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# Insect Distribution In The Commonity Forest Plantation Of Waya Hamlet, Tehoru Vilage, Tehoru Subdsistrict, Central Maluku Regency.

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**ABSTRACT**

This research aims to identify the types of insects found in community forest areas in Dusun Waya, Tehoru Village, Tehoru District, Central Maluku Regency, to analyze the factors influencing the presence of insects in the community forest area, and to evaluate the effectiveness of insect traps in the community forest area of Dusun Waya, Tehoru Village, Tehoru District, Central Maluku Regency. This research was conducted in May 2025. The method used in this study was an inventory method for insect data collection with a transect width of 20 meters and a length of 100 meters with an interval of 10 meters, followed by insect sampling.

The results of the study at the research site in Dusun Waya, Tehoru Village, Tehoru District, Central Maluku Regency, recorded 29 insect species classified into 13 orders and 26 families, with a total of 425 individuals along the entire transect. Among the 5 transects, the highest number of insects was found using the hand collecting method, which proved to be the most effective method in this study. Factors affecting the presence of insects include air temperature, humidity, and light intensity.

## INTRODUCTION

Community forests are one of the models for natural resource management based on community initiatives aimed at producing timber or other non-timber forest products as an effort to improve income and community welfare. The development of Community Plantation Forests (HTR) is carried out by communities living in or around forest areas, consisting of individuals or

The presence of insects in an area plays various ecological roles, including as pollinators, decomposers, predators, and parasitoids. The presence of insects in a given habitat can indicate biodiversity levels, ecosystem health, and landscape degradation. Insects are animals with a wide range of habitat distributions, found in various environments such as mountains, forests, agricultural fields, residential areas, and urban regions (Taradiptha et al., 2019).

Insects are the dominant group of animals on Earth today. Their number exceeds that of all other terrestrial animals combined, and they are practically found everywhere. Several hundred thousand different species have been described—three times more than all other animal groups combined—and some researchers believe the total number of insect species could reach 30 million. The distribution of insects is limited by suitable geological and ecological factors, resulting in differences in species diversity (Yumaida et al., 2020).

## RESEARCH METHODS

### Place and Time of Research

This research was conducted in the Community Plantation Forest (HTR) area located in Waya Hamlet, Tehoru Village, Tehoru Subdistrict, Central Maluku Regency, and took place in May 2025.

The tools and materials used in this study included several insect collection instruments such as *Hand Collecting* (manual hand collection), *Pitfall Traps, Sweep Nets, Bait Traps, tweezers, thermometers, measuring tapes, raffia strings, a digital camera, plastic plates, and plastic cups. The materials used consisted of water, detergents (Soklin, Daia, and Jazz 1), sugar solutions (granulated sugar, Gulaku, and white crystal sugar), and fish (Momar fish, canned fish, and tuna).

In general, this study was carried out using a *sampling method. Observation transects were established using the **inventory method* for insect data collection. Each transect measured 20 meters in width and 100 meters in length, with a 10-meter distance between transects*. Insect sampling and data collection were then conducted along these observation lines.

### Sampling Techniques

The insects found in the Community Plantation Forest (HTR) area were collected using *four insect sampling techniques (Savdurin et al., 2023).1. Hand Collecting. The hand collecting method involves direct sampling. Each type of insect found is collected manually by hand or using tweezers and then placed into collection bottles containing 70% alcohol. Observations were made on all types of insects found around low-growing plants, among rocks, on the ground surface, soil mounds, and decaying wood. 2.Pitfal Trap. This trap is used to capture insects that live on the soil surface. The traps were installed along each observation transect. A total of 30 plastic cups (approximately 15 cm in diameter) were buried so that the rim of each cup was level with the ground surface. The traps were spaced 10 meters apart. The cups were filled with a mixture of clean water, detergent (Soklin, Daia, and Jazz 1), and sugar solution (granulated sugar, Gulaku, and white crystal sugar), with a total volume of about 400 ml per cup. The traps were left for 24 hours, and the captured insects were collected the next day and stored in sample bottles. 3. Sweep Net. This trap is made from lightweight and durable materials such as gauze, making it easy to swing and observe captured insects. Insect sweeping was conducted along each observation transect. The insects caught using the net were then placed into plastic bottles containing alcohol. 4. Bait Trap. This trap used raw fish (Momar fish and tuna) as bait, placed in 15 plastic plates. The baited plates were tied to trees at 10-meter intervals* along each observation transect and left in place for 24 hours.

### Insect Identification

Insects obtained in the field were grouped by genus. Insects whose species had been recognized were identified directly in the field. Conversely, unknown insects were identified by observing their external form (morphology).

### Insect Collection

Identified insects will be collected using both wet and dry methods. For wet collection, specimens are placed in glass vials containing 70% alcohol, sorted based on their morphological characteristics, and labeled accordingly. For dry collection, limp insects are injected with 70% alcohol into the abdomen to prevent decomposition, then placed in dry collection media and labeled accordingly.

### Data analysis

The data analysis was carried out using quantitative descriptive methods with an exploratory approach, involving direct observation and sampling from the research site. The insect data were processed by calculating the Diversity Index (H') using the Shannon-Wiener Index, the Abundance Index (K), and the Morisita Index.

