**Advances in Tropical Biodiversity and Environmental Sciences**
7(2): 63-69, June, 2023
**e-ISSN:2622-0628**
DOI: 10.24843/ATBES.2023.v07.i02.p04
Available online at: https://ejournal1.unud.ac.id/index.php/atbes/article/view/258

# Insect Biodiversity in Mangrove Area of Tatengesan Village, Pusomaen District in Southeast Minahasa, North Sulawesi

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**Abstract**. The existence of insects cannot be separated from the condition of their habitat. The mangrove area of Tatengesan Village is one of the ecotourism site in Minahasa, North Sulawesi, that can support the survival of insects. This study aimed to determine the distribution and diversity of insects and the factors that influence the insect diversity in the mangrove area. The type of research used is descriptive quantitative research by conducting data collection activities, analyzing data and interpreting data with the aim of making a description of the events that occurred. The animals were exploratory collected by using insect nets (sweep net), beating cloth (beating), and bare hands (hand collecting). The results showed that there were 1225 individual insects consisting of 14 insect species, which were divided into 14 genera, 11 families and 6 orders of insects. The insect diversity index value was 0.27 which was classified as low. The dominance index value was 0.90 which was classified as high. The evenness index value was 0.10 which was classified as low.

***Keywords*** : Biodiversity, insects, mangrove, Tatengesan Village

## I. INTRODUCTION

Indonesia has the world's largest mangrove forest, as well as the greatest biodiversity and the most diverse structure. Mangrove ecosystems are rich in flora and fauna, and provide physical, economic and ecological benefits [1]. Insects are a group of animals with abundant numbers on earth and have an important role in the mangrove ecosystem which is used as a bioindicator [2]. High levels of insect diversity and high geographical distribution can provide information in environmental studies as environmental indicators, as well as environmental changes that may occur. Insects in nature have an important role as pollinator agents in the pollination process. This ecologically contributes to a role in maintaining the balance of the ecosystem and enriching biodiversity [3]. The diversity of insects in each habitat varies [4]. Availability of various types of mangrove plants is important for insect species, as larvae or imago feed. As one of the ecotourism locations, Tatengesan Village has the attractiveness and superiority of the art of biodiversity including the diversity of insects, for example butterflies.

Given the important role of insects and the absence of data on insect diversity in Tatengesan Village, it is necessary to conduct research on insect diversity in Tatengesan Village in Southeast Minahasa. The results can be used as a source of information on insect diversity for the development of Tatengesan Minahasa Tenggara Village as a Tourism Village. A similar study was conducted by Paliama *et al* [2] in Ihamahu Village which stated that different types of insects were found in the diversity of insects in the mangrove community.

## II. METHODS

This research was conducted in Tatengesan Village, Pusomaen District, Southeast Minahasa Regency from July to August 2022. The mangrove area of Tatengesan Village is located at coordinates 0°98'52.116"N and 124°88'02.068"E with a mangrove area of about 220 Ha (Fig.1), where 2 stations and 4 plots were determined on each transect with a size of 6x6 m and a distance between plots of 3 m.

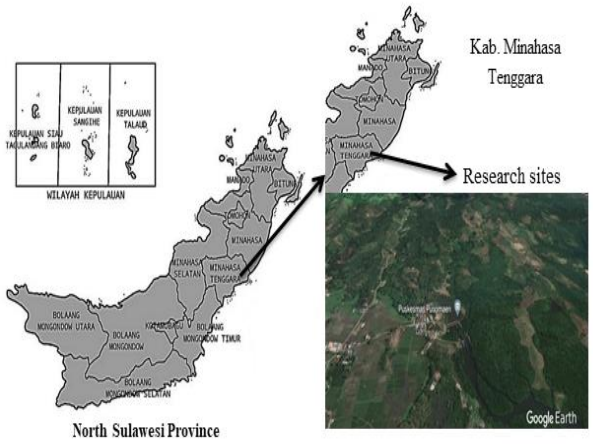


Fig.1. Research Sites

This study used insect trapping nets, fabric fences, sample bottles of large, medium and small sizes, tweezers, scissors, plastic rope, stakes, meter rolls of 30m, fiber measuring tape, soil survey instrument 4 in 1, cameras, Key of Determination and Identification Book, and Google Lens software application. While the materials used were insects, 70% alcohol, and label.

This study used a quantitative descriptive research by conducting data collection activities, analyzing data and interpreting data with the aim of making a description of the events that occurred. Data collection techniques was done with an observation directly in the field. The sampling technique in this study was a purposive sampling technique [5].

The population in this study were all insects that can be found in the mangrove area of Tatengesan Village, Pusomaen District, Southeast Minahasa, North Sulawesi. The samples of this study were insects which were successfully obtained from the sweep net, beating and hand collecting methods at 2 observation stations in Tatengesan Village.

