbo Putui customary forest. The search for stinglees bee nests was carried out using exploration method in three predetermined areas. The area was roadside (Zone I), inside the forest (Zone II), and around the river and oil palm plantation (Zone III). Data analysis was carried out quantitative descriptive. The result of the study found 7 species of stingless bees, 4 species of which with majority conservation status were found, namely *Heterotrigona itama, Tetragonula laeviceps* (yellow, black), *Tetragonula drescheri* and *Tetragonilla collina*. Meanwhile minority species found are *Tetragonula iridepennis*, *Homotrigona fimbriata* and *Tetragonula testaceitarsis*. Base on presence of 3 species that are classified as minorities found, it can be conclude that the ecosystem of Imbo Putui customary forest is still maintained and has not experienced significant changes.

*Corresponding author.
E-mail address: yanayunisa28@gmail.com

1. Introduction

Bees are one of the social insects that produce honey and can thrive in varied habitat conditions. Bee habitats can generally be found in places that have holes such as caves, trees that have holes, dead trees, soil, pipes, rock crevices, bamboo and buildings. Most bees make nests in natural environmental conditions that are close to the reach of bees to obtain food, such as in forest locations, mountains and areas that have abundant vegetation (Monita, 2023).

A species of bee that has attracted public attention in recent years is the stingless bee. The distribution of stingless bees in Indonesia is very diverse, in Sumatra there are 31 species, in Kalimantan

there are 40 species, in Java there are 14 species, in Sulawesi there are 3 species (Hidayat, 2021). Several studies on stingless bee species have been conducted in various countries.

Research on stingless bee species that have been conducted abroad include Li et al., (2021), in their research in Yunnan, Southwest China, 7 types of stingless bees were found, namely *Tetragonula collina, Lepidotrigona flavibasis, Lepidotrigona terminate, Tetragonula laeviceps, Tetragonula gressitti, Lisotrigona carpenter* and *Tetragonula pagdeni. Furthermor*e, in a study by Gonzalez *et al,* (2022), in South-Central Western Mexico, Michoacan State found 13 species of stingless bees namely *Melipona lupitae* Ayala, *Plebeia frontalis* Friese, *Plebeia moureana* Ayala, *Trigona fulviventris* Guérin, *Trigonisca pipioli* Ayala, *Frieseomelitta nigra* Cresson, *Scaptotrigona hellwegeri* Friese, *Lestrimelitta chamelensis* Ayala, *Geotrigona acapulconis* Strand, *Nannotrigona perilampoides* Cresson, Partamona bilineata Say, *Melipona fasciata* Latreille and *Plebeia fulvopilosa* Ayala

Some of the stingless bee inventory studies in Indonesia include Kerisna *et al*, (2019), in their research in the Forest Utilisation Zone of Menua Sadap Village, Embaloh Hulu District, Kapuas Hulu Regency found 8 species of stingless bees including *Geniotrigona lacteifasciata* Cameron, *Tetrigona binghami* Schwarz, *Heterotrigona itama* Cockerell, *Tetragonula collina* Smith, *Lepidotrigona terminana* Smith, *Tetragonula sirindhornae* Michener & Boongird, *Tetragonula laeviceps* Smith, *Tetragonula fuscobaltaeta* Cameron. Furthermore, in the research of Fadhilah *et al.* (2022), in the Green Open Space Area of Tanjungpura University Campus Pontianak, 3 types of stingless bees were found, namely *Heterotrigona itama*, *Tetragonula fuscobalteata* and *Tetragonula laeviceps.* Furthermore, Hidayat *et al.* (2022), in their research in Merangin Village, Bukit Bungkuk Nature Reserve Area Riau, found as many as 2 stingless bee colonies.

The survival of stingless bees is influenced by various environmental factors such as temperature, humidity, altitude, rainfall, light intensity. This is supported by the statement of Syafrizal *et al.*, (2014), that stingless bees (*Trigona* spp.) Their life is influenced by air temperature which ranges from 28 - 36 ℃. Monita (2023) states that the altitude of the place if it is above 700 mdpl is categorised as highland, medium with an altitude range of 200 - 700 mdpl, and the altitude of the place is less than 200 mdpl including lowlands. In addition, environmental conditions also affect the number of stingless bee species. Handoko & Hidayatullah (2019) state that bees will migrate if there is a disturbance in environmental conditions and will have an impact on the peace or comfort of honey bees.