### Diversity Index (H)

The diversity index is used to compare the levels of species diversity of insects found in the Community Plantation Forest. The Shannon-Wiener Diversity Index (H') was calculated using the formula (Veronika et al., 2017):

$$H' = -\sum_{i=1}^{n} \frac{ni}{N} log \frac{ni}{N}$$

Where:

H' = Shannon-Wiener Diversity Index

N = Total number of individuals of all species

 

Ni = Number of individuals of species i

Criteria:

H' > 3 = Indicates a high level of species diversity
1 < H' < 3 = Indicates a moderate level of species diversity
H' < 1 = Indicates a low level of species diversity

**Abundance Index (K)**

The species abundance index was calculated using the formula (Dharmawan, 1995):

$$\mathbf{K} = \frac{\mathbf{ni}}{\mathbf{N}}\mathbf{x100}\%$$

Where:

K = Species abundance
Ni = Number of individuals of species i
N = Total number of individuals of all species

Criteria:

K < 1% = Rare species
1% ≤ K ≤ 5% = Less abundant species
5% ≤ K ≤ 10% = Moderately abundant species
K > 10% = Highly abundant species

**Morisita Index**

The Morisita Index* is one of the indices used to measure the spatial distribution pattern of a species or population. This index is independent of distribution type, sample size, and mean values; therefore, it provides relatively stable results that are not affected by population density or sample size (Widiyanti et al., 2020).

$$\mathbf{Id} = \mathbf{n}\frac{\sum X^2 - \mathbf{N}}{\mathbf{N}\,(\mathbf{N} - \mathbf{1})}$$

Where:
Id = Morisita Index (distribution pattern)
n = Number of plots
N = Total number of individuals in all plots
$\Sigma x^2$ = Sum of squares of individuals in each sample unit

Criteria:

Id < 1 = Uniform distribution pattern

Id = 1 = Random distribution pattern

Id > 1 = Clumped distribution pattern

**General condition of the location**

he Community Plantation Forest (HTR) in Waya Hamlet, Tehoru Subdistrict, is one of the forest areas managed by the local community of Waya Hamlet. It is utilized as cultivation land for various tree species, including clove trees* and *cocoa trees, covering an area of 9,727 m². Administratively, the community plantation forest is part of Waya Hamlet, located within Tehoru Village, Tehoru Subdistrict, Central Maluku Regency. The boundaries of Waya Hamlet are as follows: north is bordered by the Manusela National Protected Forest, South: Bordered by the Sea of Waya Hamlet, West: Bordered by Haya Village, East : Bordered by Wanasa Hamlet.

## RESULTS AND DISCUSSION

**Types Of Insects Found**

Based on the results of the research conducted in the Community Plantation Forest (HTR) area of Waya Hamlet, various insect species were collected using different sampling techniques. The identified insect species are classified in Table 5.1 below.

Table 5.1. Insects Found in the Community Plantation Forest of Waya Hamlet

| Tracking /Package Number | Order | Family | Type | Local name | Individual |
|---|---|---|---|---|---|
| 1 | Opiliones | Sclerosomatidae | *Leiobunum limbatum* | Long-legged spider | 12 |
| | Orthopteran | Tettigonidae | *Mediterranean katydid* | Leaf grasshopper | 4 |
| | Celeoptera | Cerambycidae | *Acalolepta rusticantrix* | Longhorn beetle | 2 |
| | Hemiptera | Cicadidae | *Formerly tibicen* | Cicada | 4 |
| | Araneae | Sparassidae | *Heteropoda venatiri* | Brown huntsman spider | 4 |
| | Stylomatophora | Helicidae | *Cepaea nemoralis* | Garden snail | 2 |
| | Orthopteran | Phasmatodea | *Carausius morosus* | Stick insect | 6 |
| | Hymenoptera | Formicidae | *Dolichoderus thoracicus* | Black ant | 41 |
| | Coleoptera | Curculionnidae | *Dendroctonus ponderosae* | Bark beetle | 3 |
| | Isoptera | Termitidae | *Coptotermes formusanus* | Termite | 12 |
| | Diptera | Muscidae | *Bactrocera dorsalis* | Fruit fly | 4 |
| | Lepidoptera | Nymphalidae | *Mycalesis parseus* | Bush brown butterfly | 2 |