Insects were analyzed morphologically in a descriptive way to explain the morphology of each individual collected. The analysis was carried out in a quantitative descriptive manner. The insects that have been identified were then tabulated into a database using the Microsoft Excel 2010 program.

### *Research Procedure*

*Determination of Research Stations*

Observing research locations that aim to find out information on places as research objects by recognizing field conditions and the location of coordinates. Station I was mangrove area closed to residential areas. Station II was mangrove area closed to the beach, was inundated with water and only had mangrove species.

*Research Plot Placement*

Sampling plots for data collection used the checkered line method [6]. At station I, the transect was pulled towards settlements with a size of 25x25 m, while at station II, the transect was pulled from near the shoreline with a size of 25x25 m. Then, on each transect, observation plots were made with a size of 6x6 m with a distance between plots of 3 m.

*Trap Setting and Sampling*

Insect collection was carried out in the morning at 08.30-11.00 and in the afternoon at 14.00-17.00 (local time). Insect sampling was carried out using 3 methods:

a. *Insect Net Method (Sweep Net)*. The insect net used was 30 cm in diameter with a stick length of 80 cm. Insect sampling using an insect net (sweep net), by swinging the insect net from right to left 10 times (double swing) around trees where there were insects [7]. Insects caught in nets were stored in a collection bottle containing 70% alcohol and labeled.
b. *Beating Cloth Method (Beating)*. Insects were caught by beating, by placing a 1 $m^2$ cloth under the stem or branches of the tree and shaking it 10 times [8].
c. *Hand Trap Method (Hand Collecting)*. The hand collecting method is a direct sampling. The hand collecting method was carried out for one hour at each observation station, especially for ants and their nests that live in mangroves and around low plants, between rocks, the ground surface, mounds and broken wood. Each type of insect was collected by hand and put into a bottle containing 70% alcohol [2].

*Measurement of Insect Environmental Factors*

Insect factors measurement was done by measuring temperature and humidity. Temperature and humidity were measured with the Soil 4 in 1 Tool by placing the tool in the middle of the sampling plot.

*Observation and Identification of Insects*

Each caught insect was then separated and recorded for its morphological characteristics (color and shape), then photographed with a camera and then grouped according to genus. Insects were identified directly in the field using existing identification guides namely Book of Borror Identification [9] and Key Book of Determination [10].

## III. RESULT AND DISCUSSION

### *Result*

*Species of Insects in Tatengesan Village Mangrove Area*

The research that was carried out from July to August 2022 by using the sweep net, beating and hand collecting methods in the mangrove area of Tatengesan Village, found 1.225 individual insects consisted of 6 orders, 11 families, 14 genus and 14 species between *Atractomorpha crenulata, Xylocopa latipes, Oecophylla smaragdina, Camponotus pennsylvanicus, Orthetrum Sabina, Chrysomya megacephala, Catopsilia Scylla, Euploea algea, Ideopsis juventa, Graphium sarpedon, Austrocolia soror, Scolia dubia, Polistes dorsalis,* and *Chrysocoris stolii* (Table 1).

The insect orders were Lepidoptera, Hymenoptera, Odonata, Orthoptera, Diptera, and Coleoptera. The sweep net traps method obtained 14 species of 464 individual insects. *Oecophylla smaragdina* were the most common individuals found in sweep net traps. The beating traps obtained the fewest result compared to other traps, only one species with a total of 11 individual insects. The hand collecting traps obtained 3 species of 748 individual insects. *Oecophylla smaragdina* was the most common individual found in all traps. This species was the most common insect species found in the mangrove area (Table 2).

TABLE 1.
AMOUNT OF INSECT SPECIES FOUND IN THE MANGROVE AREA OF TATENGESAN VILLAGE

| Order | Family | Genus (Species) | Station | |
|---|---|---|---|---|
| | | | I | II |
| Lepidoptera | Pieridae | *Catopsilia (C. scylla)* | 1 | - |
| | Nymphalidae | *Euploea (E. algea)* | - | 1 |
| | | *Ideopsis (I. juventa)* | - | 2 |
| | Papilionidae | *Graphium (G. sarpedon)* | - | 1 |
| Hymenoptera | Formicidae | *Oecophylla (O. smaragdina)* | 395 | 773 |
| | | *Camponotus (C. pennsylvanicu)* | - | 23 |
| | Scoliidae | *Austrocolia (A. soror)* | 1 | - |
| | | *Scolia (S. dubia )* | 1 | - |
| | Vespidae | *Polistes (P. dorsalis)* | 1 | - |
| | Apidae | *Xylocopa (X. latipes)* | 2 | - |
| Odonata | Libellulidae | *Orthetrum (O. sabina)* | 5 | - |
| Orthoptera | Pyrgomorphidae | *Atractomorpha (A. crenulata)* | 13 | - |
| Diptera | Muscidae | *Chrysomya megacephala* | - | 4 |
| Coleoptera | Scutelleridae | *Chrysocoris (C. stolli)* | 1 | - |
| Number of Individuals | | | 420 | 805 |
| Total Individuals | | | 1225 | |

