PEST INVENTORY OF STINGLESS BEE COLONIES IN BIOLOGY EDUCATION AND RESEARCH FOREST (BERF) AND EDUCATION FARM (EDUFARM) UNIVERSITAS ANDALAS

UNDERGRADUATE THESIS

BY:

MIFTAHUL ILMI

NIM. 2010422027

BIOLOGY DEPARTMENT

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

UNIVERSITAS ANDALAS

PADANG

2024

PEST INVENTORY OF STINGLESS BEE COLONIES IN BIOLOGY EDUCATION AND RESEARCH FOREST (BERF) AND EDUCATION FARM (EDUFARM) UNIVERSITAS ANDALAS

UNDERGRADUATE THESIS

BY:

MIFTAHUL ILMI

NIM. 2010422027

SUPERVISOR:

1.DR. HENNY HERWINA

2. PROF. DR. DAHELMI, MS

BIOLOGY DEPARTMENT

FACULTY OF MATHEMATICS AND NATURAL SCIENCES

UNIVERSITAS ANDALAS

PADANG

2024

PEST INVENTORY OF STINGLESS BEE COLONIES IN BIOLOGY EDUCATION AND RESEARCH FOREST (BERF) AND EDUCATION FARM (EDUFARM), UNIVERSITAS ANDALAS

Undergraduated Thesis Presented as One of Requirements to Obtain a Bachelor of Science Degree in Biology Department

BY:

MIFTAHUL ILMI
NIM. 2010422027

Padang, 30th July 2024

Approved By:

Supervisor I	Supervisor II
Dr. Henny Herwina	**Prof. Dr. Dahelmi**
NIP.197302262006042001	**NIP.195909221986031001**

This undergraduate thesis has been defended before the Examination Committee for the Bachelor of Biology, Faculty of Mathematics and Natural Sciences, Universitas Andalas, Padang, on Tuesday, July 30, 2024

No	Name	Designation	Signature
1.	Dr. Jabang Nurdin	Head of Examination Committee	
2.	Dr. Henny Herwina	Secretary of Examination Committee	
3.	Prof. Dr. Dahelmi	Member of Examination Committee	
4.	Dr. Wilson Novarino	Member of Examination Committee	
5.	Muhammad Nazri Janra, M.Si, MA	Member of Examination Committee	

AUTHENTICITY DECLARATION LETTER

I hereby declare that:

My thesis is original and has never been submitted to get a bachelor's academic degree, either at Universitas Andalas or at another university. This thesis is purely my own ideas and research. In this thesis there are no works or opinions written by others, except in writing clearly listed in the Bibliography.

I make this statement truly. If in the future there are deviations and untruths in this statement, I am willing to accept academic sanctions in accordance with applicable rules.

Padang, 30th July 2024

Author,

Miftahul Ilmi

NIM. 2010422027

"So be patient, surely the promise of Allah is true" (Q.S Ghafir: 77)

By the grace of Allah, I managed to get through the storm of my 4-year journey and finish it beautifully with tears of joy and a proud smile

Four years have passed—a journey woven with threads of joy and sorrow, emotion and laughter, tears and triumphs. As I stand at the threshold of this milestone, my heart overflows with gratitude for the myriad experiences and the incredible people who have illuminated my path.

To my dearest Papa, Mama, Aca, Adek, and Amad, your unwavering support has been my foundation, my strength. You are the pillars of my life, steadfast and loving, guiding me through every high and low. Your belief in me has been the beacon that kept me moving forward.

To my cherished friends—Pam, Astri, Rayen, Vio, Stia, Dini, Tiqoh, Fifah, and Maura—you are the light of my life. Each of you has been a source of inspiration, a wellspring of laughter, and a comforting shoulder during challenging times. In my eyes, you are extraordinary, and I am forever grateful for your presence.

To all who accompanied me on this campus journey—THI Lab, HPPB and EDUFARM Research Field Team, Albatros, beloved KBI, Aslab THI 2024, MBKM MD Sungkai Team (Fifah, Tiqoh, Thoriq), Japanese Exchange Team (Yaya and Bang Fajri), Research Team 2024, PKM Virus Nipah (Aldi and Astri), PKM Entomologi Forensik (Kak Dira, Tata Kecil, Rayen), Bu En, Bu Maya, Bu Anti, My Favorite Photocopy (Kak Wira), Fastrack Team 2024 (Intan, Imam, Fiska, Lala, Rifa, Rayhan, Dana), My Master's Colleagues (Kak Fitra, Kak Amar, et al), and Pemusatan Biosistematika (Kak Zikkra, Kak Putri, Bang Panji, Bang Fajri), My big family and Dinasti Syarkawiyyah, FSI FMIPA and BPMAI Unand and Lovely Runner KDrama (who accompanies my research days, based on my friend's recommendation :) —**your companionship and camaraderie have been invaluable. Each team and each individual has contributed to this journey, making it richer and more meaningful.**

And finally, to myself—thank you for your resilience, for facing challenges head-on, and for persevering through the trials. This journey was not easy, but you embraced it with courage and determination. You have shown that every flower blooms in its own time, and every success has its own rhythm.

To everyone who has played a role in this chapter of my life, you are wonderful. Thank you for walking with me, for helping me, and for being a part of this extraordinary journey.

With heartfelt gratitude,

[Miftahul Ilmi]

PREFACE

Praise and gratitude to Allah SWT who always gives strength and health to the author, so that the author can complete this thesis on time as a graduation requirement at the Department of Biology, Faculty of Mathematics and Natural Sciences, Universitas Andalas, Padang.

This thesis is the author's final assignment research, entitled "Pest Inventory of Stingless Bee Colonies in Biology Education and Research Forest (BERF) and Education Farm (EDUFARM) Universitas Andalas". The author is very grateful to the supervisors, which are Dr. Henny Herwina and Prof. Dr. Dahelmi for their guidance and full dedication to help the author's research until completing this series of processes. Then the author also thanks to:

1. The management team of Biology Education and Research Fores (BERF) and Education Farm (EDUFARM) for their assistance in providing the author's research field.

2. Dr. Wilson Novarino, M.Si and Dr. Aadrean as Head of the Department of Biology and Head of the Study Program, Faculty of Mathematics and Natural Sciences, Universitas Andalas.

3. Dr. Syaifullah as an academic advisor who always helps and directs the author during this lecture until the completion of the thesis

4. Dr. Jabang Nurdin, Dr. Wilson Novarino, Muhammad Nazri Janra, M.Si as examiners who always provide suggestions and improvements in the completion of this thesis.

5. Animal Taxonomy Laboratory Analyst along with all lecturers and staff of the Biology Department who always provide positive support for the continuation of lectures and the preparation of this thesis.

6. The entire research team of the author who has worked hard to provide the best assistance for the continuation of the author's final assignment and thesis

7. Special to the author's parents and three siblings who always provide support from various sides, strengthening the author to continue to fight and give their best role to the author

Finally, the author hopes that this thesis will have an impact and be useful for the sustainability of research so that it becomes a solid milestone for the glory of the nation.

Padang, 30th July 2024

Author

ABSTRAK

Lebah tanpa sengat memainkan peran krusial sebagai penyerbuk di ekosistem tropis, tetapi mereka menghadapi ancaman dari predator dan parasit yang mempengaruhi kelangsungan hidup dan produktivitas koloni mereka. Penelitian ini bertujuan mengidentifikasi spesies hama yang mengganggu koloni lebah tanpa sengat dan mengevaluasi indeks keanekaragaman biologis antara kedua lokasi yaitu Biology Education and Research Forest (BERF) dan Education Farm (EDUFARM) di Universitas Andalas, Padang, Sumatra Barat. Metode penelitian melibatkan pengumpulan data dengan menggunakan metode quadra protokol dan teknik pengumpulan langsung di sekitar koloni. Hasil penelitian menunjukkan bahwa terdapat 23 spesies hama dari 11 famili dan sembilan ordo di kedua lokasi. Di BERF, ditemukan 100 individu dari 20 spesies dan 10 famili, sedangkan di EDUFARM terdapat 57 individu dari 16 spesies dan tujuh famili. Metode pengumpulan langsung (hand collecting) memberikan hasil terbanyak dalam hal individu, spesies, famili, dan ordo dibandingkan metode lainnya. Temuan penelitian menunjukkan bahwa indeks keanekaragaman di BERF lebih tinggi dibandingkan dengan EDUFARM, sementara indeks keseragaman di kedua lokasi menunjukkan hasil yang baik. Indeks dominansi lebih tinggi di EDUFARM, menunjukkan dominasi hama yang lebih besar di lokasi tersebut. Penelitian ini menawarkan wawasan mengenai keragaman hama dan dampaknya terhadap koloni lebah tanpa sengat, serta menekankan pentingnya deteksi dini dan pengelolaan hama untuk meningkatkan produktivitas koloni di masa depan.

Kata Kunci : Hama, Lebah Tak Bersengat, Meliponini, Quadra Protokol

ABSTRACT

Stingless bees play a crucial role as pollinators in tropical ecosystems, but they face threats from predators and parasites that affect the survival and productivity of their colonies. This study aims to identify pest species that interfere with stingless bee colonies and evaluate the biological diversity index between two locations, namely the Biology Education and Research Forest (BERF) and Education Farm (EDUFARM) at Universitas Andalas, Padang, West Sumatra. The research method involved data collection using the quadra protocol method and direct collection techniques around the colonies. The results showed that there were 23 pest species from 11 families and nine orders in both locations. In BERF, 100 individuals from 20 species and 10 families were found, while in EDUFARM there were 57 individuals from 16 species and seven families. The direct collection method (hand collecting) gave the highest results in terms of individuals, species, families, and orders compared to other methods. The research findings showed that the diversity index in BERF was higher compared to EDUFARM, while the evenness index in both locations showed good results. The dominance index was higher in EDUFARM, indicating greater pest dominance at that location. This study offers insights into pest diversity and its impact on stingless bee colonies, and emphasizes the importance of early detection and management of pests to improve colony productivity in the future.

Keyword: Meliponini, Pest, Quadra Protocol, Stingless Bee

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APENDICES

I. INTRODUCTION

1.1 Research Background

Insects are the dominant group of animals with almost 80 percent of the total number of animals on earth. Around 751.000 species of insects, about 250.000 species are found in Indonesia. Insects in agriculture are widely known as pests (Kalshoven, 1981). Insects in agriculture are widely known as pests. Some are predators, parasitoids, or natural enemies (Christian & Gotisberger, 2000). Insects can maintain their survival in varied habitats, high reproductive capacity, the ability to eat different types of food, and the ability to save themselves from their enemies (Borror et al., 1981).

Bees are a group of pollinating insects that play an important role in helping the pollination process for various types of plants and wild plants (Heard, 1989; Herwina et al., 2022). The existence of stingless bee in West Sumatra can be found from the lowlands to highlands (Herwina et al., 2021). There have been between 500-600 stingless bee species described from all over the world (Basari et al., 2018; Herwina et al., 2020). One group of bees that has an important role as pollinators is the group of stingless bees. Stingless bees have a very high ecological role. Even stingless bees have become familiar with people's lives and cultures (Reyes-González & Zamudio, 2020). Stingless bees are a group of eusocial insects which plays an important role in the pollination process of plants, especially wildflowers, in most tropical regions of the country (Heard, 1999).

Stingless bees belong to a large and diverse taxon consisting of more than 60 genera (Rasmussen & Cameron, 2010). The stingless bee belongs to the tribe Meliponini of the family Apidae. Worldwide, it is estimated that there are more than 600 described species in about 61 genera. Estimates of the number of species identified so far are 50 in Africa, 300 species in the Americas, 60 in Asia, 10 in Australia and four in Madagascar. However, several studies over the past two decades have used morphological characters (Michener 1990; Camargo & Pedro, 1992) and single mitochondrial DNA gene fragments with limited taxon sampling (34 species) (Costa et al., 2003) resulted in phylogeny.

Stingless bees are a group of social insects belonging to several genera such as *Tetragonula, Lepidotrigona, Geniotrigona* or *Heterotrigona*; all belong to the tribe Meliponini and the Hymenoptera together with ants, bees and stingers (Sihombing, 2005; Syafrizal et al., 2012). The stingless bee is also known by its local names kelulut, galo-galo, klanceng or teuweul. In addition, stingless bees are also known as 'resin bees' in India and in Karnataka are called 'Musare jenu' (Rasmussen, 2013). Stingless bees visit flowering plants including herbs, shrubs and trees (Rajkumari et al., 2014). In addition, stingless bees are kept in the name of 'Meliponiculture' (Leonhardt, 2017).

Bees have a defense system in the structure of the hive, although natural enemies are still a problem in the cultivation of stingless bees. These natural enemies are referred to as pests on stingless bee colonies. Natural enemies are defined as natural organisms that interfere with or kill other animals such as predators, parasites, and pathogens (Estes et al., 2001). Predators and parasites can reduce the productivity of bees and honey, affect the structure and composition of the hive, and can cause colony death (Pangestika et al., 2016).

Predators are animals that are carnivorous or prey on other animals. There are several predators that attack bee colonies including wasps, ants, and spiders (Kumar et al., 2012). Forest elephants, chimpanzees, and ferrets, various species of birds, assassin bugs and spiders are also pests for stingless bees (Wattanachaiyingcharoen & Jongjitvimol, 2007; Premila et al., 2013). The centipede *Scolopendra hardwicki* was observed preying on workers and queens of the *Trigona iridipennis* clan in India (Vijayakumar et al., 2012).

In addition, ants are also predators that harm stingless bees outside and inside the hive (Lehmberg et al., 2008). Spiders and ants include carnivorous animals that include predators (Subyanto et al., 1991; Pangestika et al., 2016). Parasites are also classified as pests in stingless bees. Parasites are organisms whose lives depend on other living things. Common parasites found in honeybees (stinging bees) include mites, fleas, moths, and beetles (Strauss et al., 2013). In addition, Pangestika et al., (2018) who conducted research in East Java found several species of pests that attack *Trigona* beehives. Some species of pests that attack *Trigona* bee colonies include: Cockroaches (Blattidae), Histeriidae beetles (*Platysoma leconti*) and Nitidulidae beetles (*Carphaphilus* sp.), geckos, lizards, termites, and ants.

All these disturbances caused by different animal species have disrupted the normal survival of stingless bees in different habitats. Therefore, stingless bees face constant threats both in natural landscape changes and man-made (Gopinatha & Basavarajappa, 2022). Studies conducted in the Kakamega forest, Kenya showed that the brood *Meliponula bocandei* Cockerell, *M. ferruginea* Cockerell (reddish-brown), *M. ferruginea* Cockerell (black), *Meliponula lendliana* Friese and the stingless Magretti bee species were susceptible to invasion of *A. tumida* maggots. He also reported other coleopteran pests such as *Rhizoplatys mucronatus* Beauvois and *Tenebroides mauritanicus*. Based on report by Kiatoko (2012) *Myrmicaria* sp. known as a predator of stingless bee species in Kenya.

The Biological Education and Research Forest (BERF) of Universitas Andalas is a secondary forest with an area of approximately 150 ha located in the Andalas University area, Padang, West Sumatra (Sari, 2015). BERF is located on the western edge of Bukit Barisan which is part of Kamalau Hill (0 '54' S, 100 '28' E). Biological Education and Research Forest has a diversity species of plants, animals, fungi, including species identified as endemic also exists. Species richness is estimated at 530 species of trees dominated by the families Euphorbiaceae, Moraceae, Fagaceae, and Lauraceae (Rizaldi et al., 2018). Insect species has also been reported such as spider (Yanti, 1999), fireflies (Octaria, 2007), butterflies (Firmalinda, 2007), ants (Putri, 2016), fecal beetles (Sari, 2015). In BERF there are several colonies of stingless bees from various genera.

However, there have been no studies on the natural enemies (pests) of the colony. This research is important to find out what animals are disruptors and inhibitors growth and development of stingless insects. This disorder affects many things, ranging from bee growth, reproduction and breeding, to its ability to produce products in the form of honey. Thus, we can anticipate the presence of pests and carry out early detection of pest attacks. It is expected from this study, in the future colonies in the BERF and EduFarm will increase the productivity of stingless bees.

1.2 Research Problem

Based on the background of the problem above, several problem formulations are obtained as follows:

1. What are pest species of stingless bee colonies found at two sampling locations in the Biological Education and Research Forest (BERF) and Education Farm (EDUFARM) at Universitas Andalas?
2. What is the biological index (biodiversity index, evenness index, and dominance index) between pest species in stingless bee colonies based on the location of the colonies and also method that used?

1.3 Research Objective

The objectives of this study are as follows:

1. To determine the pest species of stingless bee colonies found at two sampling locations in the Biological Education and Research Forest (BERF) and Education Farm (EDUFARM) Universitas Andalas.

2. To determine biological index (biodiversity index, evenness index, and dominance index) between pest species in stingless bee colonies based on the location of the colonies and also method that used.

1.4 Research Significant

The results of this study are expected to provide information about the species of pests found in stingless bee colonies in the Biological Education and Research Forest (BERF) and Education Farm (EduFarm), Universitas Andalas.

II. LITERATURE REVIEW

2.1 Description and Classification of Stingless Bees

Stingless bees taxonomically belong to the order Hymenoptera, the family Apidae and the subfamily Meliponinae. The other two subfamilies of Apidae are Apinae (honeybees), and Bombiinae (ground bees). The stingless bees of the subfamily Meliponinae vary greatly morphologically and have the highest species diversity among corbiculate bees (Apini, Bombini and Meliponini). About 700 species of stingless bees have been identified worldwide. These stingless bees range from the tropics to the subtropics (Michener, 2007; Rasmussen & Cameron, 2010).

In Indonesia, this stingless bee is known as “kelulut” (Kalimantan; Malay), “galo-galo” (West Sumatra), “klanceng” (Java), “opulo” (Sulawesi) and “te'uweul” (Sunda) (Erniwati, 2013). The names of stingless bee areas in North Luwu, are “Merang”, “Teuwel” (West Java), “Nyanteng” and “Keledan” (Lombok), “Udep” (Dayak, East Kalimantan) (Riendriasari, 2013; Syafrizal et al., 2012). Stingless bees are social insects that live in colonies. Members of stingless bee colonies consist of three castes, namely queen, male, and worker bees (Salatnaya et al., 2020). Each caste can be distinguished by its morphological form, by body size. The queen maintains the colony population through mating with males followed by continuous nesting (Sumoprastowo & Suprapto, 1980). The worker caste has the most tasks, such as foraging, caring for queens, larvae and eggs, building eggs, cleaning and guarding nests. The members of this colony all live in one nest (Michener, 2007).

2.2 Morphology of Stingless Bees

Morphologically, the body size of the subfamily Meliponinae is smaller than the other two subfamilies. The body length of stingless bees is 2-12 mm, black, light brown to yellowish with a relatively large head and long jaws (Rasmussen & Cameron, 2010). Stingless bees have fine hairs on their body surface (Fadhilah & Rizkika, 2015). The body shape of this stingless bee is the same as other bees, with a very distinctive character is the absence of a sting as one of self-defense. The absence of stings owned by both queen, male and worker bees is what distinguishes it from two other classes of honey bees, namely Apis and Bambel honey bees. The last two honey bees (Apis and Bambel) are only male bees that do not have stingers (Supeno & Erwan, 2016).

