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Research Article

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Kajian Cepat: Keanekaragaman Serangga di Sekitar Koloni Lebah Tak Bersengat di Edufarm Universitas Andalas

A Rapid Assessment: Insect Diversity Around the Stingless Bee Colony in Edufarm Universitas Andalas

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A B S T R A C T

Insects dominate the animal kingdom, comprising nearly 80% of all animal species, with around 250,000 species found in Indonesia. Among these, stingless bees are a diverse group with over 60 genera. Some stingless bees are cultivated in meliponiculture, practiced around homes and plantations. This study aimed to assess insect diversity near stingless bee colonies in the Education Farm (Edufarm), Universitas Andalas, through a rapid assessment conducted over two days in May 2024. A transect was established with three U-shaped sub-transects surrounding a stingless bee colony. The modify quadra protocol sampling (honey bait traps, leaf litter, soil cores, and hand collecting) was used around the colony. The study identified 1153 individuals from 6 orders, 9 families, and 15 species of insects, with Formicidae from Hymenoptera being the most dominant. This research offers valuable insights into insect diversity around stingless bee colonies at Edufarm and can inform better management strategies for stingless bees and the ecological structure of surrounding environments.

INTRODUCTION

Insects represent the most diverse group of animals on Earth, comprising nearly 80 percent of all known species. With approximately 751,000 species identified globally, Indonesia alone is home to around 250,000 of these fascinating organisms. While many insects are often labeled as pests in agricultural contexts, a significant portion of these creatures plays crucial roles in maintaining ecological balance and supporting various ecosystems (Kalshoven, 1981; Christian & Gottsberger, 2000). Insects demonstrate remarkable adaptability, thriving in diverse habitats and exhibiting high reproductive rates, varied diets, and sophisticated defense mechanisms against predators (Borror & Triplehorn, 1981).

Among the myriad of insects, bees as vital pollinators that enhance the reproductive success of numerous plants, including wild flora (Heard, 1989; Herwina et al., 2022). Their ecological importance extends beyond agricultural crops to maintaining biodiversity in natural ecosystems. In West Sumatra, for instance, stingless bees, known locally as *galo-galo*, can be found thriving in diverse habitats ranging from lowland forests to highland regions, adapting to various climatic and environmental conditions (Herwina et al., 2021). Globally, there are an estimated 500-600 species of stingless bees (Basari & Khairi, 2018; Herwina et al., 2020). These eusocial insects belong to the tribe Meliponini and include various genera such as *Tetragonula*, *Lepidotrigona*, and *Geniotrigona*, each with unique nesting behaviors, morphological traits, and environmental adaptations (Rasmussen & Camargo, 2008).

Stingless bees belong to the tribe Meliponini and the family Apidae, which is

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diverse, consisting of over 60 genera (Rasmussen & Cameron, 2010). Globally, they are distributed across regions, with around 300 species found in the Americas, 60 in Asia, and smaller populations in Africa and Australia. Their ecological significance cannot be overstated, as they not only pollinate a wide variety of flowering plants, including herbs, shrubs, and trees, but also engage in meliponiculture, the practice of rearing stingless bees for honey production (Rajkumari et al., 2014; Leonhardt, 2017). Stingless bees, with their extensive distribution and ecological role, are crucial contributors to biodiversity, particularly in tropical and subtropical regions. Their colonies often become focal points of activity in their ecosystems, drawing various insect species that coexist in the shared habitat.

The diversity of insects around stingless bee colonies is influenced by the characteristics of the surrounding habitat. Secondary forests with complex vegetation structures provide a variety of microhabitats that support different insect species, which play essential roles in ecosystem functions such as pollination, pest control, and nutrient recycling (Lawton et al., 1998). Remote conditions, far from human settlements, also reduce anthropogenic pressures, such as pesticide use, which is known to significantly decrease insect diversity (Potts et al., 2010). In relatively undisturbed habitats, insects can interact more freely with stingless bee colonies, serving as competitors, predators, or integral parts of the pollination ecosystem (Heard, 1999).