Station I : Mangrove area that is close to the residentials areas.
Station II : Mangrove area that is close to the beach, is inundated with water and has mangrove plants (the composition of mangrove spesies is presented in Table 4)

TABLE 2.
AMOUNT OF INSECT SPECIES TRAPPED USING SWEEP NET, BEATING AND HAND COLLECTING

| No | Species Insect | Trap | | |
|---|---|---|---|---|
| | | *Sweep Net* | *Beating* | *Hand collecting* |
| 1 | *Actractomorpha crenulata* | 11 | - | 2 |
| 2 | *Xylocopa latipes* | 2 | - | - |
| 3 | *Scolia dubia* | 1 | - | - |
| 4 | *Scolia soror* | 1 | - | - |
| 5 | *Polistes dorsalis* | 1 | - | - |
| 6 | *Oecophylla smaragdina* | 432 | 11 | 725 |
| 7 | *Camponotus pennsylvanicus* | - | - | 23 |
| 8 | *Orthetrum Sabina* | 6 | - | - |
| 9 | *Chrysomya megacephala* | 4 | - | - |
| 10 | *Catopsilia Scylla* | 1 | - | - |
| 11 | *Euploea algea* | 1 | - | - |
| 12 | *Ideopsis juventa* | 2 | - | - |
| 13 | *Graphium sarpedon* | 1 | - | - |
| 14 | *Chrysocoris stolii* | 1 | - | - |
| | Amount | 464 | 11 | 748 |

Note : + = Exist, - = No exist

TABLE 3
MICRO CLIMATE IN RESEARCH LOCATIONS

| Measured Parameters | Average | |
|---|---|---|
| | Station I | Station II |
| Temperature (ºC) | 27,6-32ºC | 26,8-30ºC |
| Humidity (%) | 67-85,4% | 77,4-88% |

Based on the results, environmental conditions of the research sites can be seen in Table 3. Station I and station II have different microclimates with temperatures ranging from 26-28°C, it still fit the optimal temperature for maintaining insect life. At station I, there were found 5 species of mangrove plants, while 3 species were found at station II. The compositions of mangrove species (Table 4) were Rhizophoraceae family consisted of 3 species; Arecaceae and Sonneratiaceae families (1 species each).

TABLE 4. COMPOSITION OF MANGROVE SPECIES

| No | Family | Species | Station | |
|---|---|---|---|---|
| | | | I | II |
| 1 | Arecaceae | *Nypa fruticans* | + | - |
| 2 | Rhizophoraceae | *Rhizopora apiculata* | + | + |
| 3 | | *Rhizopora mucronata* | + | + |
| 4 | | *Bruguiera gymnorrhiza* | + | + |
| 5 | Sonneratiaceae | *Sonneratia alba* | + | - |

*Insect Characteristics in Tatengesan Village Mangrove Area*

*1. Formicidae Family*

This ant has a head, chest and abdomen. In Fig. (A), *Oecophylla smaragdina* has a red color and elongated body size with a length of 1-2 cm which is equipped with a widened protonome. The head consists of several parts namely the antennae, clipper, frontal, carina and mandibular. Weaver ants also have sensors called maxillary palps and labia palps. The abdomen of weaver ants is round in shape consisting of 4 segments [11].

Ants are smaller in size than *Oecophylla smaragdina*. In Fig.2(B), *Camponotus pennsylvanicus* has the characteristics of a body size of 6 mm. On the head, there are eyes that extend in the direction of the head length, the back of the head is round and the front is slightly small while the top is convex. The thoracic part is curved. The protonome is clearly close to the head but slightly smaller [ 12].

*2. Nymphalidae Family*

The Nymphalidae family in Fig.2(C), has a black body with a body size of 3.8 cm. The wings have two colors, black and white, both colors are dominate, and white spots on the wings. Their body size also varies from small to large with a front wing length ranging from 1.5-7 cm [13]. Generally, the hind wings are tailless [14].

*3. Libellulidae Family*

The Libellulidae family in Fig. 2(D) has green eyes with black dots. The body of this dragonfly is green with black stripes on the chest and abdomen with a body length of 28 mm, measured forewings 21 mm and hindwings 19 mm. The eyes of this dragonfly are blue-brown. The thorax is green with a black stripe. This dragonfly is easily recognized by the swollen abdominal segments one to three with the presence of a slightly greenish pale yellow color [15].