| | | | | | |
|---|---|---|---|---|---|
| | Diptera | Muscidae | *Lucilia sericata* | Green bottle fly | 8 |
| 2 | Hemiptera | Cicadidae | *Formerly tibicen* | Cicada | 2 |
| | Araneae | Sparassidae | *Heteropoda venatiri* | Brown huntsman spider | 3 |
| | Crthopteran | Grylidae | *Velarifictorus micado* | Cricket | 1 |
| | Hymenoptera | Fomicidae | *Dolichoderus thoracicus* | Black ant | 33 |
| | Hrthopteran | Phasmatodae | *Carausius morosus* | Stick insect | 8 |
| | Diptera | Muscidae | *Lucilia sericata* | Green bottle fly | 9 |
| | Coleoptera | Scarabaeidae | *Euchirus longmanus* | Rhinoceros beetle | 1 |
| | hemiptera | Pentatomidae | *Oebalus poecilus* | Soldier bug | 2 |
| | Araneae | Nephilidae | *Nephila pilipes* | Golden orb-weaver spider | 3 |
| | Lepidoptera | Erebidae | *Erebus Ephesperis* | Moth | 2 |
| | Pentatomorpha | Coreidae | *Thasus neocalifornicus* | Leaf-footed bug | 4 |
| | Diptera | Muscidae | *Bactrocera dorsalis* | Fruit fly | 6 |
| 3 | Opiliones | Sclerosomatidae | *Leiobunum limbatum* | Long-legged spider | 8 |
| | Lepidoptera | Crambidae | *Asota heliconia* | Moth | 2 |
| | Lepidoptera | Nymphalidae | *Mycalesis parseus* | Bush brown butterfly | 3 |
| | Lepidoptera | Erebidae | *Erebus Ephesperis* | Moth | 2 |
| | Mantodea | Tenoderinae | *Tenodera sinensis* | Praying mantis | 4 |
| | Areneae | Tetragnathidae | *Tetragnatha ekstensa* | Silver spider | 2 |
| | Araneae | Sparassidae | *Heteropoda venatiri* | Brown huntsman spider | 2 |
| | Diptera | Muscidae | *Musca domestica* | House fly | 3 |
| | Araneae | Therididae | *Latrodectus geometricus* | Brown widow spider | 2 |
| | Hymenoptera | Fomicidae | *Dolichoderus thoracicus* | Black ant | 38 |
| | Pentatomorpha | Coreidae | *Thasus neocalifornicus* | Leaf-footed bug | 4 |
| | Diptera | Muscidae | *Lucilia sericata* | Green bottle fly | 8 |
| | Isoptera | Termitidae | *Coptotermes formusanus* | Termite | 11 |
| 4 | Hemiptera | Pentatomidae | *Musgraveia sulciventris* | Green stink bug | 3 |
| | Opiliones | Sclerosomatidae | *Leiobunum limbatum* | Long-legged spider | 10 |
| | Pentatomorpha | Coreidae | *Thasus neocalifornicus* | Leaf-footed bug | 6 |
| | Orthopteran | Grylidae | *Velarifictorus micado* | Cricket | 2 |
| | Hymenoptera | Fomicidae | *Dolichoderus thoracicus* | Black ant | 30 |
| | Orthopteran | Acridudae | *Atractomorpha crenulata* | Green grasshopper | 4 |
| | Lepidoptera | Nymphalidae | *Mycalesis parseus* | Bush brown butterfly | 4 |
| | Orthopteran | Tettigoniidae | *Mediterranean katydid* | Leaf grasshopper | 2 |
| | Diptera | Muscidae | *Lucilia sericata* | Green bottle fly | 8 |
| | Orthopteran | Phasmatodae | *Carausius morosus* | Stick insect | 4 |
| | Lepidoptera | Erebidae | *Erebus Ephesperis* | Moth | 1 |
| | Isoptera | Termitidae | *Coptotermes formusanus* | Termite | 12 |
| 5 | Araneae | Nephilidae | *Nephila pilipes* | Golden orb-weaver spider | 3 |
| | Orthopteran | Phasmatodae | *Anisomorpha buprestoides* | Stick insect | 7 |
| | Orthopteran | Acrididae | *Valanga Nigricornnis* | Yellow grasshopper | 4 |
| | Opiliones, | Sclerosomatidae, | *Leiobunum limbatum.* | Long-legged spider | 6 |

 

| | | | | | |
|---|---|---|---|---|---|
| | Hymenoptera | Fomicidae | *dolichoderus thoracicus* | Black ant | 25 |
| | Diptera | Muscidae | *Lucilia sericata* | Green bottle fly | 6 |
| | Phasmatodea | Heteropterygidae. | *Anisomorpha buprestoides* | Wood stick insect | 3 |
| | Hemiptera | Cicadidae | *Formerly tibicen* | Cicada | 4 |
| | Pentatomorpha | Coreidae | *Thasus neocalifornicus* | Leaf-footed bug | 2 |
| | Lepidoptera | Nymphalidae | *Mycalesis parseus* | Bush brown butterfly | 2 |
| Total Number | | | | | 425 |

The data table shows that 29 species were found at the research location, distributed across 13 orders: Opiliones, Orthoptera, Coleoptera, Hemiptera, Araneae, Stylommatophora, Hymenoptera, Isoptera, Diptera, Lepidoptera, Crthopteran, Pentatomorpha, and Mantodea. These species belong to 26 families, including: Sclerosomatidae, Tettigoniidae, Cerambycidae, Cicadidae, Sparassidae, Helicidae, Phasmatidae, Formicidae, Curculionidae, Termitidae, Gryllidae, Scarabaeidae, Crambidae, Nymphalidae, Erebidae, Tenoderinae, Tetragnathidae, Theridiidae, Muscidae, Pentatomidae, Coreidae, Acrididae, Nephilidae, Buprestidae, and Phasmatidae. The total number of individual specimens collected across all transects was 425. Among the five transects, the highest number of species and individuals was obtained using the hand collecting method, which proved to be the most effective method in this study, capturing 18 species with a total of 174 individuals. Details by transect are as follows: Transect 1: 8 species, 45 individuals, Transect 2: 9 species, 26 individuals, Transect 3: 10 species, 20 individuals, Transect 4: 7 species, 41 individuals, Transect 5: 5 species, 22 individuals. Among the 13 identified orders, those with the highest number of species found were: Orthoptera: 8 species, Lepidoptera: 8 species, Araneae: 7 species, Diptera: 7 species, Hymenoptera: 5 species. Orders with the fewest species recorded were: Opiliones: 1 species, Coleoptera: 1 species, Hemiptera: 3 species, Isoptera: 3 species, Crthopteran: 2 species, Mantodea: 1 species, Phasmatodea: 1 species.

The large number of insect individuals from the Orthoptera order found in Dusun Waya, Tehoru Village, is likely influenced by several ecological and environmental factors that support their abundance. Some possible contributing factors include:

1. Suitable Habitat Conditions

   Orthopterans, such as grasshoppers, crickets, and stick insects, generally thrive in open or semi-open areas. Vegetation-rich environments like grasslands, shrubs, young crop plantations, and secondary forests—such as the Community Plantation Forest (HTR) in Dusun Waya—provide ideal habitats for them.