Research focused on the diversity of insect communities surrounding stingless bee colonies within secondary forest habitats is essential for comprehensively understanding the complex ecological interactions that occur in these environments, as well as for advancing biodiversity conservation efforts. Understanding the biological indices of insects associated with stingless bee colonies in natural habitats is essential for developing effective habitat management strategies that support stingless bee population sustainability (Jaffe et al., 2015).

RESEARCH METHOD

Research Location

This research was conducted from May to July 2024, focusing on the collection of insect around stingless bee colonies in the Education Farm (Edufarm, coordinates 0°54’42.974’’S 100°27'56.750"E) and the Animal Taxonomy Laboratory, Biology Department, Universitas Andalas, Padang, West Sumatera, Indonesia. Identification Collections took place over six days in May, from 08:00 to 16:00 WIB.

Method and Work Procedure

To assess the insects, we utilized a modification of “Quadra Protocol Method” by (Hashimoto et al., 2001), involving a 180-meter transect divided into three 60-meter sub-transects. Within each sub-transect, four sampling techniques were implemented: honey bait traps, leaf litter sampling, soil core sampling, and hand collecting.

Fig. 1. Several colonies of stingless bee at Education Farm (Edufarm), Universitas Andalas

Honey bait traps, consisting of honey smeared on cotton wool placed on paper (10cm x 15cm), were positioned every four meters along the transect. Leaf litter sampling involved using a sieve for 30 minutes at designated spots 15 meters apart. Soil core sampling required digging a 20cm x 20cm x 15cm area for 30 minutes at each sub-transect. Hand collecting involved directly sampling insects along the transect for 30 minutes per sub-transect. This transect design ensured a standardized sampling effort across spatial gradients, allowing for consistent data collection throughout the study area.

Collected samples were preserved using a dry preservation method, with specimens pinned and pointed onto Styrofoam to maintain their structural integrity for taxonomic identification. Morphological structures were examined both macroscopically and under a stereomicroscope to observe critical. Data were organized into tables and diagrams. Biological indices, including the Shannon-Wiener Diversity Index, Evenness Index, and Dominance Index. The Shannon-Wiener Index evaluated species diversity by accounting for richness and proportional abundance (Magurran, 2013), while evenness and dominance indices measured population balance and species prevalence (Brower et al., 1997).

RESULT AND DISCUSSION

Insect Species Around Stingless Bee Colonies in Education Farm (Edufarm)

Research conducted in the Education Farm (Edufarm) identified 1,153 individuals from 6 orders, 9 families, and 15 species (Table 1). The order found with the most individuals was Hymenoptera with a total of 1119 individuals from one family, namely Formicidae. Also the order with the largest number of species comes from the Hymenoptera order with a total of 6 different species.

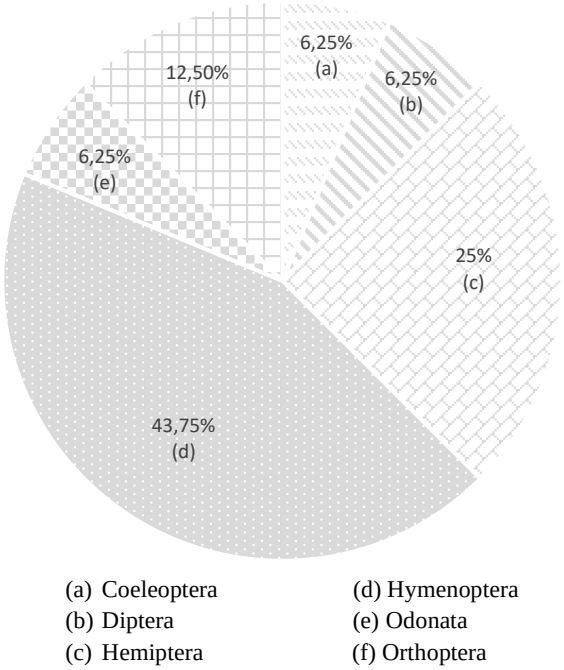

Fig. 2. Species composition of insects in several orders around stingless bee colonies at Edufarm using quadra protocol method