*4. Muscidae Family* The Muscidae family in Fig.2(E) has a body size of about 14 mm and a slightly grayish yellowish-orange color on the front of the head. The antennae are orange to reddish brown. The thorax consists of three segments, namely the prothorax, mesothorax and metathorax. There is a pair of wings on the mesothorax and on each segment there is a pair of legs. The abdomen of *Chrysomya megacephala* is metallic green [16].

*5. Pygromorphidae Family*

The morphological characteristics of this grasshopper in Fig.2(F) are a green body for about 2.3 cm. There is a pair of long longitudinal antennae that are shaped like the letter V. This grasshopper has a pair of compound eyes. The thorax consists of prothorax, mesothorax and metathorax. Grasshoppers have two pairs of wings, the front wings and hind wings. Insect wings are green and attached to the metathorax which extends to cover the abdomen [9].

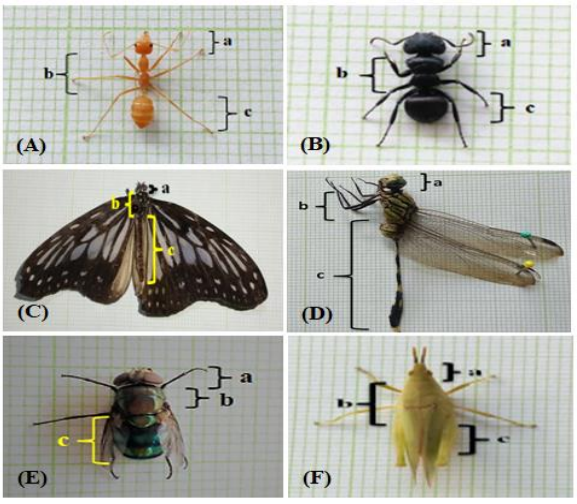


Fig. 2. Insects Family: (A) and (B) Formicidae, (C) Nymphalidae, (D) Libellulidae, (E) Muscidae, (F) Pygromorphidae; a. Caput, b. Thorax, and c. Abdomen (Personal Documentation, 2022).

***Discussion***

*Insect Species in Tatengesan Village Mangrove Area*

The difference in the amount of species from each observation station is due to factors that influence the presence of insects. The factor is the existence of disturbances, especially from human activities such as cutting down trees and the activities of fishermen looking for fish. These activities can affect the existence of insects because they can damage insect habitats and reduce food sources in these locations.

The most common species found in this research was the ant *Oecophylla smaragdina* which was found at both stations. The number of individuals of the Formicidae family at both stations was influenced by a sufficient amount of food so that they could reproduce quickly and the environmental conditions were suitable for their habitat.

The existence of insects in an ecosystem is limited by suitable geological and ecological factors, resulting in differences in the diversity of insect species. This is due to differences in climate, season, altitude, and type of food [17].

**Diversity, Dominance and Evenness Index**

The results of calculating the species diversity index, species dominance and evenness of insect species in the mangrove area are shown in Table 5. The insect diversity index of 0.27 was classified as low. The diversity index value is an indicator of the abundance or number of insect species in a certain area. Diversity of insect species was influenced by quality and quantity of food, including the number of suitable host plants, host plant density and stand composition [ 18].

TABLE 5.
DIVERSITY, DOMINANCE AND EVENNESS INDEX

| Species Diversity Index (H) | Dominance Index (D) | Evenness Index (E) |
|---|---|---|
| 0,27 | 0.90 | 0,10 |

The results of data analysis on the dominance index of insect species in the mangrove area of Tatengesan Village were classified as high, with a dominance index value of 0.90. The dominating species at both stations was *Oecophylla smaragdina*. The amount of these individuals

were influenced by environmental conditions that suit their habitat and sufficient food factors to carry out their breeding and these species are insects that live in colonies. Insect dominance is caused by the characteristics of insects such as how to live, eat, and reproduce. The greater the dominance index value, the greater the tendency for certain species to dominate [19].

The evenness index of insect species in the mangrove area of Tatengesan Village was 0.10, which was in the low category. The low evenness of insect species in the area was affected by the uneven distribution of insects. Apart from being influenced by physical environmental factors, this was also caused by the presence of predatory insects.

The evenness value indicates the distribution pattern of a species within a community. The greater the value, the more balanced the distribution pattern of a species within the community and vice versa [20].

## IV. CONCLUSION

Based on the results of insect biodiversity in Tatengesan Village mangrove area, it can be concluded:

1. There were 14 insect species found, namely *Atractomorpha crenulata, Xylocopa latipes, Oecophylla smaragdina, Camponotus pennsylvanicus, Orthetrum Sabina, Chrysomya megacephala, Catopsilia Scylla, Euploea algea, Ideopsis juventa, Graphium sarpedon, Austrocolia soror, Scolia dubia, Polistes dorsalis, and Chrysocoris stolii*.
2. The index value of insect diversity was 0.27 (low), the dominance index value was 0.90 (high), and the evenness index value was 0.10 (low).

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