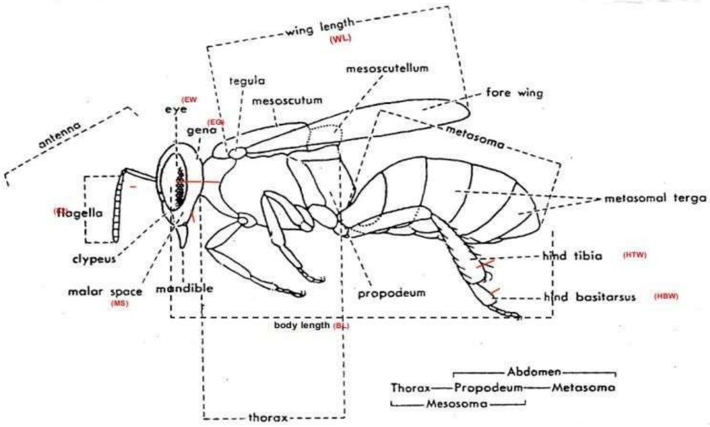


Figure 1. Morphological structures of stingless bee (Sakagami, 1990)

Morphologically, the queen bee is very easy to recognize, in addition its largest size, the abdomen is filled with eggs that are clearly visible with eyes and short wings. All worker bees are female bees whose reproductive organs do not function perfectly. Sometimes these worker bees are also capable of producing eggs, but cannot hatch. However, worker bees have organs capable of performing a variety of tasks within the colony. Worker bees are the smallest in size compared to queen bees and male bees. The wings of the worker bee almost cover the abdominal part, the hind limbs develop into pollen and resin-carrying devices, and the body is hairy. Male bees are the second caste group that has a body size larger than worker bees and smaller than queen bees. The hind limbs are not equipped with pollen collection baskets or a resin called a corbicula. These male bees in their colonies function as males of the queen bee and are few in number (Supeno & Erwan, 2016).

The morphological characters of the genus *Tetragonula* are that they have two small teeth, the malar space is shorter than the width of the antenna segment, the propodeum region in the middle is hairless and shiny, there are five hammuli on the hind wings, and the edge of the hind limbs has short hair and most of the plumose (Lamarkabel et al., 2020). The morphological characters of the genus *Trigona* have a black overall body color with an average body length range between 3.7−4.5 mm, head width range between 1.7 – 1.9 mm (Putra et al., 2016). The morphological characters of the genus *Lepidotrigona* are dominated by black on the whole body and yellow on the thoracic and abdominal parts. The eyes are brownish-black. Clypeus is black and covered in pale white or silver hair. The ocellar part is blackish and slightly fine. The scape and antennae are blackish or brownish-black with yellow hairs on the edges of the flagellomes (Suprianto et al., 2020).

The morphological characters of the genus *Heterotrigona* have slightly colored wings at the base, but not too dark and partly white in the itama species and reddish- orange tinged wings in the erythrogastra species (Rasmussen, 2008). *Heterotrigona* has no tessellation, mandible with one tooth, plumose hairs growing on the hind tibia are visible, have a hamuli number per wing of 7 pieces. Morphological characters of the genus *Geniotrigona* has no tessellation, has a mandible with two teeth, has two small to medium sized teeth, has a short scletum, has a propodium with a smooth and shining posterior median, visible fine hairs growing on the rear tibia, has a number of hamuli per 9 wings, have a malar length compared to the diameter of the fourth antenna segment are larger and has membrane-like wings (Supeno & Erwan, 2016).

2.3 Ecology and Habitat of Stingless Bees

Stingless bees want a location that has air temperatures ranging from 28-36°C and air humidity (RH) between 77-96%. Thus the altitude of the place greatly affects the distribution of bees, because every increase in altitude will give a decrease in air temperature. It is known that every 100 meters increase in sea level (asl) of a place, the air temperature will drop by 0.6°C. This condition greatly affects the abundance of stingless bee species in an area according to the height of the place from above sea level. The abundance of stingless honey bee species is the largest population found in warm climates with air temperature ranges of 18-35°C as well as diversity (Supeno & Erwan, 2016).

In nature, stingless bees live by forming colonies and nesting in certain places, such as plant trees, house wood, near rocks and so on. Stingless beehives are built in an arrangement of buildings consisting of entrace, tunnels and nest cavity. The plants that are often found for nesting vary greatly depending on the presence or absence of cavities in the stem for nesting, the type of plant and the diameter of the stem. Jaranan trees (*Atropha curcas*), bamboo (*Bambosa* spp), and Aren (*Erenga pinnata*) are some of the trees found on the island of Lombok as stingless beehives (Supeno & Erwan, 2016). Likewise, the results of research conducted by Elitz et al., (2003) found 81 hives from 13 species of stingless honey bees nesting in 43 plant species in the forests of Sabah. These plants can be found one or more beehives per tree.

2.4 Description and Classification of Pests in Stingless Bees

Insect pests associated with honeybee hives are well known. The most relevant pests associated with honeybees in North America and Australia are the small nest beetle (SHB) *Aethina tumida* (Coleoptera: Nitidulidae) and the blackish gum beetle (DSB) *Carpophilus lugubris* (Coleoptera: Nitidulidae) (Cuthbertson et al., 2013). But bees have a way to survive. The defense mechanism in *Trigona* bees is resin in the mouth of the hive and attacks in the form of bites (De Bruijn & Sommeijer, 1997; Lehmberg et al., 2008; Leonhardt et al., 2010). Aggressive bites are usually performed by stingless bees as a defense mechanism against predators (Lehmberg et al., 2008; Shackleton et al., 2015).

Females of the killer insect *Apiomerus pillipes* Santschi (Reduviidae, Harpactorinae) are predators of the genus *Melipona* (Vijayakumar et al., 2012;

Silva & Gl-Santana, 2004) in Brazil. Wattanachaiyingcharoen & Jongjitvimol (2007) report that *Pahaswollenia piliceps* Miller (Assassin bug) (Hemiptera: Reduviidae: Harpactorinae) as a stingless bee predator *Trigona collina* Smith in Thailand. *Acanthaspis siva* Far (Reduviidae: Hemiptera) is reported as a predator of stingless bees and honeybees in Kerala (Premila et al., 2013; Divya et al., 2016). Reported by Kiatoko (2012), African blue flytrap, *Elminia longicauda*, disease assessment can be estimated based on stem cell damage, pollen pots, honey pots, bee count and colony strength. Eight of *Antinori teresita* is reported to be the main hunter of stingless bees, *M. ferruginea* (black) and *M. ferruginea* in Kenya. The wasp species *Megachile disjuncta* Fabricius was observed as a predator of *T. iridipennis* in Kerala (Nisha, 2002).

Raakhee (2000) observed *Solenopsis geminata* Wheeler (ants) entering weak colonies of stingless beehives to rob pollen stocks from colonies in various locations in Kerala. Ants (*S. geminata*) are seen entering the nest especially in the early stages when the colony has just divided (Devanesanet et al., 2017). Wattena & Jongjitvimol (2007) report that *Nephila maculate* F. spider golden ball net and *Argiope* sp. The golden garden spider is a nest predator of *Trigona collina* Smith in Thailand. Various species of spiders (*Thomisus* spp.) were found preying on stingless bees in Kerala (Devanesan et al., 2017). Coleopteran larvae such as *Cetonia apaca* L. and *Cetonia morio* L. belonging to the family Cetonidae have reported harming stingless bees by entering the hive to feed on honey and digging galleries inside the wax (Leonard, 1983).

Craig et al., (1996) reported that *Nephila clavipes* L., a large orb spinning spider that feeds on *Trigona fluviventris* Friese by spinning large yellow webs. *T. fluviventris* is attracted to the color yellow and therefore they are more often trapped in the webs of *N. clavipes* than in the webs of other spiders. Large animals such as ferrets (*Paradoxurus hermaphrodite* Pallas), bears (*Melursus ursinus* Shaw), honey badgers (*Mellivora capensis* Storr), tamandus (*Tamandua tetradactyla* Linnaeus), tayras (*Eira barbara* Linnaeus) and chimpanzees (*Pan troglodytes* Blumenbach) are also reported as important enemies of stingless bees. In fact, the stingless bee *M. lendliana* is also one of the predators that often steals propolis from *M. bocandei* nests which are installed to close gaps in the nest (Kiatoko, 2012).

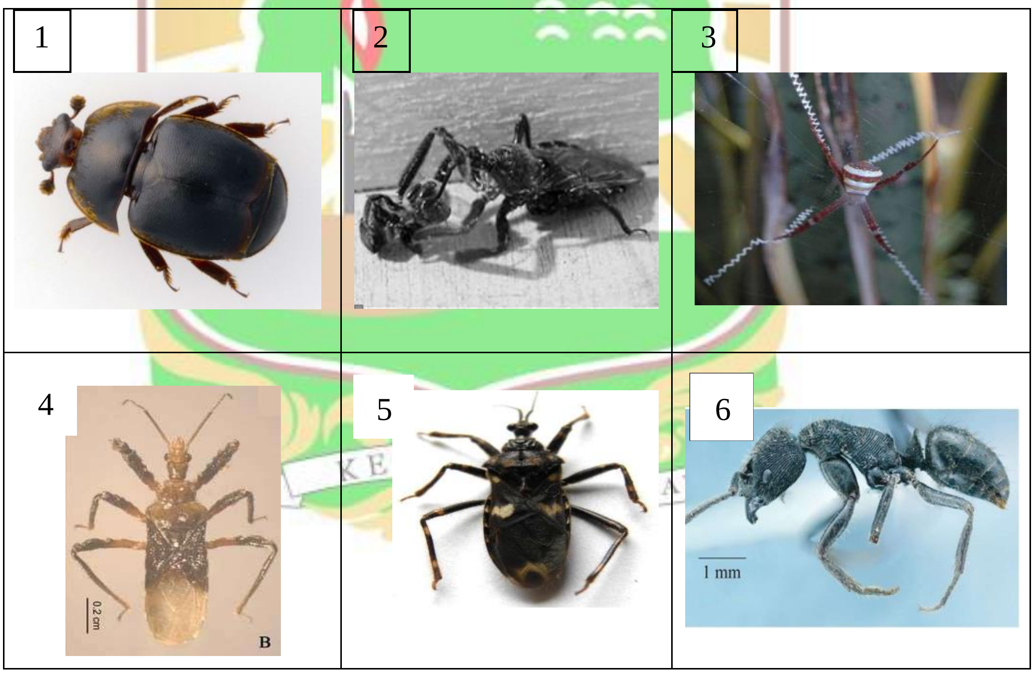


Figure 2. Some pests on stingless bees [(pic.1 *Aethina tumida*, Cuthbertson et al., 2013); (pic.2 *Apiomerus pilipes*, Silva & Gl-Santana, 2004); (pic.3 *Argiope* sp., Wattanachaiyingcharoen & Jongjitvimol, 2007); (pic.4 *Pahabengkakia piliceps*, Wattanachaiyingcharoen & Jongjitvimol, 2007); (pic.5 *Acanthaspis siva*, Premila et al., 2013); (pic.6 *Odontoponera denticulate*, Janra et al., 2020.

III. RESEARCH METHODOLOGY

3.1 Place and Time of Research

This research was conducted from May to April. Natural enemy collection was carried out for 6 days in May 2024 from 08.00-16.00 WIB each day around beehives in the Biological Education and Research Forest (BERF), Education Farm (EDUFARM) and the Invertebrate Animal Taxonomy Laboratory, Biology Department, Universitas Andalas, Padang.

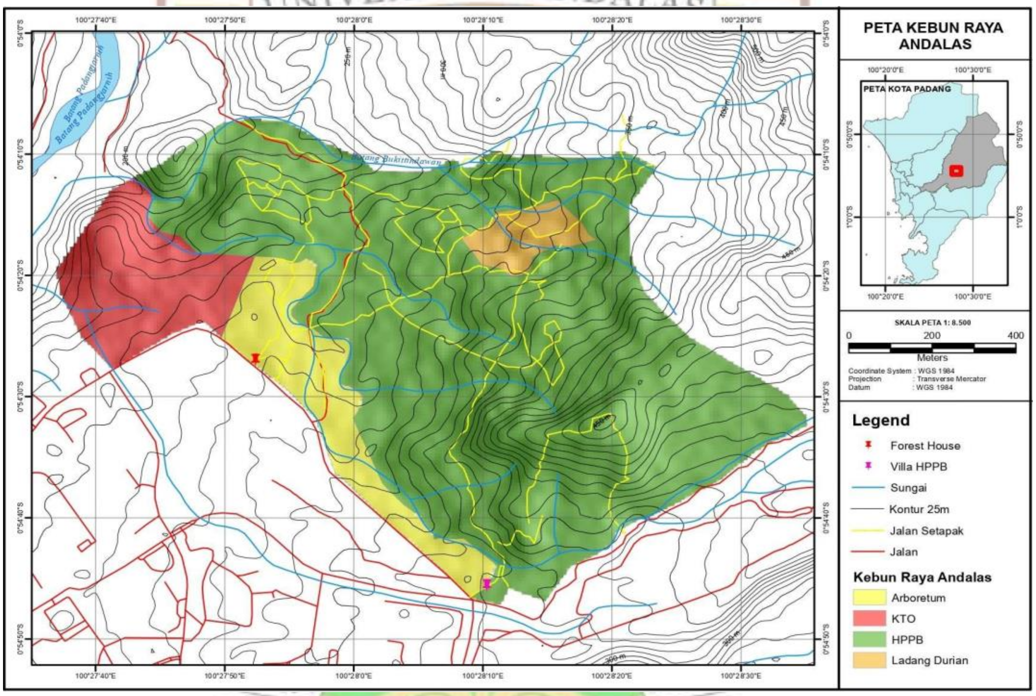


Figure 3. Location Map Andalas Botanical Garden

Biology Education and Research Forest (BERF) is located at 0°54’45.256’’S 100°28'9.6760’’E (3FQ9+2PG, Limau Manis, Pauh, Padang City, West Sumatra) and EDUFARM (Bee Research Center, Faculty of Animal Husbandry) is located at 0°54’42.974’’S 100°27'56.750"E (3FP8+QHP, Limau Manis, Pauh, Padang City, West Sumatra).

Figure 4. Research Location (BERF and EDUFARM)

3.2 Research Methods

The study was conducted with qualitative descriptive method with observational approach. Data acquisition was obtained through direct field exploration regarding pest finding data. Observations made:

3.2.1 Pests in Around Colonies

Taxon observations (including vertebrate/invertebrate categories, orders, families, genera, and species) and descriptions of their presence in stingless bee colonies. "Quadran Protocol Method" (Hashimoto et al., 2001), are method that use for sample collecting by used 180 meter transect, with 3 subtransects (each measuring 60 meters). At each subtransect, 4 methods were carried out, namely honey bait trap, leaf litter sampling, soil core sampling, and hand collecting.

Honey bait traps are placed every 4 meters along the transect by smearing honey on cotton wool placed on paper measuring 10cm x 15cm. Leaf litter sampling is a sieve method in areas that have leaf litter at a distance of 15 meters at each spot with a duration of 30 minutes at each subtransect. Soil core sampling is a method of digging soil with dimensions of 20cm (length) x 20cm (width) x 15cm (depth) carried out for 30 minutes at each subtransect. Hand collecting is a direct sampling method along the transect with 30 minutes for each subtransect.

3.2.2 Pests in Colonies with Some Parameter

Grouping and comparing pests from stingless bee colonies by some parameters: colony type, funnel type, stup size, funnel height from the ground, funnel length and diameter, and colony location

3.3 Tools and Materials

The tools used in this study were sample bottles, tweezers, drip pipettes, clear plastics, light microscopes, storage containers, specimen boxes, label paper, 70% ethanol, digital cameras, gloves, masks, tissue, petri dishes, glass objects, mounting paper (transparent), rulers, insect identification books, killing bottles, microtubes, stationery glass covers, insect pins, styrofoam, baited trap, sweep net, pitfall trap, and oven. The material used was samples of stingless bees of each type in the existing colony.

3.4 Work Procedure

3.4.1 In the Field

Research was conducted on each colony in the Biological Education and Research Forest (BERF), Education Farm (EDUFARM), Universitas Andalas. Sample collection start with making transects and carrying out 4 methods in the Quadran Protocol (honey bait trap, leaf litter sampling, soil core sampling, and hand collecting). Ants were collected using hand-collection and baited trap methods (Rizali et al., 2008; Wielgoss et al., 2010) to be later identified using Bolton (1994) and Hashimoto (2003). Birds observations were made using the MacKinnon Species List method where visible species were identified and then recorded in the species list table (MacKinnon & Phillipps, 1993; MacKinnon et al., 2010). Other pests are collected using sweep nets, pitfall traps, and hand collecting. Then environmental temperature, humidity, and soil pH also measured.

3.4.2 In the Laboratory

The collected samples were preserved using a dry preservation method (pierced using *an insect pin* on *Styrofoam*). Next, the sample observed its morphological structure with and without using a microscope to identify the pest species.

3.4.3 Data Analysis

The results of observations are continued with the identification of pest species using the help of identification books, journals and so on. Next, the data is recapitulated and displayed in the form of appropriate tables and diagrams. Analysis was also carried out on biological index, which included diversity index, evenness index and dominance index. Beside that visualization and data calculating using PAST4.

Diversity Index

Species diversity data processing uses the Shannon-Wiener Species Diversity Index (Odum, 1998).

$$H' = -\Sigma \, pi \ln pi \, ,$$

Information :

H' = Diversity Index

pi = ni/N

ni = The number of individuals in a species

N = The total number of individuals of the species found

According to (Mueeler Dumbois & Elenberg, 1974) the greater H' indicates the higher the species diversity. The value of Shannon's species diversity is defined as follows:

1. H' > 3 indicates high species diversity in an area
2. 1 ≤ H' ≤ 3 indicates moderate species diversity in an area
3. H' < 1 indicates low species diversity in an area

Evenness Index

Evenness was calculated to find out the level of evenness of the species on the research site (Brower & Zar, 1997).

$$E = H' \ln S$$

Information :

E = Evenness Index

H' = Diversity Index

S = number of species

The evenness index values range from 0–1 with the following categories:

1. $E \geq 0.5$ is under pressure
2. $0.5 > E \leq 0.75$ is labile
3. $0.75 > E \leq 1$ is stable.

Dominance Index

The dominance index was calculated using:

$$\mathbf{D = \Sigma(Pi)^2}$$

Information :

D = Dominance Index

Pi = Proportion Species (ni/N)

The criteria for the Dominance Index are as follows:

1. $0 > D \leq 0.5$ is low dominance
2. $0.5 > D \leq 0.75$ is medium dominance
3. $0.75 > D \leq 1$ is high dominance

IV. RESULTS AND DISCUSSION

4.1 Pest Species of Stingless Bee Colonies

4.1.1 General Composition of Stingless Bee Colonies

Based on research that has been done, it was obtained that in Biological Education and Research Forest (BERF) and Education Farm (EDUFARM) with quadran protocol method (around colonies) and hand collecting method (in colonies) were found 23 species from 11 family and 9 order. These species are suspected to be pest species of stingless bee colonies. The orders that were successfully studied further were squamata (reptiles), aranae (arachnids), diptera, homoptera, hymenoptera, isopods, lepidoptera, odonata, and pseudoscorpiones. Several other orders have also been researched but have not been categorized as pests.

From 10 families that are include to 9 orders, the largest number of individuals comes from the Hymenoptera order, namely the Formicidae (ants) family, totaling (68 individuals). In almost every quadrant protocol method, this family was found (honey bait trap, leaf litter sampling, soil core sampling, and hand collecting) including in colonies at both research locations. After that, the isopod family is the second largest with its family, namely Philosciidae, with a total number of individual are 21, originating from one species found in both research locations (BERF and EDUFARM). Then followed by Odonata with a total number of individuals are 13 divided into 3 different species with the same family, namely Libellulidae. Furthermore, there are 7 individuals from the order Lepidoptera which come from the same family. Then, 6 individuals from the Diptera order were found from 2 different families. And then, 5 individuals from the order Homoptera were found to come from the same family. Lastly, from the Pseudoscorpiones order, 2 individuals were found in the same family and species.