The Coleoptera order consisted of 8 individuals from 1 species, namely *Coelophora inaequalis* from the Coccinellidae family. The Diptera order included 3 individuals from the *Drosophila* genus in the Drosophilidae family. The Hemiptera order found 12 individuals from 4 different species, namely *Riptortus linearis*, *Homoeocerus* sp., *Atestiopsis anchora*, and *Brachyplatis subaeneus*, each from a different family. The Hymenoptera order recorded the largest number of individuals, totaling 1119 individuals from 6 different species such as *Anoplolepis gracilipes; Colobopsis* sp.; *Componotus* sp.; *Dolicoderus thoracicus; Polyrhachis armata; Polyrhachis dives* within the Formicidae family. The Odonata order consisted of 4 individuals from 1 species, *Orthetrum sabina*, in the Libellulidae family. The Orthoptera order was represented by 7 individuals from 2 different species in the Acrididae family, namely *Dissosteira carolina* and *Valanga nigricornis*.

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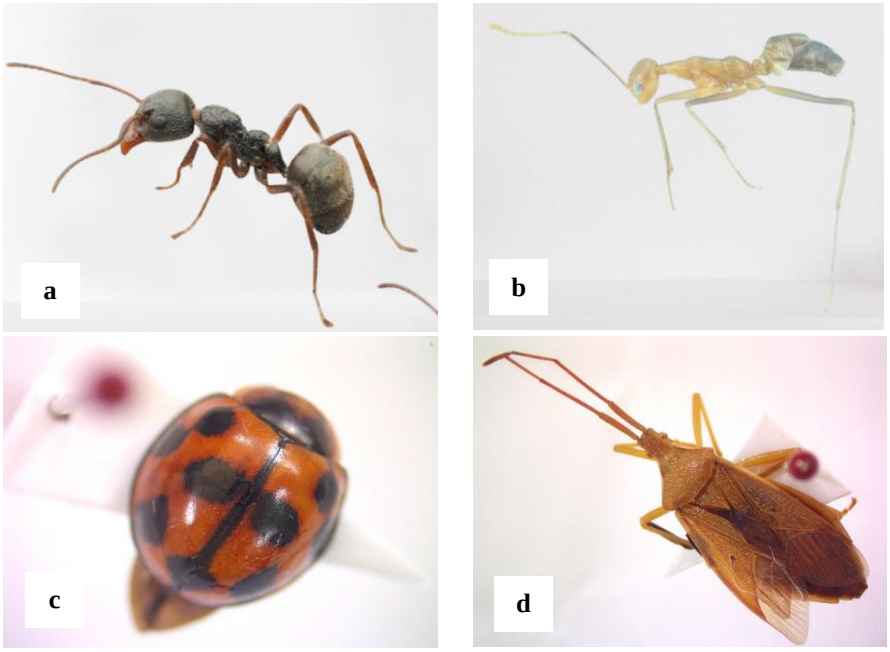

Fig. 3. Several sample of insects found around a stingless bee colony using the quadra protocol methods at Edufarm, Universitas Andalas. (a. *Dolicoderus thoracicus*; b. *Anoplolepis gracilipes.*; c. *Coelophora inaequalis*; d. *Homoeocerus* sp.)

The presence of insects around stingless bee colonies was influenced by the vegetation around the habitat. Education Farm (Edufarm) was a secondary forest with trees with large canopy cover. The number of large trees as habitats for arboreal insects affects the number of insects around stingless bee colonies, one of arboreal ants (Family Formicidae). Ants are a group of insects has an important role in the ecosystem (Kaspari, 2000) of which are associated with other organisms, become 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. 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 34 *Trigona* bees. Based on research by Pangestika et al (2018), that very aggressive ants attack individuals near the entrance to the beehive. This is the reason that causes the largest number of individuals from the order Hymenoptera (family Formicidae, ants).

Biological Index of Insects Species Around Stingless Bee Colonies at Edufarm

The biological index analysis has been carried out using the formula by entering the number of individuals from the 15 species obtained (Table 1). Among the indexes viewed were the diversity index, evenness index and dominance index.