Forests are excellent habitats for providing all the needs of bees. One forest that is currently estimated to still have a diversity of stingless bees is the Imbo Putui customary forest, Kampar Regency. The Hutan Imbo Putui is recognised by the state as a customary forest. Until now, the potential of Imbo Putui customary forest has been developed into nature tourism including stingless bee cultivation and research locations for students (Lestari, 2022).

Based on literature studies and according to the explanation of the Customary Forest Management Agency (LPHA), information on the diversity of stingless bee species in the Imbo Putui customary forest is still lacking and there has been no research on stingless bee species in the Hutan Imbo Putui. So there is no accurate data on the types of stingless bees in the forest. Therefore, it is necessary to research the diversity of stingless bees in the Imbo Putui customary forest. The data generated from this research is expected to help indigenous forest managers in developing a management plan for stingless bee species diversity.

2. The Methods

2.1 Research Design

This research is quantitative descriptive research. Quantitative descriptive research is a method of collecting and analyzing data to understand the characteristics of a phenomenon.

The design used in this study is to use the cruising method with a path length of 2000 m in each area in sampling in the Imbo Putui customary forest, Petapahan Village, Tapung District, Kampar District, Riau Province.

2.2 Tools and material preparation

Initial preparation was carried out by preparing tools and materials that would be used during the research and conducting a survey of stingless bee sampling locations using purposive sampling techniques with 3 different regional conditions. After surveying the sampling location, continued with making a map that included coordinate points.

Tools used in this study are binoculars, insect nets, bottle killing, sample bottles, digital thermohygrometer, binocular microscope, mobile phone camera, insect needle, magnifying glass, tweezers, container, machete, stationery.

Materials used were stingless bee samples, medical cotton, label paper, papillot paper, millimetre paper, 70% alcohol, A4 paper, Indo-Malayan Stingless Bees identification guidebook (e-book) by Jalil & Shuib (2012).

2.3 Range site selection

The first step in range site selection uses the range method. The roaming method was used to inventory stingless beehives in the Imbo Putui customary forest. Based on discussions with the Adat Forest Management Agency (LPHA), there are several areas that are not allowed to be explored because they are restricted areas. Therefore, 3 areas were taken to represent the entire forest. Area I is on the roadside, Area II is in the middle of the forest and Area III is around the oil palm plantation area and the river. The starting point of the exploration starts from the beginning of entering the forest and follows the existing tracking path in the Imbo Putui customary forest with a path length of 2000 m in Region I. The same goes for Regions II and III. And so on for Regions II and III. Exploration locations can be seen in Figure 1 below.

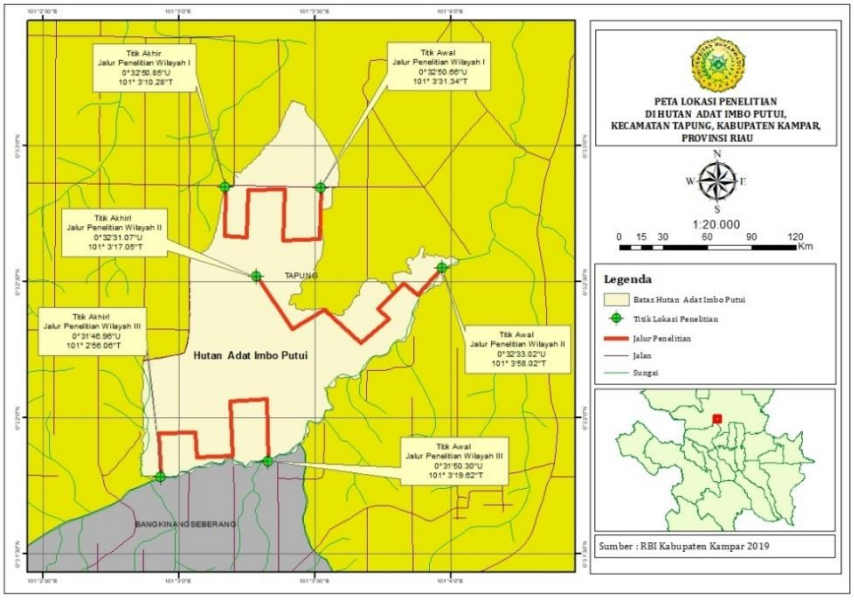

Figure 1. Research site area in the customary forest of Imbo Putui.