Based on the location, at BERF there were 100 individuals found from 20 different species consisting of 10 families from 9 different orders. Meanwhile, at EDUFARM, 57 individuals from 16 species were found from 7 families and 7 different orders. Based on the data, it is known that the number of species and individuals is greater in BERF than EDUFARM. Meanwhile, based on the method, the highest number of individuals, species, families and orders came from the hand collecting method, namely (48 individuals, 9 species, 5 families, 5 orders in BERF) and (22 individuals, 7 species, 4 families, 4 orders in EDUFARM). Meanwhile, the lowest was the soil core method at BERF (2 individuals, 2 species, 1 family, 1 order) and the leaf litter sampling method at EDUFARM (6 individuals, 2 species, 1 family, 1 order).

Table 1. Potential Pest Composition of Stingless Bee Colonies found in BERF and EDUFARM, Universitas Andalas. BT=Honey Bait Trap, LL=Leaf Litter Sampling, SC=Soil Core, HC-IN=Hand Collecting-Insect Net, N. ind sp=Number of individual of species, N. ind or=Number of individual of order

No	Order / *Family* / *Spesies*	Biological Education and Research Forest (BERF)							Education Farm (EDUFARM)							Total
		Method					N. ind Sp	N. ind Or	Method					N. ind Sp	N. ind Or	
		Around Colonies				In colonies			Around Colonies				In colonies			
		BT	LL	SC	HC-IN				BT	LL	SC	HC-IN				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	REPTILE															
	Squamata							**5**							**5**	**10**
	Gekkonidae															
1	*Hemidactylus sp.*				3	2	**5**						4	**4**		
2	*Gekko gecko*												1	**1**		
	ARTHROPODA															
	Araneae							**19**							**6**	**25**
	Agelenidae															
3	*Agelenopsis pennysylvanica*				12		**12**									
	Salticidae															
4	*Menemerus formosus*											6		**6**		
5	*Thorelliola ensifera*					7	**7**									

Table 1. (cont)

	cont.	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**
	Diptera							**3**							**3**	**6**
	Drosophilidae															
6	*Drosophila sp.*											3		**3**		
	Stratiomyidae															
7	*Hermetia illucens*					3	**3**									
	Homoptera							**5**								**5**
8	***Cicadidae***					5	**5**									
	Hymenoptera							**36**							**32**	**68**
	Formicidae															
9	*Anoplolepis gracilipes*	5				2	**7**		5					**5**		
10	*Colobopsis mutilata*				2		**2**				1			**1**		
11	*Componotus pudorosus*		2	1			**3**				1	3		**4**		
12	*Dolicoderus biturbeculatus*			1	3		**4**				3	2		**5**		
13	*Dolicoderus thoracicus*	4					**4**				4			**4**		
14	*Polyrhachis armata*		10				**10**			2		3		**5**		
15	*Polyrhachis dives*		2		1		**3**			4		1		**5**		

Table 1. (cont)

	cont.	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**	**(14)**	**(15)**
16	*Tapinoma melanocephalum*	2				1	**3**		3					**3**		
	Isopoda							**18**							**3**	**21**
	Philosciidae															
17	*Philoscia muscorum*				18		**18**				3			**3**		
	Lepidoptera							**3**							**4**	**7**
	Erebidae															
18	*Bertula lobativalva*					2	**2**						1	**1**		
19	*Ugia signifera*					1	**1**						3	**3**		
	Odonata							**9**							**4**	**13**
	Libellulidae															
20	*Neurothermis terminata*				2		**2**									
21	*Orthetrum sabina*				6		**6**					4		**4**		
22	*Pantala flavescens*				1		**1**									
	Pseudoscorpiones							**2**								**2**

Table 1. (cont)

	cont.															
	Chernetidae															
23	*Apotochernes gallinaceus*					2	**2**									
∑***Individual***		11	14	2	48	25	**100**	**100**	8	6	12	22	9	**57**	**57**	**157**
∑***Species***		3	3	2	9	16	**20**		2	2	5	7	4	**16**		**23**
∑***Family***		1	1	1	5	9	**10**		1	1	2	4	2	**7**		**11**
∑***Order***		1	1	1	5	7	**9**		1	1	2	4	2	**7**		**9**

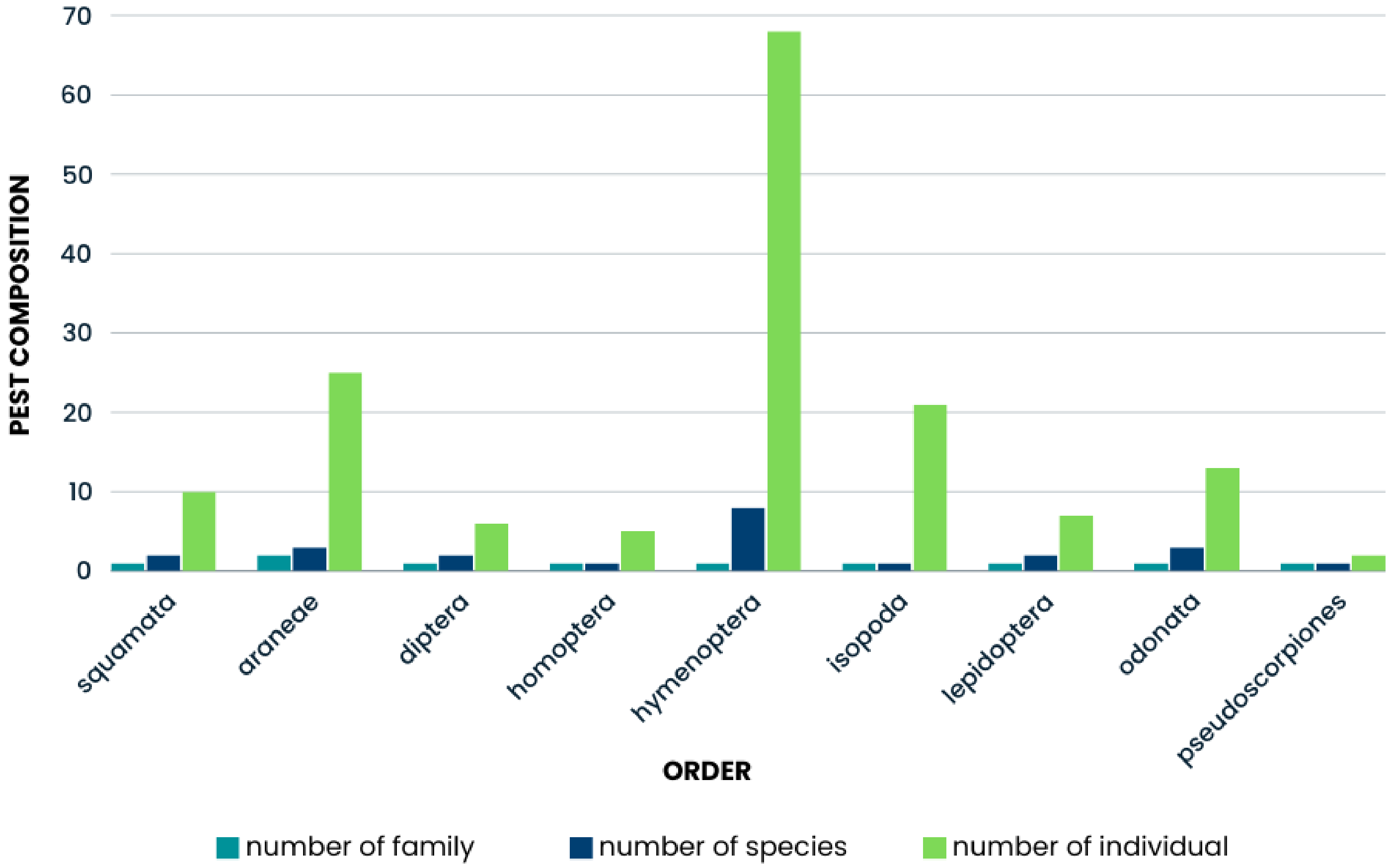


Figure 5. Pest Composition (number of Family, species, and individual of each order found in BERF and EDUFARM

a) Order Squamata

Order Squamata in both of location consist of 2 species from the same family, which are *Hemidactylus sp.* (House lizard) and *Gekko gecko*. These species found in both of location, *Hemidactylus sp.* was collected 3 individuals using hand collecting and 2 individuals in the colony at BERF, so a total of 5 individuals were obtained. Meanwhile, in EDUFARM, 4 individuals were found in the colony and were not found in other methods. The *Gekko gecko* species was found in 1 individual in EDUFARM, namely in a colony, not found in other methods and also not found in BERF. So, it can be concluded that the number of individuals from the squamata order in BERF are 5 individuals (50%) and in EDUFARM it is also 5 individuals (50%).

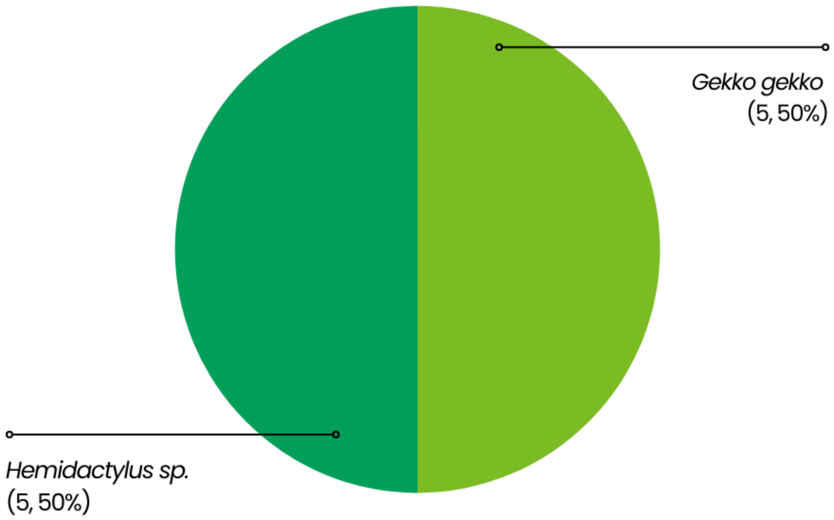


Figure 6. Pest Composition of Order Squamata (Reptile) in BERF and EDUFARM

Several studies note that the presence of *Hemidactylus sp.* can significantly reduce the survival of stingless bee colonies, especially if predation levels are high and the beehive is too easily accessible to *Hemidactylus sp.* (Smith et al., 2012). *Hemidactylus sp.* can access bee nests by climbing trees or structures where the nest is located, thereby increasing predation pressure on vulnerable colonies. *Geckos* (Gekkonidae) are diurnal or active during the day and passive. Based on research (Pangestika et. al., 2018), the lizard's body color is similar to its habitat, making it invisible to bees, making it easier for them to approach the nest and prey on bees. It can stay for a long time near the mouth of the hole through which stingless bees enter and exit. When there is stingless bee approached him, his tongue quickly stuck out and caught the stingless bee.

a) Order Araneae

Order Araneae in both of location consist of 3 species from the 2 family, which are *Agelenopsis pennysylvanica* (Agelenidae), *Menemerus formosus* (Salticidae) and *Thorelliola ensifera* (Salticidae). These species found in both of location, *Agelenopsis pennysylvanica* was collected 12 individuals using hand collecting and at BERF. Meanwhile, in EDUFARM were not found in all of methods. *Menemerus formosus* was collected 6 individuals using hand collecting and at BERF and not found in EDUFARM. *Thorelliola ensifera* was collected 7 individuals in colonies at BERF and not found in EDUFARM. So, it can be concluded that the number of individuals from the Araneae order *Agelenopsis pennysylvanica* (12 individuals, 48%), *Menemerus formosus* (6 individuals, 6.24%), and *Thorelliola ensifera* (7 individuals, 7.28%).

Spiders are animals predator for existing insects around it, so the spiders has an important role in the chain food (Bonev et al., 2006). Spider classified as carnivorous animals and most of them are insect eaters so spiders also play an important role in controlling plant pests but becomes a pest for some insect colonies (Ghavami, 2008). This predatory insect can be used as pest control because its ability as an insect eater. The spider's main prey or food is insects trapped in the web. The spider instantly paralyzes and kills its prey with its poison (Sanjaya & Dibiyantoro, 2012).

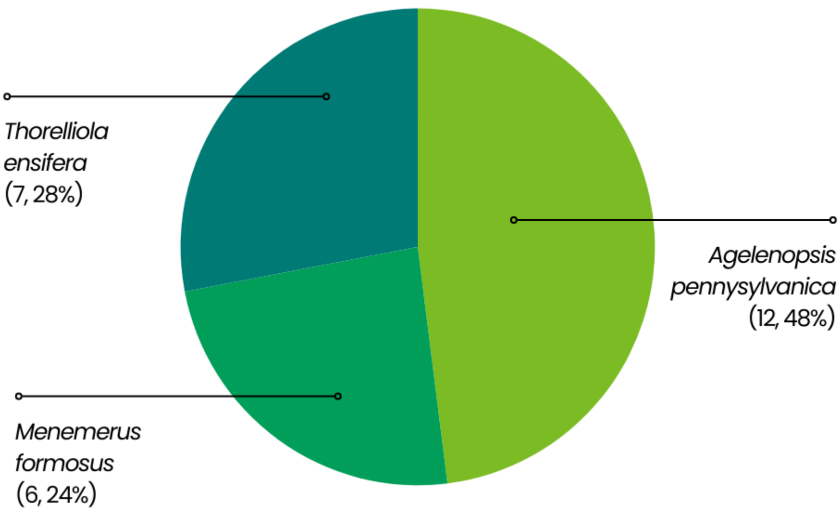


Figure 7. Pest Composition of Order Araneae in BERF and EDUFARM

According to breeders, the spiders are very aggressive in preying on individual *Trigona* bees and several species of stingless bees. Spiders will put a web in front of the colony, if the bees are trapped, it will become a source of food for the spiders. This is in accordance with Roubik's report (2006), that Archnidae *(Cryptocellus gamboa)* includes a symbiosis that is detrimental to *Trigona* bees, because it weakens and preys on individual bees.

b) Order Diptera

Order Diptera in both of location consist of 2 species from the 2 families, which are *Drosophila sp.* (Drosophilidae) and *Hermetia illucens* (Stratyomyide). These species found in both of location, *Drosophila sp.* was collected 3 individuals using hand collecting and at EDUFARM. Meanwhile, in BERF were not found in all of methods. *Hermetia illucens* was collected 3 individuals in colonies at BERF and not found in EDUFARM. So, it can be concluded that the number of individuals from the Diptera order *Drosophila sp.* (3 individuals, 50%), *Hermetia illucens* (3 individuals, 50%).

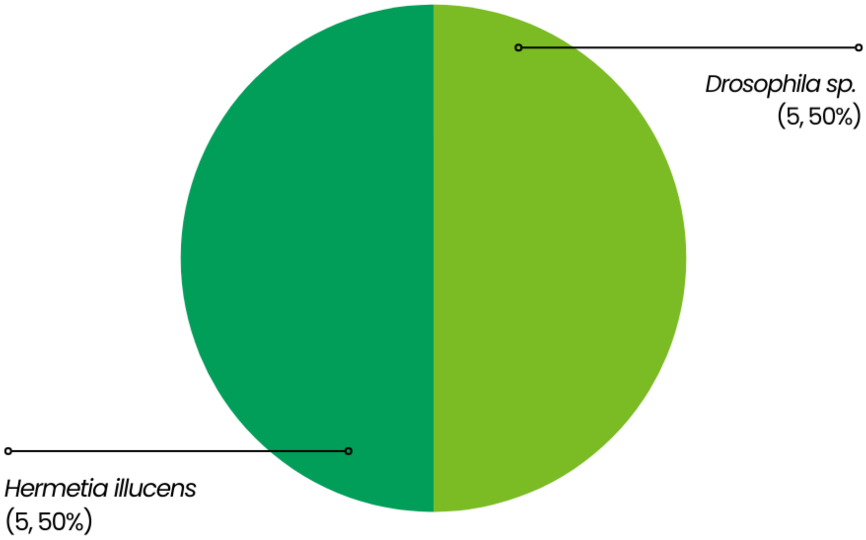


Figure 8. Pest Composition of Order Diptera in BERF and EDUFARM

Some flies, such as the Hessian fly and the apple maggot, are important pests of cultivated plants. On the other hand, many flies are useful as scavengers, others are important predators or parasites of various insect pests, others help pollinate useful plants, and some attack noxious weeds. The predaceous larvae live in many different habitats: in water, in the soil, under bark or stones, or on vegetation. Adult Diptera feed on various plant or animal juices, such as nectar, sap, or blood. Most species feed on nectar, but many are bloodsucking, and many are predaceous on other insects (Triplehorn & Johnson, 2005). Based on results research of Al Chzawi (2009) the new recognized pests include meat fly and also bee louse from diptera order. Most of the new detected pests were also reported to attack the colonies of honeybee in neighboring countries (Al Ghamdi, 1990; Yakobson & Rosenthal, 1990; and Yazbek, 1990). In the 1980s, the phorid fly

Melaloncha sinistra was frst reported to parasitize workers of *Nannotrigona postica*. Phorid fies were found at the nest entrance, where they laid eggs on foraging bees, and examining samples showed that up to 37% of workers were parasitized (Simões et al., 1996). Male stingless bees often aggregate outside of nests in order to inseminate emerging virgin queens (Brown, 1997), and phorid flies take advantage of this behavior to parasitize their host.

c) Order Homoptera

Order Homoptera in both of location consist of 1 species from one family, which is from Cicadidae family. These species found only in colonies on BERF and not found in other methods. Meanwhile, in EDUFARM were not found in all of methods. So, it can be concluded that the number of individuals from the Homoptera order (Cicadidae 5 individuals, 100%).

Cicadidae are found in colonies of stingless bees, some of which are found alive and the other are found dead. Some are inside the colony box and some are outside the box around the colony. The entry of cicadidae into the colony suggests that these taxa are taking part in attacking the colony, but it cannot be ascertained whether they are attacking the colony's young, stealing colony products, or simply disrupting colony life. There are no related publications explaining that cicadidae are pests of stingless bee colonies. However, this is suspected due to the discovery of this species in various conditions in stingless bee colonies. Thus, cicadidae is thought to be a pest of stingless bee colonies.

d) Order Hymenoptera

Order Hymenoptera in both of location consist of 68 individuals, 8 species from 1 family (Formicidae), which are *Anoplolepis gracilipes*, *Colobopsis mutilate*, *Componotus pudorosus, Dolicoderus biturbeculatus, Dolicoderus thoracicus, Polyrhachis armata, Polyrhachis dives,* and *Tapinoma melanocephalum*. These species found in both of location, *Anoplolepis gracilipes* was collected 5 individuals using honey bait trap and 2 individuals in colonies at BERF. Meanwhile, in EDUFARM were only found 5 individuals using honey bait trap and not found in other methods. *Colobopsis mutilate* was collected 2 individuals using hand collecting at BERF and 1 individuals using soil core sampling at EDUFARM. *Componotus pudorosus* was collected 2 individuals using leaf litter sampling and 1 individuals using soil core sampling at BERF. Meanwhile, in EDUFARM were found 1 individuals using soil core sampling and 3 individuals using hand collecting method. *Dolicoderus biturbeculatus* was collected 1 individuals using soil core and 3 individuals with hand collecting method at BERF.