Table 1. Complete data on orders, families, species and number of individual insects found around stingless bee colonies at Edufarm using the quadra protocol methods (Honey Bait Trap, Leaf Litter Sampling, Soil Core and Hand Collecting).

No	Orders	Family	Species	Quadra Protocol Methods (Total Number of Individuals)				
				Honey Bait Trap	Leaf Litter	Soil Core	Hand Collecting	Total
1	Coleoptera	Coccinellidae	*Coelophora inaequalis*				8	**8**

2	Diptera	Drosophilidae	*Drosophila sp.*				3	**3**
		Alydidae	*Riptortus linearis*				6	**6**
3	Hemiptera	Coroideae	*Homoeocerus* sp.				3	**3**
		Pentatomidae	*Atestiopsis anchora*				2	**2**
		Plataspidae	*Brachyplatys subaeneus*				1	**1**
			Anoplolepis gracilipes	1020	4			**1024**
			Colobopsis sp.			1		**1**
4	Hymenoptera	Formicidae	*Componotus* sp.			11	32	**43**
			Dolicoderus thoracicus			17	5	**22**
			Polyrhachis armata		6		8	**14**
			Polyrhachis dives		11		4	**15**
5	Odonata	Libellulidae	*Orthetrum sabina*				4	**4**
6	Orthoptera	Acrididae	*Dissosteira carolina*				2	**2**
			Valanga nigricornis				5	**5**
Total	**6**	**9**	**15**	**1020**	**21**	**29**	**83**	**1135**

Table 2. Data values biological indices of insects found at Education Farm (Edufarm)

Biology Index	Formula	Value
Diversity Index	H' = - ∑ pi ln (pi)	0.58
Evenness Index	E = ln (S)H′	0.11
Dominant Index	D = ∑pi^2	0.79

The biological indices analysis at the Education Farm (Edufarm) revealed that the insect community structure was ecologically imbalanced. The Shannon-Wiener diversity index (H') was relatively low at 0.58 (Table 2), indicating limited species diversity within the area. This was further supported by the very low evenness index, 0.11 (Table 2), suggesting that most individuals were concentrated in only a few species, particularly *Anoplolepis gracilipes*. This ecological imbalance was primarily driven by the high dominance index 0.79 (Table 2), which places it in the high dominance category.

The overwhelming abundance of *A. gracilipes* demonstrates that one species had clearly monopolized the community. Such dominance restricts the presence and abundance of other species, ultimately lowering overall diversity. In ecological terms, when one or a few species control most of the available resources and space, it suppresses species richness and disrupts the balance of the community. This uneven pattern may be influenced by habitat characteristics such as dense canopy cover, vegetation type, and the presence of stingless bee colonies that attract ant activity. As a result, although multiple insect species were recorded, the community at Edufarm was ecologically skewed, with limited diversity and a strong prevalence of certain dominant species over others.

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).

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). 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 (Bersel et al., 2003). The index

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increases with addition unique species or by existence greater evenness of species (Wicaksono et al., 2011).

The dominance index is used to state the level of centralization of species dominance (mastery) in a community. The dominance index ranges from 0 to 1, with categories 0 - 0.5 low dominance, 0.5 - 0.75 medium dominance and 0.75 - 1 high dominance (Odum, 1993). According to Ikbal et al (2014), species dominance is related to the diversity index, the lower the diversity value, the higher the dominance index value, and vice versa, the higher the diversity, the lower the dominance.

CONCLUSION

This study revealed that the insect community around stingless bee colonies at Edufarm was dominated by a single species, *Anoplolepis gracilipes*, which accounted for most of the 1,153 individuals recorded. Although 15 insect species were identified from 6 orders, the overall diversity and evenness were low, indicating an unbalanced community structure. The high dominance index suggests that a few species, particularly ants from the Formicidae family, strongly influenced the insect population dynamics around the bee colonies. Vegetation structure and canopy cover at Edufarm likely contributed to this dominance, especially by arboreal ants.

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