2. Abundant Food Availability

Orthopterans are herbivores, relying heavily on young leaves and grasses. Agroforestry ecosystems in community-managed forests offer a diverse and plentiful supply of natural food sources, such as tender leaves and grasses, which support large populations.

3. Rapid Reproductive Capability

   Orthopterans have short life cycles and can reproduce quickly under favorable environmental conditions. Their populations can increase rapidly, especially during the rainy season, when conditions for growth and breeding are optimal.

4. Adaptation to Disturbances

   Certain Orthopteran species, such as leafhoppers and yellow grasshoppers, are resilient to human disturbances like land clearing, farming, or selective logging. They also adapt easily to human-modified ecosystems such as mixed gardens or community forests.

5. Lack of Specific Predators

   Natural predators of Orthopterans—such as birds, reptiles, or large spiders—may be scarce or less effective due to environmental pressures or human activities. This can lead to an unchecked increase in Orthopteran populations.

On the other hand, the low number of individuals from the Phasmatodea, Stylommatophora, Mantodea, and Pentatomomorpha orders in Dusun Waya, Tehoru Village, is likely influenced by several ecological and biological factors, including:

1. Human Activity and Land Use

   Agricultural activities can threaten the survival of many arthropod species. Excessive land use leads to a decline in species diversity, increases dominance of certain species, and disrupts overall biodiversity (Latumahina & Ismanto, 2011).

2. Low Mobility and Cryptic Behavior

   Orders such as Phasmatodea (stick insects) and Stylommatophora (snails and slugs) have low mobility, making them difficult to detect during quick visual surveys. Their nocturnal habits and tendency to hide during the day further reduce detection likelihood. Similarly, Mantodea (mantises) are solitary and highly cryptic (excellent at camouflage), making them rarely visible in the field (Latumahina, 2008).

**Insect Images Found**

Figure 5.1. Yellow Grasshopper (*Valanga nigricornis*)

The Yellow Grasshopper (*Valanga nigricornis*) belongs to the order Orthoptera, family Acrididae. This species measures about 60–80 mm in body length and is yellow in color with brownish body parts. Its antennae are black. It has two pairs of wings: the dull-colored forewings serve as protection, while the transparent hindwings are used for flying. When at rest, the wings cover its back. It was found perched on *Imperata* grass and captured using a sweep net.

Figure 5.2. Leaf Katydid (*Mediterranean Katydid*)

The Leaf Katydid (*Mediterranean Katydid*) belongs to the order Orthoptera, family Tettigoniidae. It has a bright green body that mimics a leaf for natural camouflage. Its body length ranges from 50–70 mm. It has long, thin antennae exceeding its body length. The forewings are shaped and colored like leaves, while the hindwings are hidden underneath and used for flying. It has strong, long hind legs for jumping. It was found resting on a young rambutan plant and captured using the hand collecting method.

Figure 5.3. Green Bush Grasshopper (*Atractomorpha crenulata*)

This species belongs to the order Orthoptera, family Acrididae. Known for its solid green body, the Green Bush Grasshopper is considered a pest insect. It measures about 70 mm and easily camouflages among grass or green plants. It has short, thin antennae and tightly closed forewings that lie flat along the back. The hindwings are hidden and used for flying when escaping threats. The long and strong hind legs allow it to jump great distances. It was found on grass and captured using hand collecting.

Figure 5.4. Forest Cricket (*Lebinthus villemantae*)

The Forest Cricket belongs to the order Orthoptera, family Gryllidae. It is medium-sized and active during both day and night. It has a dark brown to black body with faint dorsal patterns. Measuring about 10 mm, it has long, thin antennae and large, strong hind legs for jumping and quick movement across the ground. The forewings (tegmina) cover the back, and the hindwings (if present) are hidden and used for flying. This species was found crawling on tree trunks and captured using the hand collecting method.

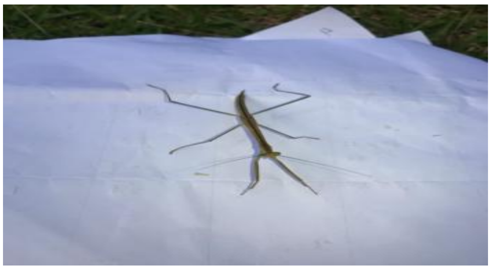

Figure 5.5. Chinese Mantis (*Tenodera sinensis*)

This species belongs to the order Mantodea, family Mantidae, and is commonly known as the Chinese mantis. It has a yellowish-brown body with a dark brown stripe running along the back, aiding in camouflage among dry grass or leaves. The estimated body length is about 100 mm. It has a pair of long antennae and raptorial forelegs adapted for catching prey. Its long wings cover the entire abdomen and are used for flying, especially in males. The mid and hind legs are long and aid in stability while perched. This predator feeds on other insects including those from the orders Orthoptera, Diptera, and Lepidoptera, and was captured using the hand collecting method.