Meanwhile, in EDUFARM were found 3 individuals using soil core sampling and 2 individuals using hand collecting method. *Dolicoderus thoracicus* was collected 4 individuals using honey bait trap at BERF. Meanwhile, in EDUFARM were found 4 individuals using soil core sampling. *Polyrhachis armata* was collected 10 individuals using leaf litter sampling at BERF. Meanwhile, in EDUFARM were found 2 individuals using soil core sampling and 3 individuals using leaf litter sampling and 3 individuals using hand collecting method. *Polyrhachis dives* was collected 2 individuals using leaf litter sampling and 1 individuals using hand collecting method at BERF. Meanwhile, in EDUFARM were found 4 individuals using leaf litter sampling and 1 individuals using hand collecting method. *Tapinoma melanocephalum* was collected 2 individuals using honey bait trap and 1 individuals in colony at BERF. Meanwhile, in EDUFARM were found 3 individuals using honey bait trap and not found in other method anymore. So, it can be concluded that the number of individuals from the Hymenoptera order *Anoplolepis gracilipes* (12 individuals, 17.6%), *Colobopsis mutilate* (3 individuals, 4.4%), *Componotus pudorosus* (7 individuals, 10%), *Dolicoderus biturbeculatus* (9 individuals, 13%), *Dolicoderus thoracicus* (8 individuals, 12%), *Polyrhachis armata* (15 individuals, 22%), *Polyrhachis dives* (8 individuals, 12%), and *Tapinoma melanocephalum* (6 individuals, 9%).

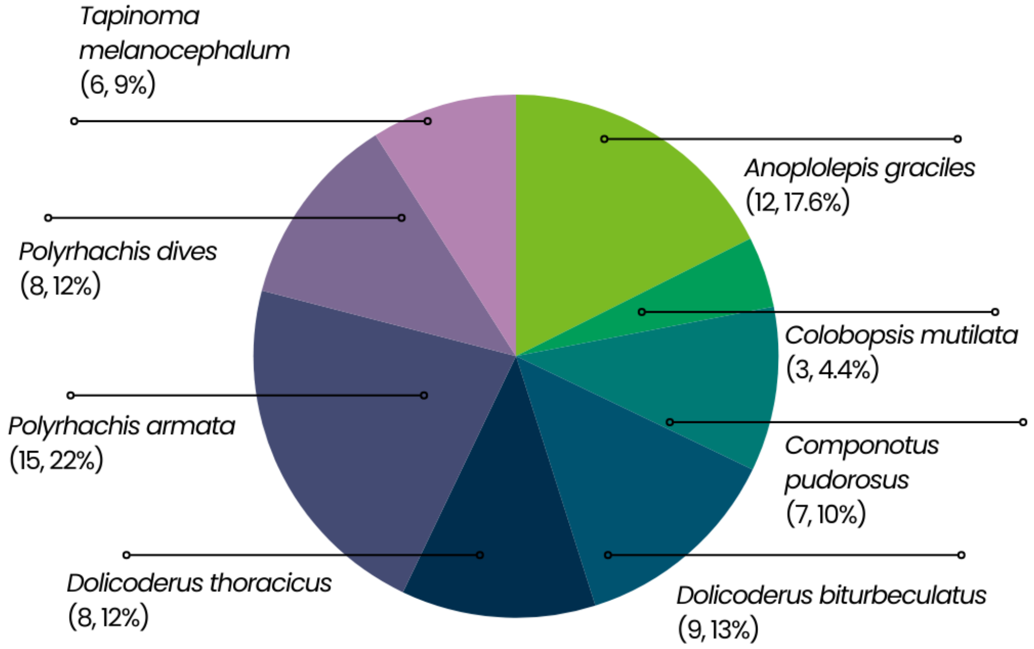


Figure 9. Pest Composition of Order Hymenoptera in BERF and EDUFARM

Ants are a group of insects has an important role in the ecosystem (Kaspari, 2000) of which are associated with other organisms, become predators and predators (Schultz, 2000; Folgarait, 1998). Ants are one of the predatory pests of stingless bees, one of which has been reported in the genus *Trigona*, in large numbers of individuals can disturbing bee colonies. The ants found in the study were mainly carnivorous, This group of insects from the Formicidae family is very likely to become a pest or at least presents competition to existing colonies because several types of ants are known to also consume Flower nectar is the main food of

Trigona bees. Based on research by Pangestika et al., (2018), that very aggressive ants attack individuals near the entrance to the beehive. Ants prey on the head and individual thorax of *Trigona* bees in a colony. Their large numbers and living in colonies make ants become predators of other insect groups, including the *Trigona* bees studied at that time. Ants build nests in stups and rob the bees of their food. In light attacks it doesn't bother much, but in heavy attacks can result in the bees leaving the box or not returning to the hive. Earlier some investigators like Garg and Sharma (1990) said d black ants as important enemies of honeybees in India. Sharma and Sundaraj (2011) conducted a study on pests and predators of *Apis cerana F.*, *Apis mellifera L.*, and also stingless bee and revealed two species of ants (*Formica fusca L.* and *Camponotus compressus F.)* were found invading in honeybee colonies. Ant has the largest number of individuals among all types of insects, because included as social insects that live in colonies (Hölldobler & Wilson, 1990; Lach et al., 2010). Ants were also reported in previous studies on activity at night, as a predator (Powell & Clark, 2004), and has the eye organ is modified to be active at night (Narendra et al., 2013).

e) Order Isopoda

Order Isopoda in both of location consist of 1 species from one family, which is *Philoscia muscorum* (Philosciidae family). This species found using hand collecting method on BERF with the total number of individuals are 18. Meanwhile, in EDUFARM this spesies found with soil core method, the total number of individuals are 3. So, it can be concluded that the number of individuals from the Isopoda order *(Philoscia muscorum* 21 individuals, 100%).

Philoscia muscorum (family Philosciidae) from the order Isopoda is a land animal that also lives in wood. This species is suspected to be a pest because it is often found in colonies of stingless bees. Its presence in colony stands is thought to be a threat to stingless bee species.

f) Order Lepidoptera

Order Lepidoptera in both of location consist of 2 species from the 1 family (Erebidae), which are *Bertula lobativalva* and *Ugia signifera*. These species found in both of location, *Bertula lobativalva* was collected 2 individuals using hand collecting (near with colony) at BERF. Meanwhile, in EDUFARM was found 1 individual using hand collecting (near with colony). *Ugia signifera* was collected 1 individual using hand collecting (near with colony) at BERF and 3 individuals using hand collecting (near with colony) at EDUFARM. So, it can be concluded that the number of individuals from the Lepidoptera order *Bertula lobativalva* (3 individuals, 48%) and *Ugia signifera* (4 individuals, 7.28%).

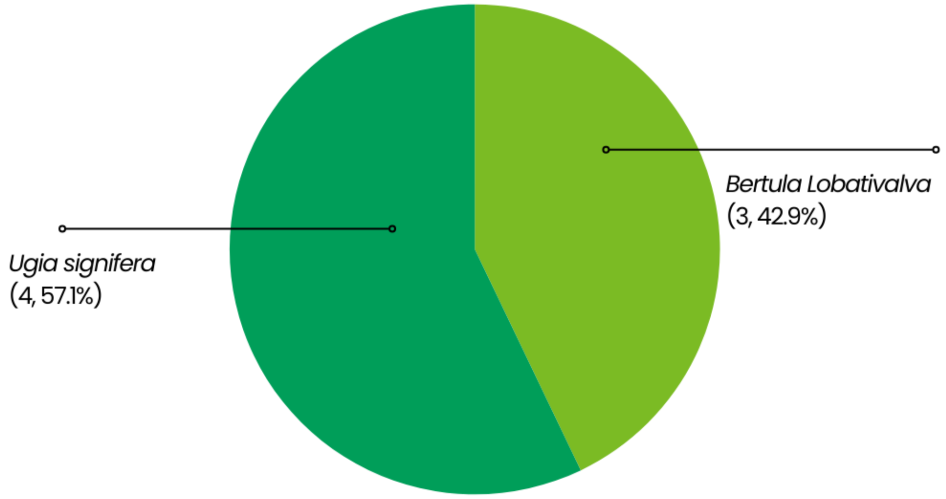


Figure 10. Pest Composition of Order Lepidoptera in BERF and EDUFARM

A number of moth species such as Greater wax-moth (*Galleria mellonella L.*), lesser wax-moth (*Achroia grisella F.*), dried fruit moth (*Vitula edmandsae serratilineella R.*), Mediterranean flour moth (*Anagasta kuchniella Z.)* and *Vitula edmansae P*. attacked the colonies of honeybees in search of hive products like honey, pollen and beeswax. Death's head moth (*Acherontia spp.*) occasionally fed upon honey and pollen stores of bee colonies (Smith, 1960). Wax moths as pests of bees and from India; *Varroa jacobsoni* was firstly reported by the author in *A. cerana* colonies from Nellore, Andhra Pradesh. The wax moth *Achroia grisella*, a pest of *Apis mellifera,* was found infesting weak colonies of *Melipona bicolor* and *M. quadrifasciata anthidioides* (Cepeda, 2006).

g) Order Odonata

Order Odonata in both of location consist of 13 total individuals, 3 species from 1 family, which are *Neurothermis terminate, Orthetrum sabina* and *Pantala flavescens*. All these species found in both of location. *Neurothermis terminate* was collected 2 individuals using insect net (include to HC method) at BERF. Meanwhile, in EDUFARM were not found in all of methods. *Orthetrum sabina* was collected 6 individuals using insect net (include to HC method) at BERF and 4 individuals using insect net (include to HC method) at EDUFARM. *Pantala flavescens* was collected 1 individual using insect net (include to HC method) at BERF and not found in EDUFARM. So, it can be concluded that the number of individuals from the Odonata order *Neurothermis terminate* (2 individuals, 48%), *Orthetrum sabina* (10 individuals, 6.24%), and *Pantala flavescens* (1 individual, 7.28%).

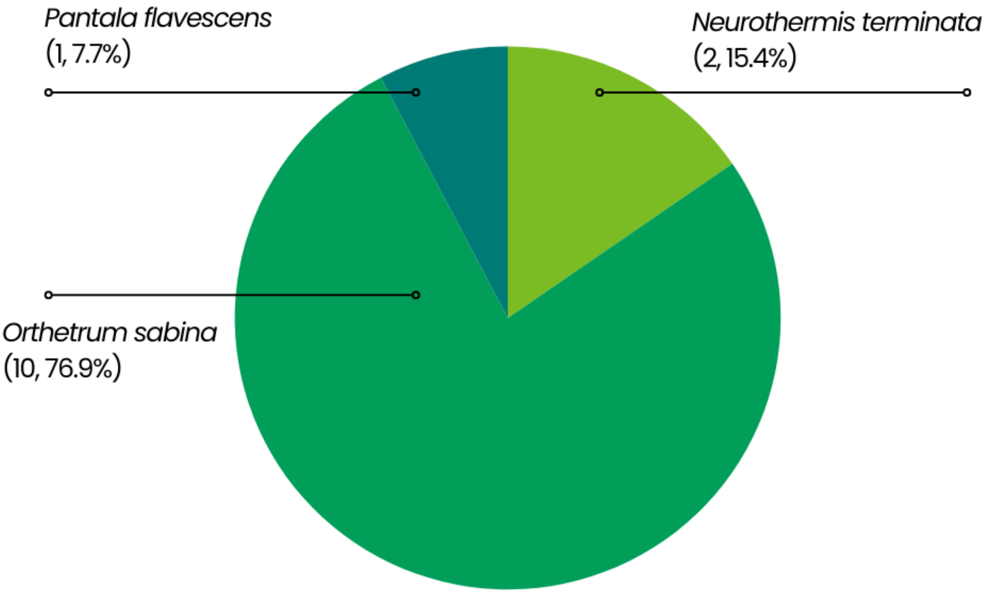


Figure 11. Pest Composition of Order Odonata in BERF and EDUFARM

Stingless bees also have the potential to preyed on by the types of dragonflies found located around the farm. Dragonflies are predatory insects. Based on research by Janra et al. (2020), there are five types of dragonflies, all of which are included into the Libellulidae family (suborder Anisoptera) recorded during observations. These were observed perched on plants on the surface the ground or on the branches of the tree canopy around stingless bee farms. Dragonflies have eyes compounds that are very large and very large sensitive, so they can detect movement prey such as mosquitoes, flies, aphids, butterflies, bees or larger dragonflies small (Setiyono et al., 2017). Dragonflies from the family These Libellulidae are larger than individuals kelulut so predation incidents are expected very possible. Predation ability dragonflies are positively correlated with their body size, so the dragonflies are large can eat prey insects that are comparatively large or predatory small insects in large numbers many (Rathod & Parasharya, 2015). They

Generally it will ambush its prey in the air, especially if the kelulut flies around where these dragonflies usually perch.

h) Order Pseudoscorpiones

Order Pseudoscorpiones in both of location consist of 2 individuals 1 species from one family, which is *Apotochernes gallinaceus* (Chernetidae family). This species found in colonies on BERF with the total number of individuals are 2. Meanwhile, in EDUFARM this species was not found. So, it can be concluded that the number of individuals from the Pseudoscorpiones order (*Apotochernes gallinaceus* 2 individuals, 100%).

Some pseudoscorpions also act as the bee pests. Several familiar spiders build webs, capture and consume honeybees whereas, other may be occasional pests of honeybees outside the hives (Smith, 1960). Pseudoscorpions, which resemble scorpions due to presence of pedipalps, are also sometimes harmful to bee colonies.

4.1.2 Pest Species of Stingless Bee Colonies in BERF

In general, the comparison of the presence of stingless bee pest in the BERF and EDUFARM areas is quite different. It can be seen from the pest of stingless bee data found in BERF that it is quite varied and has a fairly wide range of individual numbers. This is shown in the range 0-20 and highest data is at number 37. Meanwhile, the pest of stingless bee data found in EDUFARM tends to be seen in the 0-10 range. However, there is the highest data for EDUFARM at number 33 and that include to isolate data because this is not an average number.

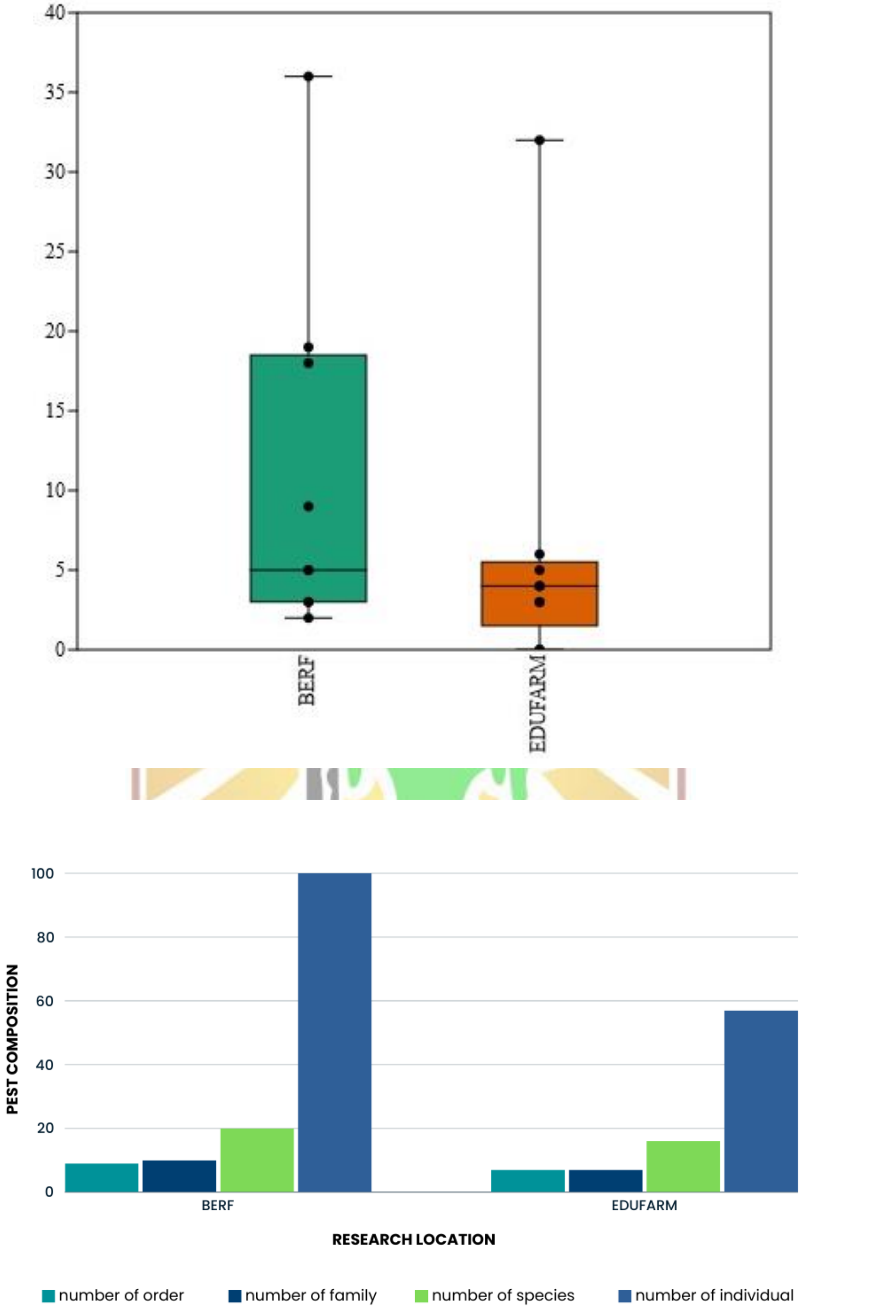


Figure 12. Pest Composition between BERF and EDUFARM and Number of order, family, species, individuals compare between BERF and EDUFARM

Based on research studied, 10 order were found in BERF with 11 families include there. From that order, there are 20 species and 100 total number of individuals. Order found in BERF are (Squamata order, 1 family, 1 species, 5 total individuals), (Araneae order, 2 families, 2 species, 19 total individuals), (Diptera order, 1 family, 1 species, 3 total individuals), (Homoptera order, 1 family, 1 species, 5 total individuals), (Hymenoptera order, 1 family, 8 species, 36 total individuals), (Isopoda order, 1 family, 1 species, 18 total individuals), (Lepidotera order, 1 family, 2 species, 3 total individuals), (Odonata order, 1 family, 3 species, 9 total individuals), and (Pseudoscorpiones order, 1 family, 1 species, 2 total individuals).

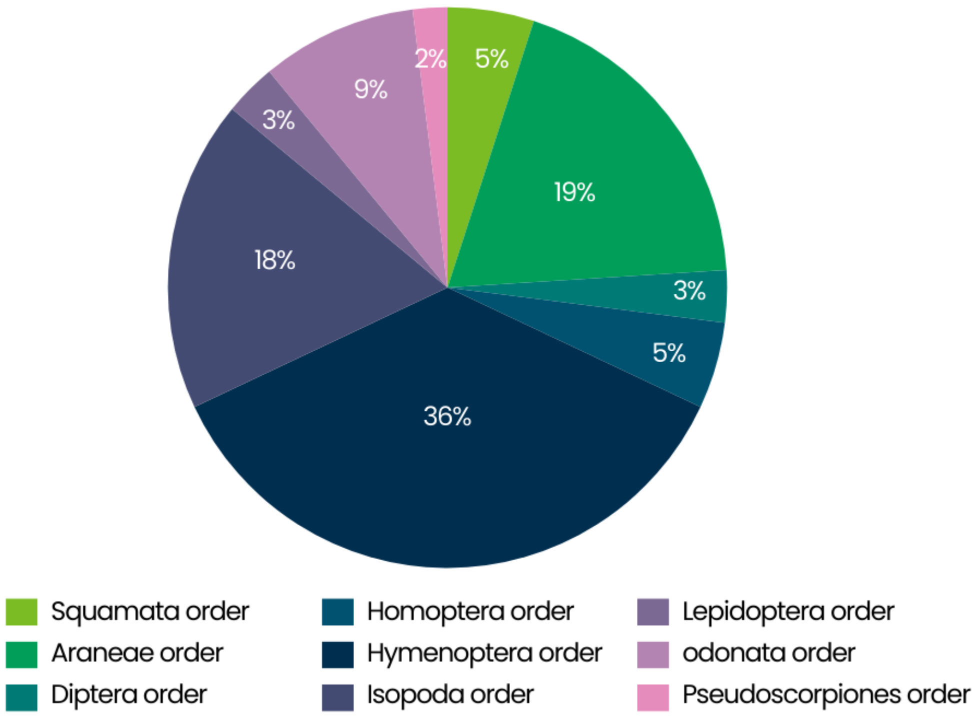


Figure 13. Pest Order Composition at BERF

4.1.3 Pest Species of Stingless Bee Colonies in EDUFARM

Based on research studied, 7 order were found in BERF with 7 families include there. From that order, there are 16 species and 57 total number of individuals. Order found in BERF are (Squamata order, 1 family, 2 species, 5 total individuals), (Araneae order, 1 families, 1 species, 6 total individuals), (Diptera order, 1 family, 1 species, 3 total individuals), (Hymenoptera order, 1 family, 8 species, 32 total individuals), (Isopoda order, 1 family, 1 species, 3 total individuals), (Lepidotera order, 1 family, 2 species, 4 total individuals), and (Odonata order, 1 family, 1 species, 4 total individuals).