2.4 Stingless bee inventory and collection

The first step of this research is to conduct a stingless bee nest inventory to find stingless bee nesting points. If a stingless bee nest is found, the shape parameters of the stingless bee entries are observed directly and documented using a mobile phone camera. Furthermore, the number of stingless bee

colonies was counted and the colony counts obtained were recorded in a notebook. After that, stingless bees were sampled using an insect net.

2.5 Preservation of stingless bee samples

Stingless bee samples obtained are preserved by placing them in a killing bottle containing cotton wool and 70% alcohol. Then the stingless bee samples that have been preserved are stored using sample bottles and labelled.

2.6 Environmental parameter measurement

Observations of environmental parameters (air temperature and humidity) were made using a digital thermohygrometer. The digital thermohygrometer was placed on the ground until the numbers stopped to get the results of air temperature and soil moisture. The results obtained were recorded in a notebook and documented with a mobile phone camera. Furthermore, all samples that have been obtained are taken to the Biology Laboratory for identification.

2.7 Identification of stingless bee samples

Samples obtained were identified by looking at the morphology of stingless bees under a binocular microscope. Then the morphological samples of stingless bees are documented. The morphology of stingless bees seen under the microscope is matched with the identification guidebook (e-book) of Indo-Malayan stingless bees by Jalil & Shuib (2012). Furthermore, morphometric measurements of stingless bees ranging from overall length, head length, abdomen length, thorax length and wing length were measured using a ruler. Then the measurement results were documented and recorded in a notebook.

2.8 Population and samples

The population in this study were stingless bees in the customary forest of Imbo Putui. While the sample used is stingless bees taken from 3 areas with each path length measuring 2000 m.

2.9 Data collection techniques

Data collection techniques were carried out using the roaming method. In this case, it is done by observing the morphology of stingless bees, measuring the morphometry of stingless bees, measuring the number of stingless bee colonies, observing the shape of stingless bee entries and measuring environmental factors (temperature and humidity). Morphological observations of stingless bees were made using a binocular microscope and morphometric measurements of stingless bees were made using a ruler. After that, the results of morphological observations and morphometric measurements of stingless bees were matched with the identification guidebook (e-book) of Indo-Malayan Stingless Bees by Jalil & Shuib (2012). Furthermore, documentation was carried out on samples that had been identified.

2.10 Data analysis

Data on stingless bee species, stingless bee morphology and morphometry, number of stingless bee colonies, shape of stingless bee entries and supporting data on environmental parameters (temperature and humidity) are displayed in the form of tables and figures. The data obtained were analysed quantitatively, namely on data on the type of stingless bees, stingless bee morphometry and the number of colonies which were then described descriptively and supported by stingless bee morphology data, the shape of stingless bee entries, environmental factors in the form of ambient temperature and humidity. Based on conservation status, if the stingless bee species data obtained has the majority of the number found, the Imbo Putui customary forest ecosystem is still maintained and has not undergone

significant changes. However, if the stingless bee species data obtained has a minority number, Imbo Putui customary forest has undergone changes or there is a disturbance to the forest

3. Result and Discussion

3.1 Stingless bee species in the Imbo Putui customary forest

Identification results of stingless bee species in the Imbo Putui customary forest are founded 38 colonies, 7 species, 4 genus and 1 family bees which can be seen in Table 1.

Table 1. Types of stingless bees in the Adat Forest of Imbo Putui

Family	Genus	Species	Region			Total colonies
			I	II	III	
Apidae	Tetragonilla	*Tetragonilla collina*	15	3	8	26
	Tetragonula	*Tetragonula laeviceps yellow*	1	0	1	2
		T. laeviceps black	1	1	0	2
		T. iridepennis	0	1	0	1
		T. drescheri	0	1	1	2
		T. testaceitarsis	0	1	0	1
	Heterotrigona	*Heterotrigona itama*	0	3	0	3
	Homotrigona	*Homotrigona fimbriata*	0	1	0	1
		Total colonies	17	11	10	38

Based on Table 1 above, it shows that the highest number of stingless bee species is the type of *T. collina* which can be found in Regions I, II and III. *T. collina* is a common species and is easily found in various habitats. This is supported by the statement of Hudaya (2019), that the most popular stingless bee species and have a wide distribution pattern are the species of T. *laeviceps, H. itama, T. apicalis, T. fuscobalteata, T. valdezi, T. collina* and *T. terminate.* The results of temperature and humidity measurements obtained are quite favourable for the presence of stingless bees. This is also supported by the results of research by Kerisna *et al.* (2019), obtained environmental conditions of stingless bee habitat with temperatures ranging from 26 ℃ - 33 ℃ and humidity 60% - 82%.