Figure 5.6. Stick Insect (Phasmid)

 

The Stick Insect belongs to the **order** Phasmatodea and is known for its appearance resembling twigs or branches. Its body is extremely slender and elongated, greenish-brown, which allows it to blend into plant stems. It has six long legs and a pair of long antennae, enhancing its camouflage. Adult individuals can reach up to 100 mm in length. Wings are either absent or not clearly visible. It moves slowly and relies heavily on camouflage rather than speed or flight for protection. It was captured using hand collecting**.**

Figure 5.7. Wood Stick Insect (*Valanga nigricornis*)

This insect, said to belong to the order Phasmatodea, family Heteropterygidae**,** has a brown, bark-like body color, resembling tree branches or trunks as a form of natural camouflage. Its body is rough with small spines along the back, characteristic of the Heteropterygidae family. It inhabits dense tropical forests, is herbivorous, and active at night (nocturnal). It often remains motionless in a twig-like posture for extended periods. It was found using the hand collecting technique.

Figure 5.8. Brown Widow Spider (*Latrodectus geometricus*)

The Brown Widow Spider belongs to the order Araneae**,** family Theridiidae**.** This species was found on the ground in bright conditions and captured using the hand collecting method. It is characterized by a distinct egg sac covered with spiky projections and a body length of approximately 13 mm.

Figure 5.9. Golden Orb-Weaver Spider (*Nephila pilipes*)

This spider belongs to the order Araneae, family Nephilidae**.** Active during the day and found near ground level, it has a body length of about 5 cm. Its abdomen is black with golden-yellow markings. It has a characteristic body structure with eight long, hairy legs, a head, thorax, and eight eyes, along with visible fangs.

Figure 5.10. Rhinoceros Beetle (*Euchirus longmanus*)

The Rhinoceros Beetle is from the order Coleoptera, family Scarabaeidae. Known for its large size and tough body, the males possess long horns on their heads and pronotums, used during fights over mates or territory. The body is shiny brown with a hard exoskeleton. Males have large horns, while females do not. Body length ranges between 30–60 mm. It was found on a langsat tree branch and captured using the hand collecting method.

Figure 5.11. Green Stink Bug (*Musgraveia sulciventris*)

This insect belongs to the order Hemiptera, family Tessaratomidae**,** commonly known as the Bronze Orange Bug. It has a broad, oval body with bright colors like copper-orange or shiny brown, particularly in adults. This coloration serves as aposematic signaling to predators, warning of its ability to emit a foul-smelling chemical defense. Body length is around 25–30 mm. It is a phytophagous (plant-eating) insect and was found perched on a young langsat tree, captured using the hand collecting method.

Figure 5.12. Leaf-Footed Bug (*Thasus neocalifornicus*)

Known as the Giant Mesquite Bug, this species belongs to the order Hemiptera, family Coreidae. It has a large body with striking patterns and widened, leaf-like hind legs, typical of Coreidae. Bright coloration and unique patterns serve as aposematism. Adults are about 25–30 mm in length, dark with red or orange markings. Nymphs are especially bright with red bodies and white spots. It is phytophagous and was found using the hand collecting method.

Figure 5.13. Common Bushbrown Butterfly (*Mycalesis perseus*)

This butterfly belongs to the order Lepidoptera, family Nymphalidae**,** subfamily Satyrinae. It is known for its prominent eyespots (ocelli) on the underside of the wings, which serve as defense mechanisms against predators. It is medium-sized with a wingspan of about 40 mm. Its wings are grayish-brown with 2–4 eye-like spots on the underside of the hindwings. These patterns are highly visible when the wings are closed and help divert predator attacks. It was observed in flight and captured using a sweep net**.**

Figure 5.14. Giant Moth (*Erebus ephesperis*)

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*Erebus ephesperis* is a nocturnal moth from the order Lepidoptera, family Erebidae. It is a large moth with dark coloring and wing patterns resembling tree bark or stones, serving as camouflage. The wingspan can reach up to 80 mm. The forewings have dark, wavy lines and subtle eyespot markings, while the hindwings are slightly lighter but still well-camouflaged. It has thread-like (filiform) antennae and does not have the coiled proboscis typical of butterflies. This moth was found resting on a plant and captured using a sweep net.

**Factors Influencing Insect Presence**

The results of microclimate factor measurements in the community plantation forest (Hutan Tanaman Rakyat) area of Dusun Waya, Tehoru Village, are presented in the table below:

Table 5.3.1. Microclimate Factor Measurements at the Research Site

| Transect | Air Temperature (℃) | Humidity (%) | Light Intensity (lux) |
|---|---|---|---|
| I | 28.5 | 85.4 | 54.4 |
| II | 26.7 | 77.9 | 30.3 |
| III | 29.7 | 78.6 | 37.2 |
| IV | 27.6 | 76.8 | 35.7 |
| V | 30.1 | 79.9 | 46.6 |
| **Average** | **28.52** | **79.72** | **40.86** |

Climate factors such as temperature**,** humidity, and light intensity play a crucial role in determining insect activity and distribution. (*Pribadi, 2019*)

The results of microclimate measurements in the community plantation forest (Hutan Tanaman Rakyat) of Dusun Waya, Tehoru Village, show that the average air temperature reached 28.52 **°C**. This temperature falls within the optimal range for tropical insects, as it supports increased metabolic rates, growth, and daily activity. Under suitable temperature conditions, insects become more active in feeding, mating, and reproduction. However, exposure to extreme temperatures beyond their tolerance limits can lead to thermal stress, resulting in reduced activity (*Sutanto et al., 2017*).

The average relative humidity, recorded at 79.72%**,** also plays a crucial role in supporting insect presence. High humidity helps maintain water balance within insect bodies, thereby reducing the risk of dehydration due to evaporation. This condition is especially beneficial for herbivorous and predatory insects that are sensitive to water loss. A study by *Sari and Aminah (2018)* found that humidity is closely related to the abundance of soil-dwelling insects in agricultural ecosystems, as it influences feeding behavior and survival.