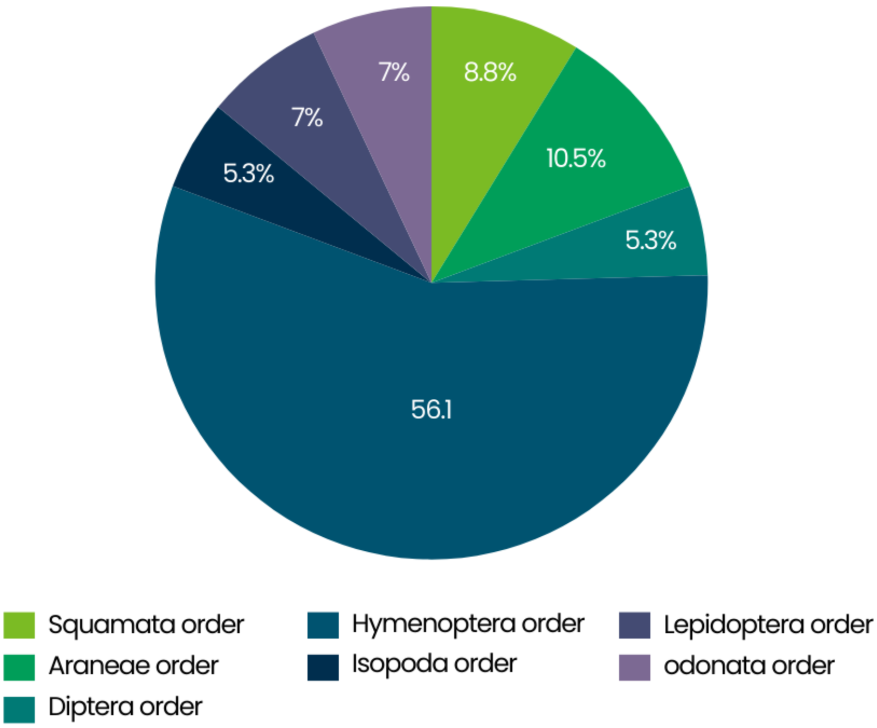


Figure 14. Pest Order Composition at EDUFARM

4.2 Biological Index of Pest Species in Stingless Bee Colonies

4.2.1 General Diversity and Evenness Index of Pest Species

Based on results obtained in study, the value of the diversity index and evenness was obtained in different ranges at both research location (BERF and EDUFARM). The results of this calculation were contained full in Table 2. In general H’ index level in BERF (1.837) higher then EDUFARM (1.51), but still in moderate diversity. The evenness index in BERF (0.6975) also higher then EDUFARM (0.6467).

Table 2. Data values for the number of taxa, individuals, and other biological index values in BERF and EDUFARM using PAST4 Application

	BERF	EDUFARM
Taxa_S	9	7
Individuals	100	57
Dominance_D	0.2055	0.3377
Simpson_1-D	0.7945	0.6623
Shannon_H	1.837	1.51
Evenness_e^H/S	0.6975	0.6467
Brillouin	1.656	1.29
Menhinick	0.9	0.9272
Margalef	1.737	1.484

Table 3. Data values for the number of individuals, species, family and other biological index values in BERF and EDUFARM using PAST4 Application

	BERF			EDUFARM		
	NoI	NoS	NoF	NoI	NoS	NoF
Taxa_S	9	9	9	7	7	7
Individuals	10	20	100	7	17	56
Dominance_D	0.02222	0.1737	0.2055	0	0.2279	0.3481
Simpson_1-D	0.9778	0.8263	0.7945	1	0.7721	0.6519
Shannon_H	2.564	2.061	1.837	2.374	1.786	1.487
Evenness_e^H/S	1.443	0.8722	0.6975	1.535	0.8526	0.6321
Brillouin	1.441	1.428	1.656	1.218	1.225	1.266
Menhinick	2.846	2.012	0.9	2.646	1.698	0.9354
Margalef	3.474	2.67	1.737	3.083	2.118	1.491

In line with measured diversity index value, the evenness value found also shows different, where the highest evenness value was found in BERF. Based on the results found, it can be seen that in the calculation of the diversity index of each order no one was classified as high diversity, where the value of the diversity index in the high range was above 3 (H'>3), while in this study the highest diversity index value was found at BERF. This shows that the diversity of pest in BERF and EDUFARM with moderate diversity.

Various scholars have employed a general diversity index to assess the abundance of species within a community and their interrelationships (Anderson-Cook & Borror, 2016). When a community contains numerous species with no single species dominating, its diversity is considered high (Odum, 1996). This index also indicates the community's stability, reflecting both the variety of types and the number of individuals within it (Sutrisna et al., 2020). Species diversity is one of the most important indices which are used for the evaluation of ecosystems at different scales (Ardakani, 2004). Biodiversity measurement typically focuses on the species level and local diversity can be studied with various indices such as species richness or Simpson's index which are commonly used to evaluate different trends in plant diversity. Simpson's index of Diversity values range between 0 and 1; when the value closer to 1 it is more diverse and when it closer to 0 it is less diverse (Al-Sghair et al., 2019).

Stingless bees need food in the form of pollen, nectar and resin in sufficient quantities and quality. In relation to this, cultivation of a type of plant needs to be done. Planting must be varied, so that the supply of food from the plants will remain available from morning to evening. The factor that attracts honey bees to visit other plants is the aroma received by the bees. Bees receive sensors through antennas to find out the location of flowers to take food (nectar and pollen). The aroma of food carried to the beehive can also be used as a guide for other worker bees to find honey from the same flowers. Vegetation in BERF varies greatly but there are almost no flowering plants as a source of nectar. Most of the vegetation in BERF is tall trees as a source of resin for propolis production. While in BERF the canopy cover is more open compared to BERF but flowering food sources are more available such as bridal tears flowers, calliandra and so on as a source of nectar for honey production. The condition of the vegetation in BERF and EDUFARM can be seen in Appendix 6.

4.2.2 Pest of Stingless Bee Diversity and Evenness Based on Location

4.2.2.1 Pest of Stingless Bee Diversity and Evenness at BERF

Based on results obtained in study, the value of the diversity index and evenness was obtained in different ranges at BERF. The results of this calculation were contained full in Table 4.

As a shown in Table 4. Data biological index value in BERF have different number based on number of family, species, or individual. Diversity index using Shannon H' Index shown in Number of Family have value level 2.564 (moderate level) and higher then number of species value level 2.061 (moderate level) and also higher then number of individual value level 1.837 (moderate level). In other side, the evenness index level shown different value, number of family (1.443), number of species (0.8722), number of individual (0.6975).

Table 4. Data values for the number of taxa, individuals, species, family and other biological index values in BERF using PAST4 Application

	Number of Family	Number of Species	Number of Individual
Taxa_S	9	9	9
Individuals	10	20	100
Dominance_D	0.02222	0.1737	0.2055
Simpson_1-D	0.9778	0.8263	0.7945
Shannon_H	2.564	2.061	1.837
Evenness_e^H/S	1.443	0.8722	0.6975
Brillouin	1.441	1.428	1.656
Menhinick	2.846	2.012	0.9
Margalef	3.474	2.67	1.737

The high and and low diversity index and evenness in different location, wa different from each order, where in each order value level influenced by the factor of the number of individuals in each order in different location, while in measuring the diversity index and evenness based on location , this value will be influenced by number of species for each habitat. Therefore, the difference in height and low of this data depends on external factors, especially environmental factors in the habitat, such as temperature, light density, climate, and also vegetation (Odum, 1996).

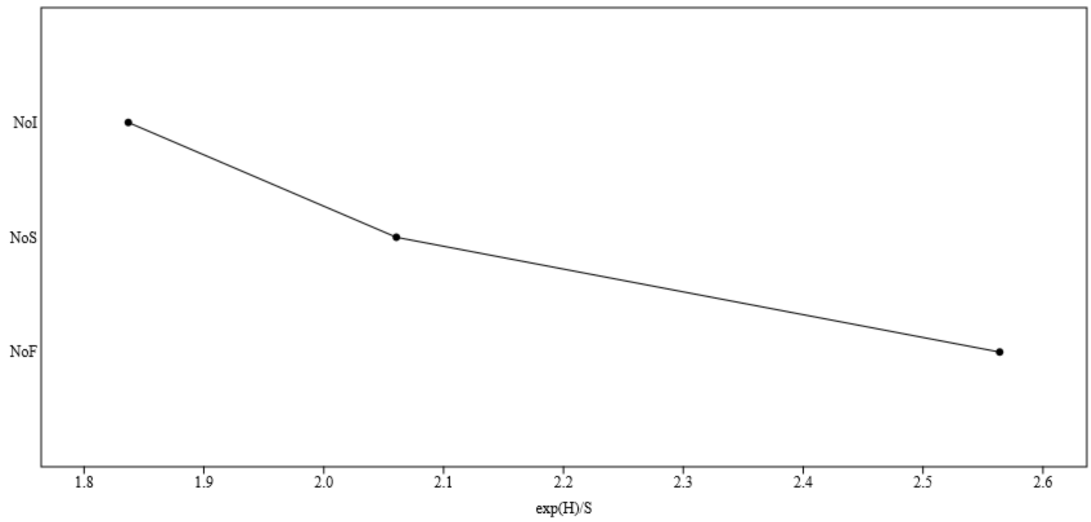


Figure 15. Biodiversity Index (Shannon H) of BERF Using PAST4 Visualization

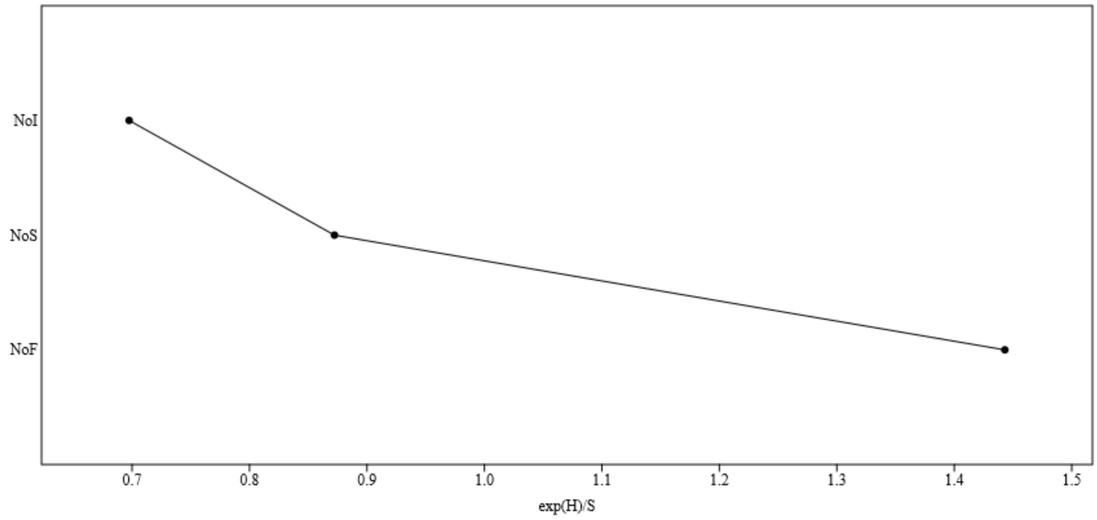


Figure 16. Evenness Index of BERF Using PAST4 Visualization

Evenness Index is intended to find out how the data on the number of individuals of one type (abundance of species) is spread out among the many species found (abundance of all types). This is to find out how the number of individuals of one type is scattered in a data sample (community). If all types in a data sample have an individual number that goes to the same number or has the same number of numbers; it shows that the evenness index is equal or not difference. If all types really reach the same number (one number); means that evenness is perfect, and will go to zero (0) as an abundance of uneven or unequal species (Beise et al., 2003).

4.2.2.2 Pest of Stingless Bee Diversity and Evenness at EDUFARM

Based on results obtained in study, the value of the diversity index and evenness was obtained in different ranges at EDUFARM. The results of this calculation were contained full in Table 5.

As a shown in Table 5. Data biological index value in BERF have different number based on number of family, species, or individual. Diversity index using Shannon H' Index shown in Number of Family have value level 2.375 (moderate level) and higher then number of species value level 1.786 (moderate level) and also higher then number of individual value level 1.487 (moderate level). In other side, the evenness index level shown different value, number of family (1.535), number of species (0.8526), number of individual (0.6321).

Table 5. Data values for the number of taxa, individuals, species, family and other biological index values in EDUFARM using PAST4 Application

	NoF	NoS	NoI
Taxa_S	7	7	7
Individuals	7	17	56
Dominance_D	0	0.2279	0.3481
Simpson_1-D	1	0.7721	0.6519
Shannon_H	2.374	1.786	1.487
Evenness_e^H/S	1.535	0.8526	0.6321
Brillouin	1.218	1.225	1.266
Menhinick	2.646	1.698	0.9354
Margalef	3.083	2.118	1.491

The diversity index is used to measure richness and diversity in a community or ecosystem. Diversity can be divided into two main components: species diversity (species diversity) and relative uniformity (species evenness). Species diversity refers to quantity The Shannon-Wiener Diversity Index, which combines species diversity and relative uniformity into one metric. This index is calculated based on the number of species and the proportion of individuals in each species in the community (Shannon & Weaver, 1949). Species that exist in a community, while relative uniformity measures the relative distribution of individuals between these species.

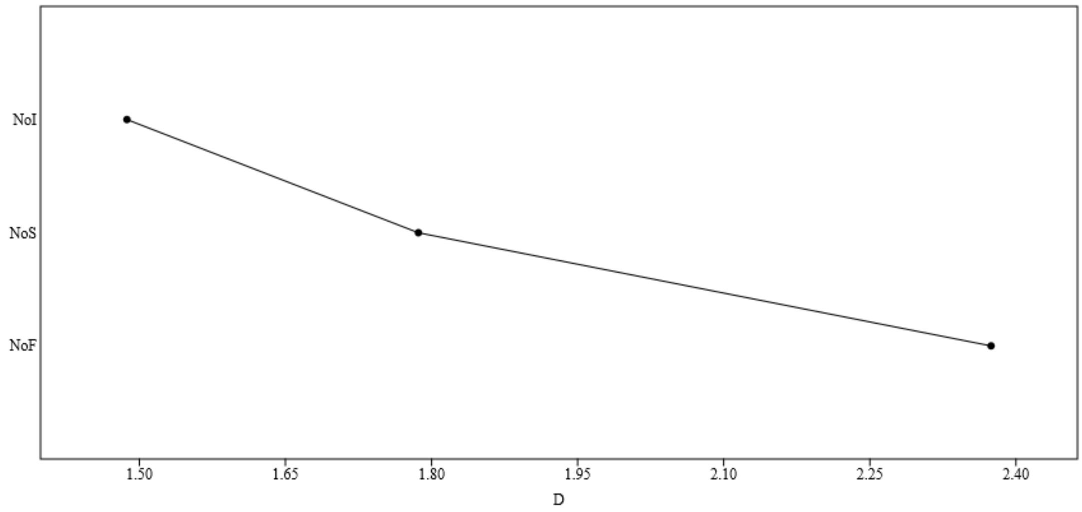


Figure 17. Biodiversity Index (Shannon H) of EDUFARM Using PAST4 Visualization

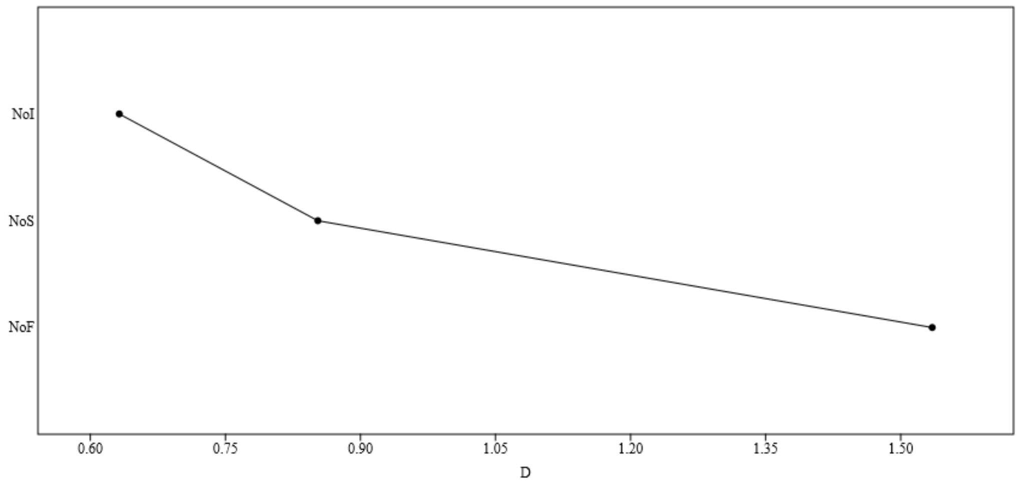


Figure 18. Evenness Index of EDUFARM Using PAST4 Visualization

Ecological indexes are used in various ecological studies to understand the complexity and stability of ecosystems. They help in identifying changes that may occur due to environmental disturbances or management practices (Gotelli & Colwell, 2001). Beside that, different evenness indices can be recommended depending on the structural aspects of a community that users wish to measure (Smith & Wilson, 1996).

4.2.3 Pest of Stingless Bee Diversity and Evenness Based on Method

Based on results obtained in study, the value of the diversity index and evenness was obtained in different method. The results of this calculation were contained full in Table 6.

As a shown in Table 6. Data biological index value in different methods have different number value. Diversity index using Shannon H' Index shown in Honey Bait Trap Method (BT) is 0.7069 (low level), using Leaf Litter Sampling (LL) is 0.6359 (low level), using Soil Core Sampling (SC) is 0.4458 (low level), using Hand Collecting (HC) is 0.6296 (low level). In other side, the evenness index level shown different value in different methods. Evenness Index shown in Trap Method (BT) is 1.014 (low level), using Leaf Litter Sampling (LL) is 0.9443 (low level), using Soil Core Sampling (SC) is 0.47809 (low level), using Hand Collecting (HC) is 0.9385 (low level).

Table 6. Data values at both location (BERF and EDUFARM) based on differences in sampling methods using PAST4 Application

	BT	LL	SC	HC	IN COLONIES
Taxa_S	2	2	2	2	2
Individuals	19	20	14	70	34
Dominance_D	0.4854	0.5579	0.7363	0.5627	0.5989
Simpson_1-D	0.5146	0.4421	0.2637	0.4373	0.4011
Shannon_H	0.7069	0.6359	0.4458	0.6296	0.5926
Evenness_e^H/S	1.014	0.9443	0.7809	0.9385	0.9044
Brillouin	0.5912	0.5283	0.3222	0.5899	0.5228
Menhinick	0.4588	0.4472	0.5345	0.239	0.343
Margalef	0.3396	0.3338	0.3789	0.2354	0.2836

Both locations have similar vegetation structures because the altitude of the locations is not much different. However, the EDUFARM location has an abundant diversity of vegetation, including flowering plant species. Meanwhile, BERF is poor with flowering plants, there are only a few litter areas.