The least stingless bee species found were *T. iridepennis, H. fimbriata* and *T. testaceitarsis* which were only found in Region II (centre of the forest). Based on the results of the study, it shows that these three species are rarely found in various regions. However, these three species can adapt because the three species are in the middle of the forest, which means that these three species get food sources. Based on the results of research by Rivaldy *et al.* (2023), mentioned the type of *T. iridepennis* found only 1 colony. Furthermore, Syafrizal et al. (2020), mentioned that the type of *H. fimbriata* was found the least with 1 colony in the Samarinda area. Then the results of research by Lindawati *et al.* (2023), mentioned that the species *T. testaceitarsis* was not found in secondary forests and primary forests.

Generally, trees from the nest can be used as a food source for stingless bees. The more types of trees in an area, the more food sources are obtained by stingless bees so as to affect the existence of a population of stingless bee species and limited food availability can cause stingless bees to migrate (Handoko & Hidayatullah, 2019). The carrying capacity of the availability of stingless bee feed in an area has an important role in achieving success both in terms of production and in maintaining the stingless bee population (Erwan *et al.*, 2022).

3.2 Conservation status of stingless bees

Based on the results of the literature study, the conservation status of the majority found and the minority found can be seen in Table 3.

Table 2. Conservation status of stingless bee types observation

Types of Bees	The presence status	
	Majority	Minority
Tetragonilla collina	✓	
Tetragonula laeviceps yellow	✓	
T. laeviceps black	✓	
T. iridepennis		✓
T. drescheri	✓	
T. testaceitarsis		✓
Heterotrigona itama	✓	
Homotrigona fimbriata		✓

Based on Table 2 the conservation status of stingless bees has not been specifically evaluated by the International Union for Conservation of Nature (IUCN). However, based on the results of the literature study, the status of the species *H. itama, T. laeviceps yellow, T. laeviceps black, T. collina* and *T. drescheri* is still widely found and has the ability to develop in various habitat conditions. This statement is supported by the results of research by Suderajat et al. (2021), which states that *H. itama* bees are found on the Sriwijaya University Indralaya campus while *T. laeviceps* is found in every habitat. The results of research by Pratama et al. (2023), also stated that *T. laeviceps* is spread in all habitat types, which means that *T. laeviceps* can adapt to different environmental conditions.

Furthermore, Hudaya (2019) also stated that the most popular stingless bee species and have a wide distribution pattern are the species *Tetragonula laeviceps, T. fuscobalteata, T. valdezi, T. collina, H. itama, Tetrigona apicalis*, and *Lepidotrigona terminate*. The results of research on the number of *T. drescheri* species found in the Imbo Putui customary forest are more when compared to the results of Ramadani's research (2016), which states that the *T. drescheri* species was only found in 1 colony. This means that the *T. drescheri* species found in the Adat Forest of Imbo Putui can adapt well and get enough food sources so that its presence is more.

The species status of *Tetragonula iridepennis, T. testaceitarsis* and *H. fimbriata* is found in small numbers because these species have high adaptability so they need habitats that can balance their ability to adapt so that existing populations are maintained. This is supported by the results of Rivaldy *et al.* (2023), stating that the type of *T. iridepennis* was only found in 1 colony. Then the results of research by Lindawati *et al.* (2023), mentioned that the species of *T. testaceitarsis* was not found in secondary forests and primary forests. Furthermore, the statement of Salatnaya *et al.* (2023), mentioned that the Homotrigona genus has a limited distribution in certain areas such as Sumatra, Java and Kalimantan and followed by the results of research by Syafrizal *et al.* (2020), also mentioned that the type of *H. fimbriata* was found at least with 1 colony in the Samarinda area.

4. Conclusion

There are several types of stingless bees found in the Imbo Putui customary forest are 7 species with a total of 38 colonies. The majority of stingless bee conservation status is found in the species of *Hetetrotrigona itama, Tetragonula laeviceps (yellow, black), Tetragonula drescheri* and *Tetragonilla collina*. While the minority stingless bee species found are *Tetragonula iridepennis, Tetragonula testaceitarsis* and *Homotrigona fimbriata*. Base on presence of 3 species that are classified as minorities found, it can be conclude that the ecosystem of Imbo Putui customary forest is still maintained and has not experienced significant changes. Further research needs to be done on stingless bee species that have the potential to be cultivated by the community around the Imbo Putui customary forest area.

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