Meanwhile, the average light intensity, measured at 40.86 lux, provides varied lighting conditions that influence insect activity rhythms. Most insects exhibit positive phototaxis, becoming more active under higher light intensities—such as butterflies, bees, and pollinating flies. However, some groups are more active in low-light conditions, including nocturnal beetles and certain moth species. *Andi et al. (2016)* reported that light intensity is correlated with pollinator activity in plantation areas, where peak activity occurs under moderate to high lighting conditions.

**Effectiveness of Insect Trap Installation**

Based on the research conducted in the community plantation forest (Hutan Tanaman Rakyat) in Dusun Waya, the results of each insect trapping method are as follows:

**Insect Collection Results Using the Pitfall Trap Technique**

| Transect | Insect Species | Type of Bait | Daia | Jazz 1 | Soklin | Granulated Sugar | Powdered Sugar | Crystal Sugar |
|---|---|---|---|---|---|---|---|---|
| **1** | 1. Black Ant (*Dolichoderus thoracicus*) | | 3 individuals | 4 individuals | 5 individuals | 5 individuals | 4 individuals | 5 individuals |
| | 2. Huntsman Spider (*Heteropoda venatoria*) | | 1 individual | – | – | 2 individuals | – | 1 individual |
| **2** | 1. Black Ant (*Dolichoderus thoracicus*) | | 4 individuals | 4 individuals | 3 individuals | 4 individuals | 4 individuals | 4 individuals |
| | 2. Huntsman Spider (*Heteropoda venatoria*) | | – | – | – | 1 individual | – | – |
| | 3. Field Cricket (*Velarifictorus micado*) | | – | – | – | – | – | 1 individual |
| **3** | 1. Black Ant (*Dolichoderus thoracicus*) | | 3 individuals | 5 individuals | 4 individuals | 6 individuals | 3 individuals | 3 individuals |

| Transect | Insect Species | Type of Bait | Daia | Jazz 1 | Soklin | Granulated Sugar | Powdered Sugar | Crystal Sugar |
|---|---|---|---|---|---|---|---|---|
| | 2. Huntsman Spider (*Heteropoda venatoria*) | | – | – | – | – | – | 1 individual |
| **4** | 1. Black Ant (*Dolichoderus thoracicus*) | | 2 individuals | 4 individuals | 4 individuals | 3 individuals | 3 individuals | 2 individuals |
| | 2. Field Cricket (*Velarifictorus micado*) | | – | – | – | – | – | 2 individuals |
| **5** | 1. Black Ant (*Dolichoderus thoracicus*) | | 2 individuals | 2 individuals | 3 individuals | 3 individuals | 3 individuals | 2 individuals |

Total Individuals Collected: 107

**Insect Collection Results Using the Bait Trap Technique**

| Transect | Insect Species | Type of Bait | Canned Fish | Tuna | Momar Fish |
|---|---|---|---|---|---|
| **1** | 1. Black Ant (*Dolichoderus thoracicus*) | | 5 individuals | 5 individuals | 5 individuals |
| | 2. Green Bottle Fly (*Lucilia sericata*) | | 3 individuals | 3 individuals | 3 individuals |
| | 3. Fruit Fly (*Bactrocera dorsalis*) | | 1 individual | 1 individual | 2 individuals |
| **2** | 1. Black Ant (*Dolichoderus thoracicus*) | | 4 individuals | 4 individuals | 4 individuals |
| | 2. Green Bottle Fly (*Lucilia sericata*) | | 3 individuals | 3 individuals | 3 individuals |
| | 3. Fruit Fly (*Bactrocera dorsalis*) | | – | 3 individuals | 3 individuals |
| **3** | 1. Black Ant (*Dolichoderus thoracicus*) | | 3 individuals | 5 individuals | 4 individuals |
| | 2. Green Bottle Fly (*Lucilia sericata*) | | 2 individuals | 3 individuals | 3 individuals |
| | 3. Fruit Fly (*Bactrocera dorsalis*) | | 1 individual | – | 2 individuals |
| **4** | 1. Black Ant (*Dolichoderus thoracicus*) | | 4 individuals | 4 individuals | 4 individuals |
| | 2. Green Bottle Fly (*Lucilia sericata*) | | 2 individuals | 3 individuals | 3 individuals |

| **Transect** | **Insect Species** | **Type of Bait** | **Canned Fish** | **Tuna** | **Momar Fish** |
|---|---|---|---|---|---|
| **5** | 1. Black Ant (*Dolichoderus thoracicus*) | | 3 individuals | 3 individuals | 4 individuals |
| | 2. Green Bottle Fly (*Lucilia sericata*) | | 1 individual | 3 individuals | 2 individuals |

Total Individuals Collected: 112

**Insect Collection Results Using the Sweep Net Technique**

| **Transect** | **Insect Species** | **Sweep Net** |
|---|---|---|
| **1** | 1. False-Eyed Butterfly (*Mycalesis parseus*) | 2 |
| **2** | 1. Moth (*Erebus ephesperis*) | 2 |
| **3** | 1. Moth (*Erebus ephesperis*) | 2 |
| | 2. False-Eyed Butterfly (*Mycalesis parseus*) | 3 |
| | 3. Moth (*Asota heliconia*) | 2 |
| **4** | 1. Moth (*Erebus ephesperis*) | 1 |
| | 2. False-Eyed Butterfly (*Mycalesis parseus*) | 4 |
| **5** | 1. False-Eyed Butterfly (*Mycalesis parseus*) | 2 |
| | 2. Yellow Grasshopper (*Valanga nigricornis*) | 4 |