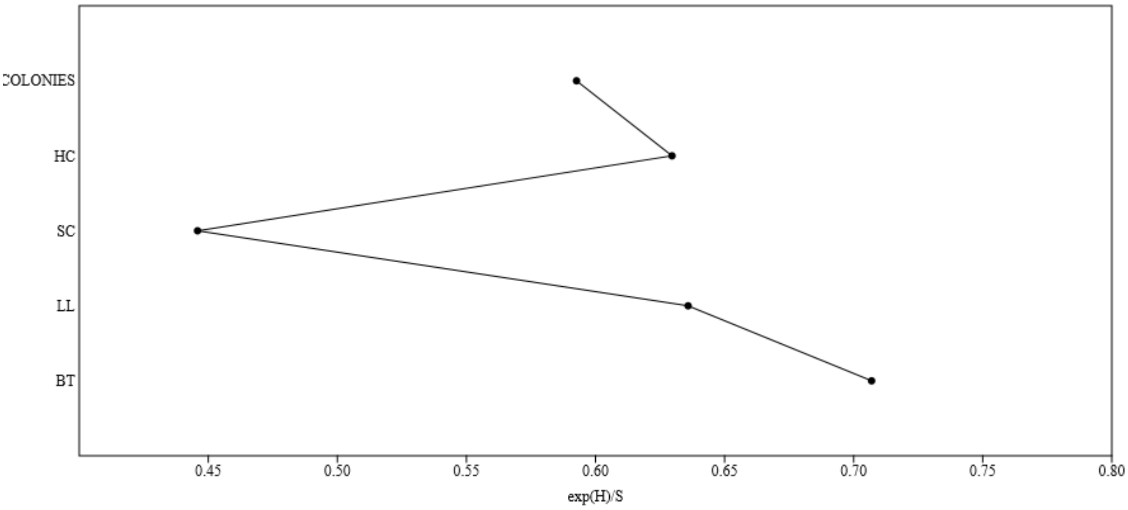


Figure 19. Biodiversity Index (Shannon H) Based on Method Using PAST4 Visualization

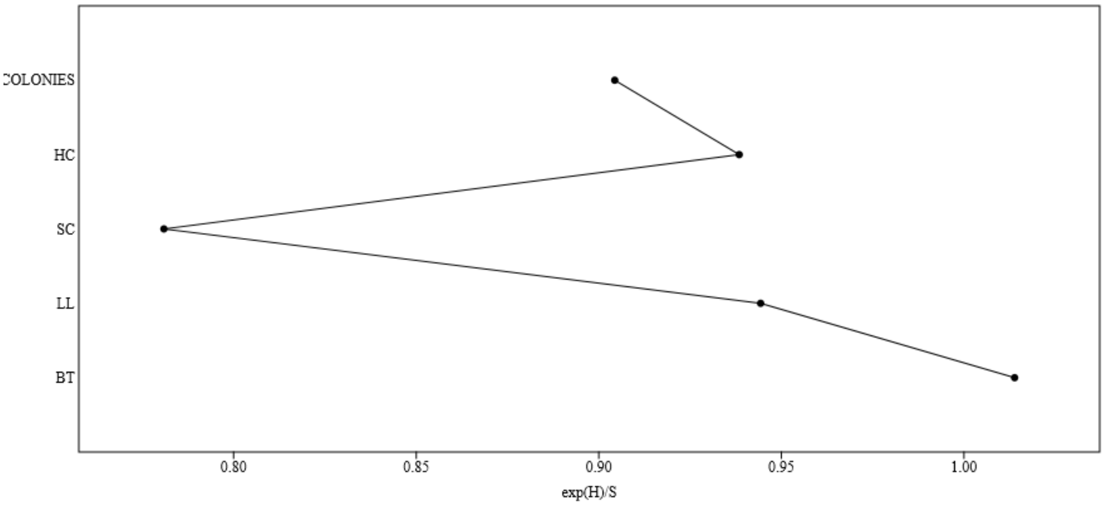


Figure 20. Evenness Index Based on Method Using PAST4 Visualization

The richness of plant species is almost infinitesimal compared to EDUFARM. However, the emergence of more stingless bee colony pests in BERF is thought to be due to the colonies being less healthy and less well maintained. Meanwhile at EDUFARM, the colony is still new and colony maintenance is going well so not many pests are found. The diversity index is a mathematical depiction to make it easier to analyze information about the number of types of individuals and how many individual types there are existing in an area (Tambunan, 2013). The advantages of this index are can take into account the number of species and species evenness. The index increases with addition unique species or by existence greater evenness of species (Wicaksono et al., 2011).

4.2.4 Pest of Stingless Bee Dominance Index

Based on results obtained in study, the value of the dominance index shown in figure 24 below. Dominance index in BERF less then in EDUFARM. In BERF dominance index value near to 0 (D approaching numbers 0 around 0.205), but in EDUFARM dominance index value more far to 0 (D=0.34). The dominance index is used for know the species richness as well balance of the number of individuals each species in an ecosystem. Dominance index ranges from 0-1. D = 0 means no there are species that dominate species others or internal community structures stable state. D = 1 means there is other species, or community structure unstable due to ecological pressure.

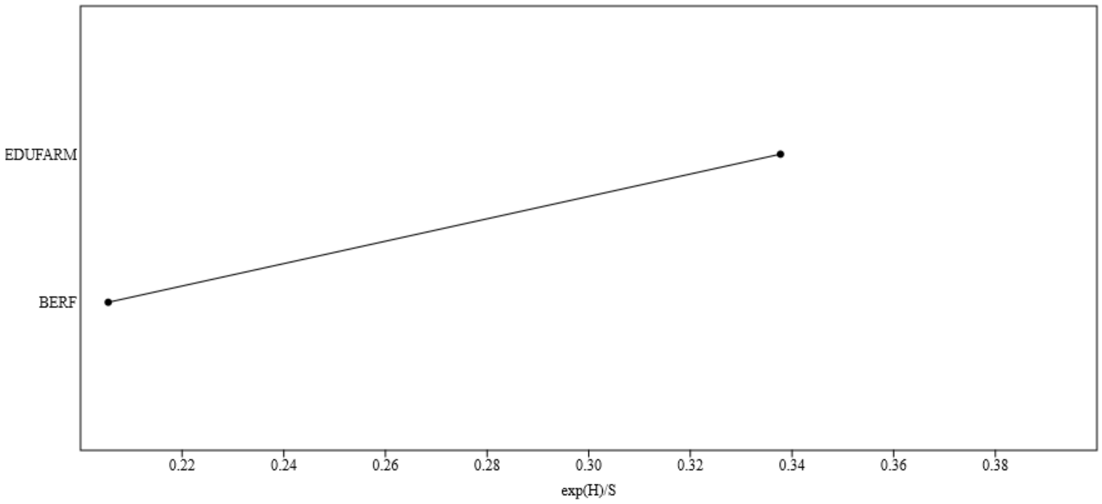


Figure 21. Dominance Index Using PAST4 Visualization

On the other hand, environmental factors such as temperature, light intensity and humidity influence the existence of stingless bees which in turn also influences the existence of insect pests and their predators. Stingless bees prefer warwer nectar when the ambient temperature is low, but in high ambient temperature above 34°C they no longer prefer warmer nectar (Norgate et al., 2010). Based on Contrera et al (2007) stingless bees from Melipona genus in temperature below 25°C will do pre flight warming by pulsing their flight muscle to achieve higher thorax temperature in comparison with their environment. The data about environment factors available in appendix 5. Based on temperature in both location (BERF=28.7°C and EDUFARM=31.15°C) is at a normal and effective condition for stingless bee activity.

V. CLOSING

5.1 Conclusion

The conclusion that can be concluded from this study was:

1. The total pest species found in both locations consisted of 9 orders, 11 families, 23 species and 157 numbers of individuals. In BERF, pests were found from 9 orders, 10 families, 20 species and 100 individual numbers. Meanwhile, at EDUFARM, pests were found from 7 orders, 7 families, 16 species and 57 numbers of individuals.

2. The biological index of the two locations is quite different. In terms of biodiversity index, diversity in BERF is much more varied than EDUFARM. The Evenness Index of both locations is quite good (medium evenness). The similarity index shows that the two locations are well connected so they are presented with similar diversity. The dominance index shows that EDUFARM has higher dominance than BERF.

5.2 Suggestion

The suggestions that can be obtained from this research was:

1. Further research was needed specifically for each order or family as an effort to conserve these pest of Stingless Bee Colonies in BERF and EDUFARM.

2. Further research was needed complete species identification data that explains in detail the specific taxa along with target species and predation activities, nuisance pests, and others.

REFERENCE

Al-Chzawi, A. A. M. A., Zaitoun, S. T., & Shannag, H. K. (2009). Incidence and geographical distribution of honeybee (Apis mellifera L.) pests in Jordan. In *Annales de la Société entomologique de France* (Vol. 45, No. 3, pp. 305-308). Taylor & Francis Group.

Al-Ghamdi A. A. 1990. Survey of honeybee diseases, pests and predators in Saudi Arabia. MPhil thesis, University of Wales, Cardiff , 171 p.

Al-Sghair, F. G., Mahklouf, M. F., & Abudaya, E. A. (2019). Spesies diversity and floristic analysis of the family poaceae in Libya depending on the flora of Libya. *Jurnal Vulpia*, *8*(7), 56-76.

Anderson-Cook, C. M., & Borror, C. M. (2016). The difference between "equivalent" and "not different". *Quality Engineering*, *28*(3), 249-262.

Ardakani MR. (2004). Ecology. Tehran University Press, 340

Basari, N., Ramli, S. N., & Mohd Khairi, N. A. S. (2018). Food reward and distance influence the foraging pattern of stingless bee, Heterotrigona itama. *Insects*, *9*(4), 138.

Beisel, J. N., Usseglio-Polatera, P., Bachmann, V., & Moreteau, J. C. (2003). A comparative analysis of evenness index sensitivity. *International Review of Hydrobiology: A Journal Covering all Aspects of Limnology and Marine Biology*, *88*(1), 3-15.

Bolton B. (1994). Identification Guide to the Ant Genera of the World. Cambridge, Massachusetts: Harvard University Press.

Bonev, B., Grieve, S., Herberstein, M. E., Kishore, A. I., Watts, A., & Separovic, F. (2006). Orientational order of Australian spider silks as determined by solid-state NMR. *Biopolymers: Original Research on Biomolecules*, *82*(2), 134-143.

Borror, D. J., Long, D. D., & Triplehorn, C. A. (1981). An Introduction to the Study of Insects.

Brower, J. E., Zar, J. H., & von Ende, C. N. (1997). Field and Laboratory Method forGeneral Ecology Wm. C.

Brown, B. V. (1997). Parasitic phorid flies: a previously unrecognized cost to aggregation behavior of male stingless bees. *Biotropica*, *29*(3), 370-372.

Camargo, JMF., & Pedro, SRM. (1992). Systematics, Phylogeny and Biogeography of Meliponinae (Hymenoptera, Apidae): A small review. *Apidologie*, 23(1): 509- 522.

Cepeda, O. I. (2006). Division of labor during brood production in stingless bees with special reference to individual participation. *Apidologie*, *37*(2), 175-190.

Christian W., & Gottsberger G. (2000). Diversity Preys in Crop Pollination. *Crop Science* 40 (5): 1209-1222.

Contrera, F. A., & Nieh, J. C. (2007). The effect of ambient temperature on forager sound production and thoracic temperature in the stingless bee, Melipona panamica. *Behavioral Ecology and Sociobiology*, *61*, 887-897.

Costa, MA., Del Lama MA., Melo, GA., & Sheppard, WS. (2003). The Molecular Phylogeny of Stingless Bees (Apidae, Apinae, Meliponini) was Inferred from the 16S rDNA Sequence of Mitochondria. *Apidologie*, 34(1): 73-84.

Craig, C. L., Weber, R. S., & Bernard, G. D. (1996). Evolution of predator-prey systems: spider foraging plasticity in response to the visual ecology of prey. *The American Naturalist*, *147*(2), 205-229.

Cuthbertson AGS., Wakefield ME., Powell ME., Marris G., Anderson H., Budge GE., Mathers JJ., Blackburn LF., & Brown MA. (2013). The Small Hive Beetle *Aethin atumida*: A Review of its Biology and Control Measures. *Current Zoology* 59(5), 644–653.

De Bruijn LLM., & Sommeijer MJ. (1997). Colony Foraging in Differents Species of Stingless Bees (Apid*ae*, Meliponinae) and the Regulation of Individual Nectar Foraging. *Insect Soc* 44:350- 47.

Devanesan, S., Premila, K. S., & Shailaja, K. K. (2017). Meliponiculture for Pollination Support, Yield Enhancement and Poverty Eradication. *Biodiversity for Sustainable Development* (pp. 267- 272). New York, USA.

Divya, K., Amritha, V., & Devanesan, S. (2016). Nest Architecture of Stingless Bees. *Life Sciences*, 5(6), 2035-2038.

Elitz T., Bruhl CA., Imiyabir Z., & Linsenmair KE. (2003). Nesting and Nest Trees of Stingless Bees (Apidae: Meliponini) in Lowland Dipterocarp Forests in Sabah, Malaysia, with Implications for Forest Management.

Forest Ecology and Management. 172: 301-313.

Erniwati. (2013). Kajian Biologi Lebah tak Bersengat (Apidae : *Trigona*) di Indonesia.*Fauna Indonesia* 12 (1): 29-34.

Estes J., Crooks K., & Holt R. (2001). Predators Ecological Role of. *Encyclopedia of biodiversity* 4:857-878.

Fadhilah, R., & Rizkika, K. (2015). Laba Lebah Tanpa Sengat. Jakarta: My Trubus Potential Business.

Firmalinda, W. (2007). *Diversity and Stratification of Vertical Fruit Nymphalidae Butterflies in the Forest of Education and Research in Biology (HPPB)* (Doctoral dissertation, Dissertation]. Andalas University. Padang.[Indonesian]).

Folgarait, P. J. (1998). Ant biodiversity and its relationship to ecosystem functioning: a review. *Biodiversity & Conservation*, *7*, 1221-1244.

Ghavamı, S., & Amooz, S. G. (2008). Spider (order Araneae) fauna of citrus orchards in northern part of Iran. *Journal of Applied Biological Sciences*, *2*(1), 73-76.

Gopinatha, BN., & Basavarajappa S. (2022). Pests and Predators Interference on the Stingless Bee Population Inhabited at Different Habitats Amidst South-eastern Karnataka, India. *Journal of Entomology and Zoology Studies*.

Gotelli, N. J., & Colwell, R. K. (2001). Quantifying biodiversity: procedures and pitfalls in the measurement and comparison of species richness. *Ecology letters*, *4*(4), 379-391.

Hashimoto, Y., Yamane, S., & Mohamed, M. (2001). How to design an inventory method for ground-level ants in tropical forests. *Nature and Human Activities*, *6*, 25-30.

Hashimoto Y. (2003). Identification Guide to the Ant Subfamily of Borneo. Tools for Monitoring Soil Biodiversity in the ASEAN Region. Darwin Initiative.

Heard, T.A. (1989). Propagation of Hives of *Trigona carbonaria* Smith. (Hymenoptera: Apidae). *J. Aust. Ento*. Soc., 27:303-304.

Heard, T. A. (1999). The Role of Stingless Bees in Crop Pollination. *Annual review of entomology*, *44*(1), 183-206.

Herwina, H., Salmah, S., Jasmi., Yaherwandi., Mairawita., Janra, MN., Rusdimansya., Christy BY., Sari DA., & G Putri. (2020). West Sumatran Stingless Bees (Hymenoptera: Apidae: Meliponini): What Can be told from its Local Distribution. *Earth and Environmental Science*.

Herwina, H., Ratni, E., Wellyalina., Jasmi., & Setyaka, V. (2021). Pendampingan Usaha Bukik Nabu (UBUNA) dalam Budidaya Lebah Tanpa Sengat (Galo-Galo) dan Pengembangan Produk Turunannya di Limau Manis, Padang. *Jurnal Warta Andalas*. 28(4), 386-392.

Herwina, H., Janra, M. N., Salmah, S., Mairawita, M., & Jasmi, J. (2022). Analisis Cepat terhadap Budidaya Galo-Galo (Apidae: Meliponini) di Desa Suntur, Kecamatan Barangin, Kota Sawahlunto. Aksiologiya: *Jurnal Pengabdian Kepada Masyarakat*, 6(3), 388-399.

Hölldobler, B., & Wilson, E. O. (1998). *Journey to the ants: a story of scientific exploration*. Harvard University Press.

Janra, M., Herwina, H., & Salmah, S. (2020). Identifikasi Potensi Predator dan Hama pada Peternakan Kelulut (Hymenoptera; Apidae; Meliponini; Tetragonula, Lepidotrigona) melalui Pengamatan Cepat di Kabupaten Padang Pariaman, Sumatera Barat. *Jurnal Sumberdaya HAYATI*, *6*(2), 67-74.

Kalshoven LGE. (1981). Pest of Crops in Indonesia. Van der Laan PA, penerjemah. Jakarta: Ichtiar Baru-Van Hoeve. (Terjemahan dari: De Plagen van de Cultuurgewassen in Indonesie).

Kaspari, M. (2000). Do imported fire ants impact canopy arthropods? Evidence from simple arboreal pitfall traps. *The Southwestern Naturalist*, 118-122.

Kiatoko, N. (2012). Distribution, Behavioural Biology, Rearing and Pollination Efficiency of Five Stingless Bee Species (Apidae: Meliponinae) in Kakamega forest, Kenya. Ph.d Thesis. Pure and Applied Science of Kenyatte University, Kenya.140-226 pp.

Kumar MS., Singh AJAR., & Alagumuthu G. (2012). Traditional Beeskeeping of Lebah tak Bersengat (*Trigona sp.)* by Kani Tribes of Western Ghats, Tamil Nadu, India. *Indian J Tradit Knowledge* 11:342-345.

Lach, L., Tillberg, C. V., & Suarez, A. V. (2010). Contrasting effects of an invasive ant on a native and an invasive plant. *Biological Invasions*, *12*, 3123-3133.

Lamarkabel Jacobus SA., Victor GS, Wulandari S., & Anang L. (2020). Karakteristik Morfologi dan Morfometrik Lebah Madu Tak Bersengat (Apidae; Melliponinae) pada Koloni di Daerah Pesisir Pulau Ambon. *Jurnal Budidaya Pertanian*, 17(1):28-35.

Lehmberg L., Dworschak K., & Nico B. (2008). Defensive Behavior and Chemical Deterrence Against Ants in the Stingless Bee Genus *Trigona* (Apidae, Meliponini). *Journal of Apicultural Research* 47:17-21.

Leonard, F.W. (1983). Investigation on the Fauna Associated with the Pollen Collected by Honeybees, *Apis mellifera*. MSc thesis, University of Maryland, College Park.

Leonhardt SD., Zeilhofer S., Bluthgen N. &, Schmitt T. (2010). Stingless Bees Use Terpenes as Olfactory Cues to Find Resin Sources. *Chem Senses* 35:603-611.

Leonhardt SD. (2017). Chemical Ecology of Stingless Bees. *Journal of chemical ecology*. 43(4):385-402.

MacKinnon J., & Phillips K. (1993). A Field Guide to the Birds of Sumatra, Java and Bali. London: Oxford University Press.