**Total Individuals Collected: 22**

**Insect Collection Results Using the Hand Collecting Technique**

| **Transect** | **Insect Species** | **Hand Collecting** |
|---|---|---|
| **1** | 1. Harvestman Spider (*Leiobunum limbatum*) | 12 |
| | 2. Leaf Katydid (*Mediterranean katydid*) | 4 |
| | 3. Cicada (*Formerly Tibicen*) | 4 |
| | 4. Longhorn Beetle (*Acalolepta rusticantri*) | 2 |
| | 5. Garden Snail (*Cepaea nemoralis*) | 2 |
| | 6. Stick Insect (*Carausius morosus*) | 6 |
| | 7. Stink Bug (*Dendroctonus ponderosae*) | 3 |
| | 8. Termite (*Coptotermes formosanus*) | 12 |
| **2** | 1. Cicada (*Formerly Tibicen*) | 2 |
| | 2. Harvestman Spider (*Leiobunum limbatum*) | 2 |
| | 3. Stick Insect (*Carausius morosus*) | 8 |
| | 4. Rhinoceros Beetle (*Euchirus longmanus*) | 1 |
| | 5. Leaf-Footed Bug (*Thasus neocalifornicus*) | 4 |
| | 6. Soldier Bug (*Oebalus poecilus*) | 2 |
| | 7. Golden Orb Spider (*Nephila pilipes*) | 3 |
| | 8. Green Shield Bug (*Musgraveia sulciventris*) | 2 |
| **3** | 1. Harvestman Spider (*Leiobunum limbatum*) | 8 |

| **Transect** | **Insect Species** | **Hand Collecting** |
|---|---|---|
| | 2. Termite (*Coptotermes formosanus*) | 11 |
| | 3. Soldier Bug (*Oebalus poecilus*) | 2 |
| | 4. Green Shield Bug (*Musgraveia sulciventris*) | 3 |
| | 5. Golden Orb Spider (*Nephila pilipes*) | 4 |
| | 6. Leaf-Footed Bug (*Thasus neocalifornicus*) | 4 |
| | 7. Praying Mantis (*Tenodera sinensis*) | 4 |
| | 8. Silver Spider (*Tetragnatha extensa*) | 2 |
| | 9. Brown Widow Spider (*Latrodectus geometricus*) | 2 |
| | 10. Jewel Beetle (*Bupertis aurulenta*) | 2 |
| **4** | 1. Harvestman Spider (*Leiobunum limbatum*) | 10 |
| | 2. Leaf Katydid (*Mediterranean katydid*) | 2 |
| | 3. Stick Insect (*Carausius morosus*) | 4 |
| | 4. Termite (*Coptotermes formosanus*) | 12 |
| | 5. Leaf-Footed Bug (*Thasus neocalifornicus*) | 6 |
| | 6. Green Locust (*Atractomorpha crenulata*) | 4 |
| | 7. Green Shield Bug (*Musgraveia sulciventris*) | 3 |
| **5** | 1. Harvestman Spider (*Leiobunum limbatum*) | 6 |
| | 2. Cicada (*Formerly Tibicen*) | 4 |
| | 3. Stick Insect (*Carausius morosus*) | 7 |
| | 4. Golden Orb Spider (*Nephila pilipes*) | 3 |
| | 5. Cricket (*Velarifictorus micado*) | 2 |
| | **Total Individuals Collected: 174** | |

The results of the insect capture revealed variation in the number of insects collected from each trapping method, with the following details:

1. Hand Collecting

The hand collecting method was the most effective in this study, yielding the highest number of captures with 18 species and a total of 174 individuals. Specifically: Transect 1: 8 species, 45 individuals, Transect 2: 9 species, 26 individuals, Transect 3: 10 species, 20 individuals, Transect 4: 7 species, 41 individuals, Transect 5: 5 species, 22 individuals This method’s effectiveness is likely due to its active and selective nature, as researchers can directly search for insects without being restricted by time or space. It also allows for the identification of insect frequency, range, and distribution. Another advantage of this method is that it can detect insects hiding behind leaves and tree branches. (Fransina et al., 2014).

2. Sweep Net

The sweep net method captured 4 species with a total of 22 individuals, broken down as follows: Transect 1: 1 species, 2 individuals, Transect 2: 1 species, 2 individuals, Transect 3: 3 species, 7 individuals, Transect 4: 2 species, 5 individuals, Transect 5: 2 species, 6 individuals According to Southwood and Henderson (2000), this method is fairly effective, especially for collecting insects that live on low vegetation, such as grasshoppers, butterflies, and leaf insects. However, its success is heavily influenced by factors such as vegetation type, sampling time, and weather conditions. Fast-moving insects also present a challenge to this method. (Fransina et al., 2014).

3. Pitfall Trap

The pitfall trap method captured only 3 species with a total of 107 individuals. The distribution per transect is as follows: Transect 1: 4 species, 30 individuals, Transect 2: 4 species, 23 individuals, Transect 3: 4 species, 29 individuals, Transect 4: 3 species, 20 individuals, Transect 5: 1 species, 15 individuals. This method is particularly effective for ground-dwelling insects such as ants, hunting spiders, and crickets. The lower number of species captured may be due to environmental conditions that are less favorable for ground insect activity, such as low humidity or a lack of leaf litter for shelter. The working principle of this trap is to allow surface-active insects to fall into the container and become trapped. (Amrulloh et al., 2023)

4. Bait Trap

The bait trap also showed relatively low effectiveness, capturing only 3 species with a total of 112 individuals: Transect 1: 3 species, 27 individuals, Transect 2: 3 species, 27 individuals, Transect 3: 3 species, 22 individuals, Transect 4: 2 species, 20 individuals, Transect 5: 2 species, 16 individuals. The effectiveness of this method depends heavily on the type of bait used and the attractiveness of the bait to the target insects. If the bait is unsuitable or less appealing to the insect species in the study area, the success rate of the trap can decrease. Additionally, factors such as wind and the presence of natural food sources nearby may reduce the bait's attractiveness. According to Sutrisno and Nugroho (2018), the success of bait traps is highly dependent on the type of bait and the feeding preferences of the target insect species. If the bait does not match the preferences of local insects, the capture rate will be low. (Amrulloh et al., 2023)

Based on the results obtained, hand collecting is the most effective method for capturing insects in the study area and under the specific research conditions. This method is recommended as the primary technique for insect sampling, while the other methods remain important to complement the data—particularly for insect species with specific habitats or behaviors that may not be easily accessed through active methods.

**Species Diversity Index, Abundance, and Morisita Index of Insects at the Research Site**

Based on the calculation results of species diversity index, species abundance, species dominance, evenness, and the Morisita index of insects in the Community Forest (Hutan Tanaman Rakyat) of Dusun Waya, Tehoru Village, Tehoru Subdistrict, Central Maluku Regency, the results are presented in the following table:

**Calculation Results of Insect Diversity, Abundance, and Distribution Indices**

| Parameter | Value | Description |
|---|---|---|
| Diversity Index | 2.365 | Moderate |
| Abundance | 8.471 | Moderately Abundant Species |
| Distribution | 1.760 | Clustered Distribution Pattern |

**Diversity Index**

The table above shows that the insect diversity index is **2.365**, which falls into the **moderate** category. This diversity value indicates the relative abundance or scarcity of insect species in a particular area and reflects the complexity of the ecosystem. This is in accordance with the diversity index criteria from Kumalararas (2018): **H > 3** = High Diversity, **1 < H < 3** = Moderate Diversity, **H < 1** = Low Diversity. A physically stable environment tends to support a large number of species, while unstable environments are usually inhabited by only a few**.** Low diversity indicates that the community has low complexity and limited interspecies interactions. According to Firmansyah (2008), there are seven interrelated factors that determine the degree of species diversity in an ecosystem: a. **Time** – Species diversity increases over time. Older communities (which have developed longer) usually have more organisms than younger ones. This ecological development can take place over just a few generations. b. **Spatial Heterogeneity** – The more heterogeneous the physical environment, the more complex the flora and fauna communities, leading to higher species diversity. c. **Competition** – Occurs when multiple organisms use the same limited resources. Even when resources are sufficient, competition still arises through interference or exploitation.
d. **Predation** – Helps maintain population balance among competing species, thus increasing the chance of coexistence and enhancing diversity. However, both excessive and insufficient predation can lower diversity. e. **Climate Stability** – Stable conditions such as consistent temperature and humidity allow for a greater number of species to coexist and support long-term evolutionary processes. f. **Productivity** – Higher productivity can support more species, contributing to higher biodiversity.

**Abundance Index**

The abundance index value of insect species at the research site is 8.471, indicating that species are moderately abundant. Some species are highly abundant, while others are less numerous, with many species having a moderate number of individuals**.** According to Odum (1993), the abundance index is used to measure the number of individuals within a community or population at a specific point in time. A high abundance index suggests that the area supports a moderate to high number of species or individuals, reflecting a relatively rich community.

**Morisita Index**

The Morisita index value obtained for the insect species distribution is 1.760, indicating that the individuals tend to have a clustered distribution pattern. The interpretation of the Morisita Index (Id) is as follows: **Id < 1**: Random distribution, **Id = 1**: Uniform distribution, **Id > 1**: Clustered distribution. According to Morisita (1959), the Morisita Index is used to determine the **spatial distribution pattern** of a population. A clustered distribution indicates that individuals tend to aggregate or group together, rather than being evenly or randomly distributed throughout the habitat.

**Conclusion**

Based on the results of the study, it can be concluded that: 1. A total of 29 insect species belonging to 12 orders were found in the Community Forest of Dusun Waya, with a total of 425 individuals**.** The orders identified were: *Opiliones*, *Orthoptera*, *Coleoptera*, *Hemiptera*, *Araneae*, *Stymmatophora*, *Hymenoptera*, *Lepidoptera*, *Mantodea*, *Diptera*, *Phasmatodea*, and *Pentatomorpha*.2. Climatic factors such as temperature, humidity, and light intensity play a crucial role in determining both the activity and distribution of insects in the community forest of Dusun Waya, Tehoru Village, Tehoru Subdistrict, Central Maluku Regency.3. Effectiveness of Insect Trapping Methods The hand collecting method proved to be the most effective method overall, yielding the highest number of captured individuals. This method allows researchers to selectively capture active and visible insects from various substrates, including vegetation and ground surfaces. In general, a combination of several trapping methods is more effective in providing a comprehensive overview of insect diversity, as each method may target different insect behaviors and habitats.

**Suggestions**

Conservation efforts are needed to protect the Community Forest in Dusun Waya in order to maintain the abundance and diversity of insect species. These efforts may include planting host plants that can support the lifecycle of various insects. Reducing human activities that damage natural habitats and increasing green areas around the forest are recommended. Additionally, community outreach and education programs should be conducted to raise awareness about the important roles insects play in ecosystems, such as pollination and decomposition.

 

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