MacKinnon J., Phillips K., & van Balen S. (2010). Burung-Burung di Sumatera, Jawa, bali dan Kalimantan. Bogor: Puslitbang Biologi-LIPI

Michener, CD. (1990). Klasifikasi Apidae (Hymenoptera). Buletin Sains Universitas Kansas, 54(4): 75.

Michener CD. (2007). The Bees of The World. The John Hopkins Univ Pr, Baltimore.

Mueller-Dombois, D., & Ellenberg, H. (1974). Vegetation types: a consideration of available methods and their suitability for various purposes.

Narendra, A., Gourmaud, S., & Zeil, J. (2013). Mapping the navigational knowledge of individually foraging ants, Myrmecia croslandi. *Proceedings of the Royal Society B: Biological Sciences*, *280*(1765), 20130683.

Nisha, M. M. (2002). Management of Stingless Bee *Trigona iridipennis* Smith (Meliponinae: Apidae) in the homesteads of Kerala. M.Sc (Ag.) thesis, Kerala Agricultural University, Thrissur. pp. 62-63.

Norgate, M., Boyd-Gerny, S., Simonov, V., Rosa, M. G., Heard, T. A., & Dyer, A.

G. (2010). Ambient temperature influences Australian native stingless bee (Trigona carbonaria) preference for warm nectar. *PloS one*, *5*(8), e12000.

Octaria B. (2007). Keanekaragamn Jenis Kunang-kunang (Coleoptera: Lampyridae) di Hutan Pendidikan dan Penelitian Biologi (HPPB). Skripsi Padang Universitas Andalas.

Odum, H. T. (1996). Scales of ecological engineering. *Ecological Engineering*, *6*(1-3), 7-19.

Odum, E. P. (1998). *Dasar-Dasar Ekologi*. Diterjemahkan oleh Tjahjono Samingan. Edisi Ketiga. Gadjah Mada University Press. Yogyakarta.

Pangestika NW. (2016). Additional Nest Structure and Flower Constancy of Stingless Bees (Hymenoptera: Apidae) [Tesis]. Bogor, Indonesia: Institut Pertanian Bogor.

Pangestika, N. W., Atmowidi, T. & Kahono, S. (2018). Additional Nest Structures and Natural Enemies of Stingless Bees (Hymenoptera: Apidae: Meliponinae). *Jurnal Sumberdaya Hayati*. 4 (2): 42-47.

Powell, S., & Clark, E. (2004). Combat between large derived societies: a subterranean army ant established as a predator of mature leaf-cutting ant colonies. *Insectes Sociaux*, *51*, 342-351.

Premila KS., Devanesan S., & Shailaja KK. (2013). Reduviid bug *Acanthaspis siva* – a Predator of Honey Bee and Stingless Bee in Kerala. *Insect Environment* 19:197- 198.

Putra NS., Watiniasih NL., & Suartini M. (2016). Jenis Lebah Trigona (Apidae: Meliponinae) pada Ketinggian Tempat Berbeda di Bali. *Jurnal Simbiosis*. (1)6- 9.

Putri, D., Herwina, H., Arbain, A., & Handru, A. (2016). Ant species composition in Macaranga spp. trees at a conservation forest of palm oil plantation in West Sumatra, Indonesia. *Journal of Entomology and Zoology Studies*, *4*(1), 342-348.

Raakhee, M. (2000). Bioecology and Management of Stingless Bees (Apidae: Meliponinae). M. Sc.(Ag.) thesis, Kerala Agricultural University, Thrissur, 68.

Rajkumari P., Sharmah D., Rahman A., & Patgiri P. (2014). Diversity and Distribution Pattern of Hymenopteran Insects in Jorhat District, Assam, India. *International Journal of Science and Research.* 3(12):1938-1941.

Rasmussen C., (2008). Catalog of the Indo-Malayan/Australasian Stingless Bees (Hymenoptera: Apidae: Meliponini). *Zootaxa* 1935. Magnolia Press.

Rasmussen, C., & Cameron, SA. (2010). Global Stingless Bee Phylogeny Supports Ancient Divergence, Vicariance, and Long-distance Dispersal. *Biological Journal of the Linnean Society*, 99(1): 206-232.

Rasmussen C. (2013). Stingless Bees (Hymenoptera: Apidae: Meliponini) of the Indian sub-continent: Diversity, Taxonomy and Current Status of Knowledge. *Zootaxa.* 3647(3):401-402.

Rohmare, V. B., Rathod, D. M., Dholu, S. G., Parasharya, B. M., & Talmale, S. S. (2015). An inventory of odonates of central Gujarat, India. *Journal of Threatened Taxa*, *7*(11), 7805-7811.

Reyes-González, A., & Zamudio, F. (2020). Competition Interactions Among Stingless Bees (Apidae: Meliponini) for Croton yu catanensis Lundell resins. *International Journal of Tropical Insect Science*, 40(4), 1099–1104.

Riendriasari, S.D. (2013). *Budidaya Lebah Madu Trigona sp. Mudah dan Murah. Makalah Seminar Alih Teknologi "Budidaya Lebah Madu* Trigona sp.". Balai Teknologi Hasil Hutan Bukan Kayu. Mataram.

Rizaldi, Mairawita, Novarino W, Nurainas, Nurdin J & M. Idris. (2018). An Introduction to the Biological Education and Research Forest of Andalas University. Andalas University Press, Padang, Indonesia.

Rizali A., Bos MM., Buchori D., Yamane S., & Schulze CH. (2008). Ants in Tropical Urban Habitat: The Myrmecofauna in a Densely Populated Area of Bogor, West Java, Indonesia. *HAYATI Journal of Biosciences* 15:77-84.

Roubik, D. W. (2006). Stingless bee nesting biology. *Apidologie*, *37*(2), 124-143.

Sakagami S F, Inoue T., & Salmah S. (1990). Stingless Bees of Central Sumatra. In: Sakagami SF, Ohgushi RI, Roubik DW. Natural History of Social Wasps and Bees in Equatorial Sumatra (Sapporo (JP): Hokkaido

University Pr.) pp 125- 137.

Salatnaya H., Fuah AM., Widodo WD., & Winarno. (2020). Aktivitas *Tetragonula laeviceps* (Hymenoptera: Apidae: Meliponini) pada Perkebunan Pala *(Myrictica fragrans* Hout) Monokultur dan Polikultur di Jawa Barat. *Koli Journal* 1: 14-20.

Sanjaya, Y., & Dibiyantoro, A. L. (2012). Keragaman serangga pada tanaman cabai (Capsicum annuum) yang diberi pestisida sintetis versus biopestisida racun laba-laba (Nephila sp.). *Jurnal Hama Dan Penyakit Tumbuhan Tropika*, *12*(2), 192-199.

Sari, Y. I., Dahelmi, D., & Herwina, H. (2015). Jenis-Jenis Kumbang Tinja (Coleoptera: Scarabaeidae) di Hutan Pendidikan dan Penelitian Biologi (HPPB) Universitas Andalas, Padang. *Jurnal Biologi UNAND*, *4*(3).

Schultz, T. R. (2000). In search of ant ancestors. *Proceedings of the National Academy of Sciences*, *97*(26), 14028-14029.

Setiyono.J.,S. Diniartsih,E.N.R. Oscilata & N.S.Budi. (2017). Dragonflies og Yogyakarta. Jenis Capung Daerah Istimewa Yogyakarta. Indonesia Dragonflya Society, Yogyakarta.

Shackleton K., Toufailia HA., Balfour NJ., Nascimento FS., Alves DA., Francis L., & Ratnieks W. (2015). Appetite for Self Destruction: Suicidal Biting as a Nest Defense Strategy in *Trigona* Stingless bees. *Behav Ecol Sociobiol* 69:273-281.

Shannon, C. E., & Weaver, W. (1949). A Mathematical theory of Communication, e University of Illinois Press. *Champaign, IL, USA.*

Sharma, G., & Sundararaj, R. (2011). Association of ants and honeydew producing sucking pests in Bangalore provenance of sandal (Santalum album Linn.). In *Biological Forum-An International Journal* (Vol. 3, No. 2, pp. 62-64).

Sihombing DTH. (2005). *Ilmu ternak lebah madu*. Yogyakarta: Gajah Mada University Press.

Silva, A.C., & Gl-Santana, H. R. (2004). Predation of *Apiomerus pillipes* (Fab.) (Hemiptera, Reduviidae, Harpactorinae, Apiomerini) over meliponinae bees (Hymenoptera, Apidae) in the State of Amazonas, Onas, Brazil. *Revista Brasileria de Zoologia*. 21: 769 – 774.

Simões, D., Noll, F. B., & Zucchi, R. (1996). Duration of Protopolybia exigua exigua (de Saussure) nests and related aspects as influenced by phorid fly infestation (Vespidae, Polistinae, Epiponini). *Sociobiology*, *28*(1), 121-130.

Smith, F. G. (1960). Comb foundation: its use for African honeybees. *Bee World*, *41*(9), 235-240.

Smith, K. F., Yabsley, M. J., Sanchez, S., Casey, C. L., Behrens, M. D., & Hernandez, S. M. (2012). Salmonella isolates from wild-caught Tokay geckos (Gekko gecko) imported to the US from Indonesia. *Vector-Borne and Zoonotic Diseases*, *12*(7), 575-582.

Smith, B., & Wilson, J. B. (1996). A consumer's guide to evenness indices. *Oikos*, 70-82.

Strauss U., Human H., Gauthier L., Crewe RM., Dretemann V., & Park CWW. (2013). Seasonal Prevalence of Pathogens and Parasites in the Savannah Honeybee (*Apis mellifera* scutellata). *Invertebrate Pathology* 114:45-52.

Subyanto., Sulthoni A., Siwi SS., & Lilies C. (1991). *Kunci Determinasi Serangga.* Yogyakarta: UGM.

Sumoprastowo RM., & Suprapto RA. (1980). *Beternak Lebah Madu Modern.* Jakarta: PT. Bhantara Niaga Media.

Supeno B., & Erwan. (2016). *Pengenalan Pembelajaran Tentang Lebah Madu (Honey Bees).* Lombok: Arga Puji Press Mataram Lombok.

Suprianto., Trianto M., & Alam N. (2020). Karakter Morfologi dan Analisis Daerah Conserved Gen Elongation Factor 1α (EF1α) pada *Lepidotrigona terminate. Journal of Biology Science*, 7(2): 30-39.

Sutrisna, M., Bagus, I., Saskara, N., & Ayu, I. (2020). Prospective analysis of sustainable tourism development in penglipuran village as a tourist village role model in Bali. *Technium Soc. Sci. J.*, *13*, 184.

Syafrizal., Bratawinata AA., Sila M., & Marji D. (2012). Jenis Lebah Kelulut (*Trigona spp.)* di Hutan Pendidikan Lempake. *Mulawarman Scientiffie 11*:11-18.

Tambunan, G.R., M.U. Tarigan, dan Lisnawita. (2013). Indeks Keanekaragaman Jenis Serangga Pada Pertanaman Kelapa Sawit (Elaeis guineensis Jacq.) di

Kebun Helvetia PT Perkebunan Nusantara II. J. Online Agroekoteknologi USU 1 (4):1081-1091.

Triplehorn, C. A., & Johnson, N. F. (2005). Order Hymenoptera. *Borror and Delong's Introduction to the Study of Insects, 7th edition. Thomas Brooks/Cole, Belmont, CA*, 481-570.

Vijayakumar K., Muthuraman M., & Jayaraj R. (2012). Predation of Stingless Bee (*Trigona iridipennis:* Apidae, Meliponinae) by Centipede *(Scolopendra hardwicki:* Chilopoda: Scolopendramorpha). *International Journal of Advanced Life Sciences* 5:156-159.

Wattanachaiyingcharoen W., & Jongjitvimol T. (2007). First Record of the Predator, *Pahabengkakia piliceps* Miller, 1941 (Reduviidae, Harpactorinae) in the Stingless Bee, *Trigona collina* Smith, 1857 (Apidae, Meliponinae) in Thailand. *The Natural History Journal of Chulalongkorn University* 7:71-74.

Wicaksono, K. P., Suryanto, A., Nugroho, A., Nakagoshi, N., & Kurniawan, N. (2011). Insect as Biological Indicator from Protected to The Disturb Landscape in Central Java Indonesia. *AGRIVITA Journal of Agricultural Science*, *33*(1), 75-84.

Wielgoss A, Tscharntke T, Buchori D, Fiala B, Clough Y. (2010). Temperature and a Dominant Dolichorine Ant Species Affect ant Diversity in Indonesian Cacao Plantations. *Agriculture, Ecosystem and Environment* 135:253-259.

Yakobson B. A., Rosenthal C. (1990). Th e status of bee pests in Israel, p. 213-214 in: Ritter W. (ed) Proceedings of the international symposium on recent research on bee pathology, 5-7 September 1990, Ghent, Belgium. Rijksstation voor Nematologie en Entomologie on behalf of Apimondia, Merelbeke, Belgium.

Yanti, E. (1999). Komposisi dan Struktur Komunitas Laba-laba (Araneae) Permukaan Tanah pada Daerah Hutan dan Semak Belukar di HPPB Unand Padang.

Yazbek R. 1990. Beekeeping in Syria. Bee World 71(1): 41-42.

APPENDICES

Appendix 1. Complete Data Sampling Using the Quadran Protocol Method at BERF and EDUFARM Location

Tabel 1. Insect and Arachnida Composition of Stingless Bee Colonies found in BERF and EDUFARM, Universitas Andalas. BT=Honey Bait Trap, LL=Leaf Litter Sampling, SC=Soil Core, HC-IN=Hand Collecting-Insect Net, N. ind sp=Number of individual of species, N. ind or=Number of individual of Order

No	Order / *Family* / *Spesies*	Biological Education and Research Forest (BERF)							Education Farm (EDUFARM)							Total
		Method							Method							
		Around Colonies				In colonies	N. ind Sp	N. ind Or	Around Colonies				In colonies	N. ind Sp	N. ind Or	
		BT	LL	SC	HC-IN				BT	LL	SC	HC-IN				
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	Araneae							**30**							**9**	**39**
	Agelenidae															
1	*Agelenopsis pennysylvanica*				12		**12**									
	Oxyopidae															
2	*Oxyopes sp.*				9		**9**									
3	*Oxyopes javanus*				2		**2**					3		**3**		
	Salticidae															
4	*Menemerus formosus*											6		**6**		
5	*Thorelliola ensifera*					7	**7**									

Table 1. (cont)

	Blattodea					**4**				**4**
	Ectobiidae									
6	*Supella longipalpa*	4			**4**					
	Coleoptera					**9**			**8**	**17**
	Coccinellidae									
7	*Coelophora inaequalis*						8	**8**		
8	*Exochomus quadripustulatus*			6	**6**					
9	*Micraspis crocea*		3		**3**					
	Diptera								**3**	**3**
	Drosophilidae									
10	*Drosophila sp.*						3	**3**		
	Hemiptera					**12**			**12**	**24**
	Alydidae									
11	*Riptortus linearis*						6	**6**		
12	***Coroideae***									
13	*Gonocerus acuteangulatus*		5		**5**		3	**3**		

Table 1. (cont)

	Pentatomidae														
14	*Atestiopsis anchora*											2	**2**		
	Plataspidae														
15	*Brachyplatis subaeneus*											1	**1**		
	Pyrrhocoridae														
16	*Bothrogonia ferruginea*				7		**7**								
	Homoptera							**5**							**5**
17	***Cicadidae***					5	**5**								
	Hymenoptera							**1036**						**1548**	**2548**
	Formicidae														
18	*Anoplolepis gracilipes*	684				19	**703**		1024	4			**1024**		
19	*Colobopsis mutilata*				3		**3**				1		**1**		
20	*Componotus pudorosus*		18	5			**23**				11	32	**43**		
21	*Dolicoderus biturbeculatus*			4	16		**20**				15	5	**20**		
22	*Dolicoderus thoracicus*	2					**2**				2		**2**		
23	*Polyrhachis armata*		21				**21**			6		8	**8**		
24	*Polyrhachis dives*		7		2		**9**			11		4	**15**		

Table 1. (cont)

25	*Tapinoma melanocephalum*	255			**255**		435			**435**		
	Isopoda					**18**					**3**	**21**
	Philosciidae											
26	*Philoscia muscorum*		18		**18**			3		**3**		
	Lepidoptera					**19**					**16**	**35**
	Erebidae											
27	*Bertula lobativalva*			2	**2**				1	**1**		
28	*Ugia signifera*			1	**1**				3	**3**		
	Lycaenidae											
29	*Arthopala horsfieldi*			1	**1**							
	Nymphalidae											
30	*Agraulis vanillae*			2	**2**							
31	*Euploea phaenareta*			2	**2**							
32	*Faunis canens*			1	**1**							
33	*Hympolimnas bolina*								1	**1**		
34	*Junonia almana*								1	**1**		
35	*Junonia hedonia*			2	**2**							

Table 1. (cont)

36	*Junonia orithya*							1	**1**		
37	*Ypthima huebneri*			1	**1**						
	Papilionidae										
38	*Papilio memnon*							1	**1**		
	Pieridae										
39	*Appias libythea*							2	**2**		
40	*Leptosia nina*							3	**3**		
41	*Eurema sp.*			7	**7**			3	**3**		
	Odonata					**9**				**4**	**13**
	Libellulidae										
42	*Neurothermis terminata*		2		**2**						
43	*Orthetrum sabina*		6		**6**		4		**4**		
44	*Pantala flavescens*		1		**1**						
	Orthoptera					**16**				**7**	**23**
	Acrididae										
45	*Dissosteira carolina*	8			**8**		2		**2**		
46	*Phlaeobo infumata*			6	**6**						
47	*Valanga ndricornis*			2	**2**		5		**5**		

Table 1. (cont)

	Pseudoscorpiones							**2**								**2**
	Chernetidae															
48	*Apotochernes gallinaceus*					2	**2**									
∑***Individual***		941	58	9	86	66	**1160**	**1160**	1459	21	32	92	14	**1610**	**1610**	**2770**
∑***Species***		3	5	2	13	16	**35**		2	3	5	15	9	**29**		**48**
∑***Family***		1	3	1	8	10	**17**		1	1	2	11	4	**16**		**22**
∑***Order***		1	3	1	6	7	**11**		1	1	2	7	1	**9**		**12**

Appendix 2. Figure Pest of Stingless Bee Colonies at BERF and EDUFARM

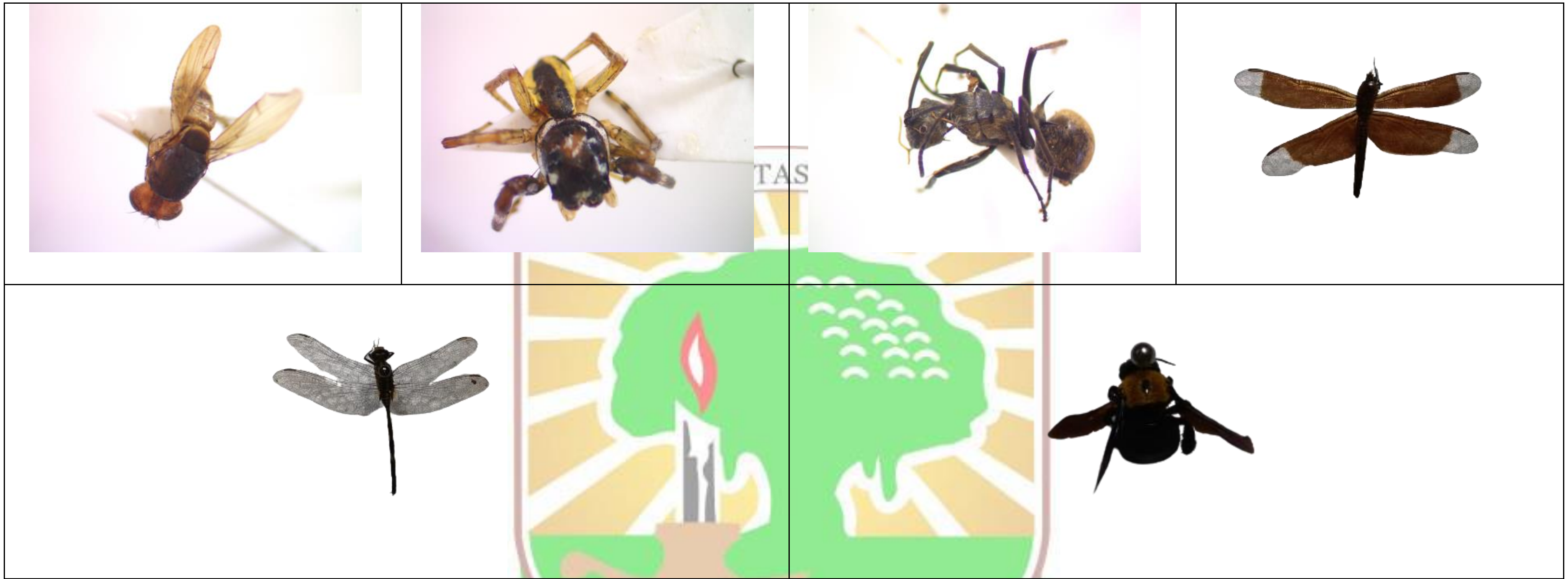
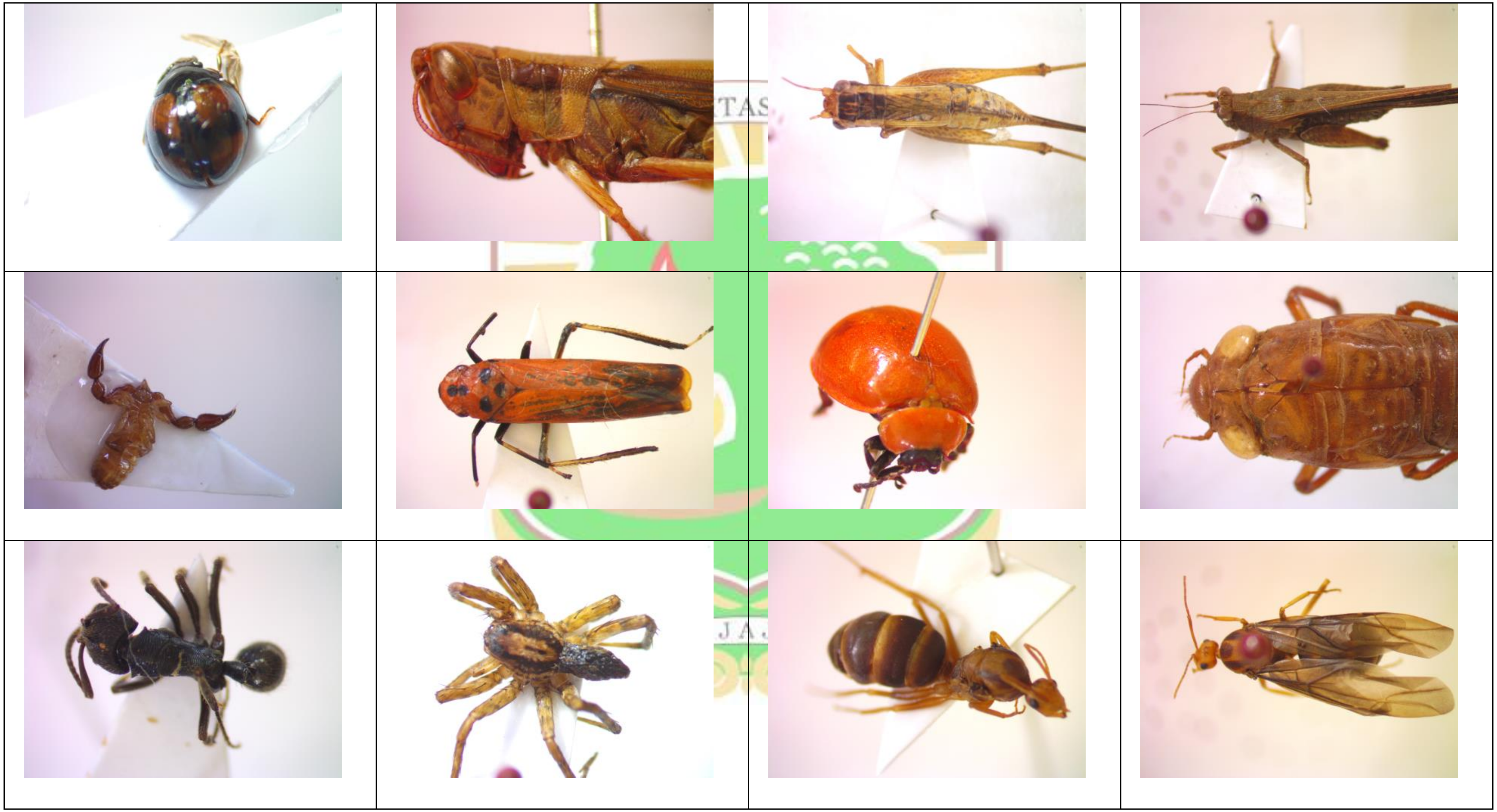


Figure 1. [From left to the right, (*Hemidactylus sp.*); (Cicadidae); (*Thorelliola ensifera*); (*Apatochernes gallinaceus*); (*Anoplolepis gracilipes*); (Queen of *Anoplolepis gracilipes*); (*Agelenopsis pennsylvanica*); (*Dolicoderus biturbeculatus*); (*Colobopsis mutilate*); (*Philoscia muscorum*); (*Componotus pudorosus*); (*Polyrachis armata*); (*Drosophila sp.*); (*Menemerus formosus*); (*Polyrhachis dives*); (*Neurothermis sp.*); (*Orthetrum sabina*); (*Xylocopa confuse*).

Appendix 3. Figure Whole Insect in Stingless Bee Colonies at BERF and EDUFARM



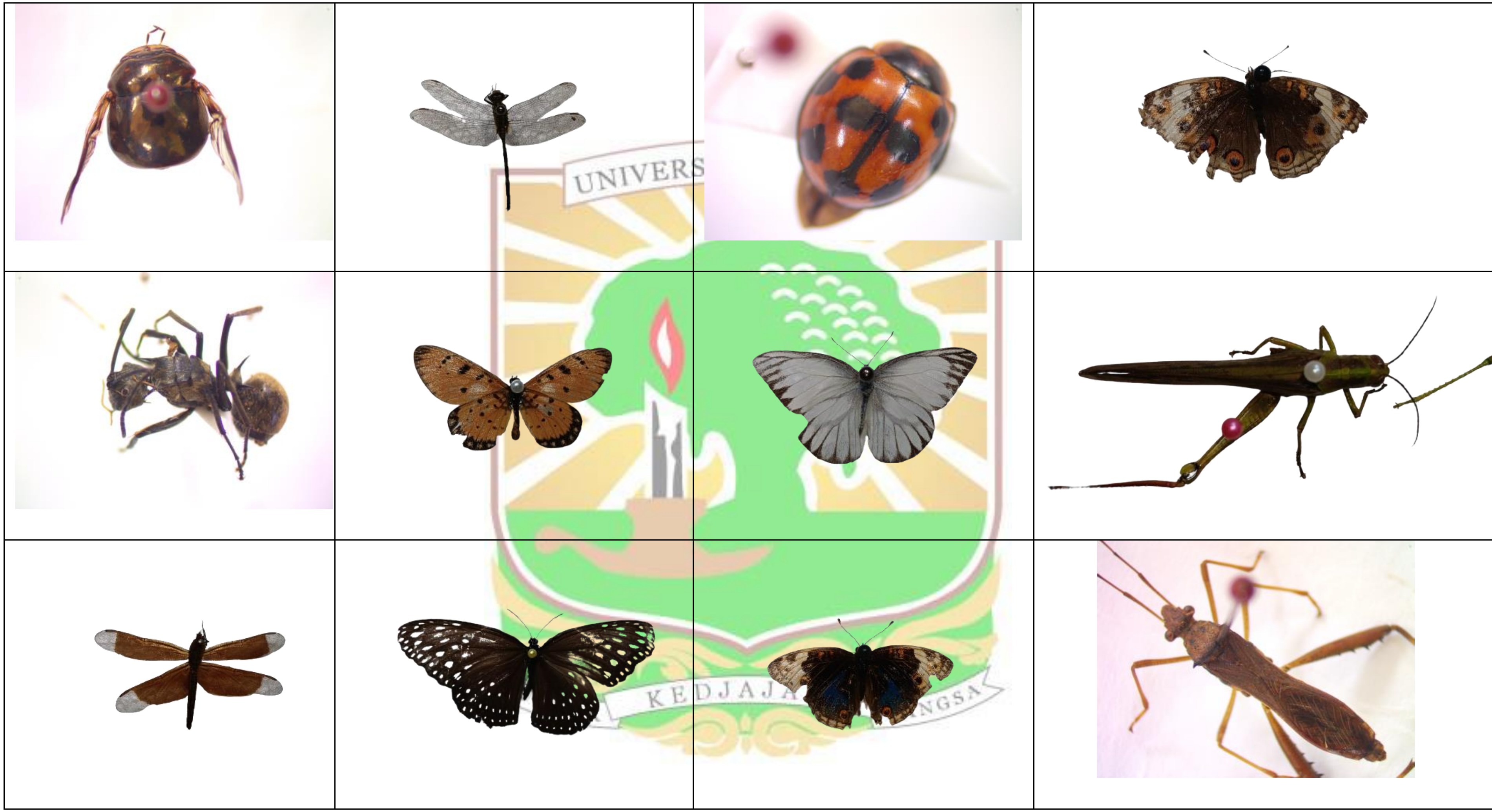


Figure 2. [From left to the right, (*Exochomus quadripustulatus*); (*Valanga nidricornis*); (*Dissosteira Carolina*); (*Phlaeobo infumata*); (*Apatochernes gallinaceus*)*;* (*Bothrogonia ferruginea*); (*Micraspis crocea*); (*Cicadidae*); (*Dolicoderus biturbeculatus*); (*Agelenopsis pennsylvanica*); (*Anoplolepis gracilipes*); (Queen of *Anoplolepis gracilipes*); (*Thorelliola ensifera)*; (*Colobopsis mutilate*); (*Hemidactylus sp.*); (*Oxyopes sp.*); (*Menemerus formosus*); (*Polyrachis armata);* (*Supella longipalpa*); (*Atestiopsis anchora*); (*Philoscia muscorum*); (*Componotus pudorosus*); (*Drosophila sp.*); (*Oxyopes javanicus*); (*Brachyplatis subaeneus*); (*Orthetrum Sabina*); (*Coelophora inaequalis*); (*Junoria almanac*); (*Polyrhachis dives);* (*Agraulis vanilla*); (*Appias libythea*); (*Chortippus aquaticum*); (*Neurothermis sp*); (*Euploea phaenareta*); (*Junonia orithya*); (*Riptortus linearis*).

Appendix 4. List of Plant Vegetation in BERF and EDUFARM

Family	Genus	Species	Location	
			BERF	EDUFARM
Anacardiaceae	*Mangifera*	*Mangifera sp.*	*	
Annonaceae	*Cyathocalyx*	*Cyathocalyx ridley*	*	
Apocynaceae	*Alstonia*	*Alstonia scholaris*	*	*
Cannabaceae	*Gironiera*	*Gironiera nervosa*	*	*
Dilleniaceae	*Dilenia*	*Dilenia indica*	*	*
Dipterocarpaceae	*Canarium*	*Canarium sp.*	*	
	Shorea	*Shorea sp*	*	
Elaeocarpaceae	*Elaeocarpus*	*Elaeocarpus porfivolius*	*	*
Eupphorbiaceae	*Macaranga*	*Macaranga triloba*	*	
Fabaceae	*Adenanthera*	*Adenanthera pavonian*		*
	Calliandra	*Calliandra sp.*		*
	Parkia	*Parkia speciosa*	*	*
	Saraca	*Saraca indica*		*
Fagaceae	*Castanopsis*	*Castanopsis ramnifolia*	*	
	Querqus	*Querqus ewickii*	*	

Lamiaceae	*Clorodendron*	*Clorodendron deflexum*		*
Lauraceae	*Ediandra*	*Endiandra sp.*	*	
	Litsea	*Litsea sp.*	*	*
Malvaceae	*Durio*	*Durio zibenthinus*	*	
	Microcos	*Microcos florida*	*	
	Pterospermum	*Pterospermum javanicum*	*	*
	Sterculia	*Sterculia oblongata*	*	
Melastomataceae	*Ptenandra*	*Ptenandra sp.1*		*
	Ptenandra	*Ptenandra sp.2*		*
	Ptenandra	*Ptenandra echinata*		*
Meliaceae	*Aglaia*	*Aglaia trichostemon*	*	
Moraceae	*Arthocarpus*	*Arthocarpus sp.*	*	
	Arthocarpus	*Arthocaprus borneensis*	*	
	Arthocarpus	*Arthocarpus maingayi*	*	
	Morace	*Morace sp.*	*	
Myristicaceae	*Knema*	*Knema kunstleri*	*	*
	Myristica	*Myristica sp.*	*	
Passifloraceae	*Passiflora*	*Passiflora foetida*		*

Pentaphylacaceae	*Adinandra*	*Adinandra Dumosa*	*	
Phyllanthaceae	*Aporusa*	*Aporusa praineana*	*	*
	Baccaurea	*Baccaurea wellichii*	*	*
Polygonaceae	*Antigonon*	*Antigonon leptous*		*
Rhizophorazceae	*Rhizopora*	*Rhizopora sp.*	*	*
Rubiaceae	*Lasianthus*	*Lasianthus oblongus*	*	
Rutaceae	*Acronychia*	*Acronychia laurifolia*	*	*
Sapindaceae	*Pometia*	*Pometia sp.*	*	*
	Pometia	*Pometia pinnata*	*	
Tiliaceae	*Grewia*	*Grewia umbellata*		*

Appendix 5. Environmental Factor of BERF and EDUFARM

Location	Temperature (°C)	Average	Light Intensity (Lux)	Average	Humidity (RH)	Average
BERF	27.5	28.7	609	609	83	83
	29.9		609		83	
EUFARM	30.2	31.15	305	305	68	83
	32.1		305		68	

Appendix 6. Differences between BERF and EDUFARM Vegetation

Picture 3. Two pictures from left, the condition of EDUFARM vegetation. The right one is picture of BERF condition of vegetation.

Appendix 7. Documentation

Figure 4. Research Activities in EDUFARM

Figure 5. Research Activities in BERF

SKRIPSI_Miftahul Ilmi-1724207424349

ORIGINALITY REPORT

15%	11%	9%	5%
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	ijcrar.com Internet Source	3%
2	Submitted to Universitas Andalas Student Paper	1%
3	Submitted to South University Student Paper	1%
4	baadalsg.inflibnet.ac.in Internet Source	1%
5	Bainah Sari Dewi, Azalia Zania, Evi Damayanti, Kuswandono, Rudi Hilmanto. "Diversity, Evenness, and Dominance Index of Amphibians in Lowland Rain Forest: A Case of Anura Ordo in Way Kambas National Park, Indonesia", Jurnal Sylva Lestari, 2024 Publication	1%
6	www.scribd.com Internet Source	1%
7	link.springer.com Internet Source	1%

8	eproceeding.undwi.ac.id Internet Source	1 %
9	article.sciencepublishinggroup.com Internet Source	1 %
10	innspub.net Internet Source	1 %
11	journal.ipb.ac.id Internet Source	1 %
12	Fauziyah, Nurhayati, S M Bernas, A Putera, Y Suteja, F Agustiani. "Biodiversity of fish resources in Sungsang Estuaries of South Sumatra", IOP Conference Series: Earth and Environmental Science, 2019 Publication	<1 %
13	Mardhiana, Rosnauli Panjaitan, Rita Diana, Tati Harryati. "Study Of The Ground Cover Species Important For Agriculture In Peat Swamp Forest Area Tengku Dacing Village", IOP Conference Series: Earth and Environmental Science, 2022 Publication	<1 %
14	www.entomoljournal.com Internet Source	<1 %
15	Tokumoto, Yuji, Takao Itioka, Tatsuhiro Ohkubo, Osamu Tadauchi, and Michiko Nakagawa. "Assemblage of flower visitors to	<1 %

Dillenia suffruticosa and possible negative effects of disturbances in Sarawak, Malaysia : Flower visitors to", Entomological Science, 2013.
Publication

---

16 Abd Al-Majeed Ahmed Al-Chzawi, Shahera Talat Zaitoun, Hail Kamel Shannag. " Incidence and Geographical Distribution of Honeybee (L.) Pests in Jordan ", Annales de la Société entomologique de France (N.S.), 2013 <1%
Publication

---

17 iopscience.iop.org <1%
Internet Source

---

18 J V Hasinu, R Y Rumthe, J A Leatemia. "Insect diversity in vegetable crops of Waemital Village, West Seram, Indonesia", IOP Conference Series: Earth and Environmental Science, 2021 <1%
Publication

---

19 academicjournal.yarsi.ac.id <1%
Internet Source

---

20 jjbs.hu.edu.jo <1%
Internet Source

---

21 repository.pnb.ac.id <1%
Internet Source

---

22 H Herwina, Y Yaherwandi, J Nurdin, MN Janra, S Salmah, J Jasmi, BY Christy. "Characteristics <1%

of stingless bees (Hymenoptera: Apidae: Meliponini) from Universitas Andalas Limau manis campus complex and its implication in pollination and ecotourism", African Journal of Food, Agriculture, Nutrition and Development, 2022
Publication

23	rsdjournal.org Internet Source	<1 %
24	Submitted to Chulalongkorn University Student Paper	<1 %
25	Rima Nabilah Haifa, Zahidah Hasan, Heti Herawati, Isni Nurruhwati, Asep Sahidin. "Spatial Distribution of Phytoplankton in Jatigede Reservoir, West Java, Indonesia", Asian Journal of Fisheries and Aquatic Research, 2020 Publication	<1 %
26	limnologie.univ-lyon1.fr Internet Source	<1 %
27	repository.umy.ac.id Internet Source	<1 %

Exclude quotes Off
Exclude bibliography On
Exclude matches < 20 words

SKRIPSI_Miftahul Ilmi-1724207424349

PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20

PAGE 21

PAGE 22

PAGE 23

PAGE 24

PAGE 25

PAGE 26

PAGE 27

PAGE 28

PAGE 29

PAGE 30

PAGE 31

PAGE 32

PAGE 33

PAGE 34

PAGE 35

PAGE 36

PAGE 37

PAGE 38

PAGE 39

PAGE 40

PAGE 41

PAGE 42

PAGE 43

PAGE 44

PAGE 45

PAGE 46

PAGE 47

PAGE 48

PAGE 49

PAGE 50

PAGE 51

PAGE 52

PAGE 53

PAGE 54

PAGE 55

PAGE 56

PAGE 57

PAGE 58

PAGE 59

PAGE 60

PAGE 61

PAGE 62

PAGE 63

PAGE 64

PAGE 65

PAGE 66

PAGE 67

PAGE 68

PAGE 69

PAGE 70

PAGE 71

PAGE 72

PAGE 73

PAGE 74

PAGE 75

PAGE 76

PAGE 77

PAGE 78

PAGE 79

PAGE 80

PAGE 81

PAGE 82

PAGE 83

PAGE 84

PAGE 85

PAGE 86

PAGE 87

PAGE 88

PAGE 89

PAGE 90

PAGE 91

PAGE 92

PAGE 93

PAGE 94

PAGE 95

PAGE 96

PAGE 97

PAGE 98