Journal Of Biology Education Research (JBER)
Vol 6(1) 2025 | ISSN: 2774-7859
DOI: 10.55215/jber.v6.i1.35

https://journal.unpak.ac.id/index.php/jber

Insect Diversity in Dramaga Protected Forest Area Bogor West Java

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Received: 22 Februari 2025 Revised: 25 April 2025 Accepted: 2 Mei 2025

Abstract

Dramaga Protected Forest is a good habitat for various fauna, including insects. Insects have a positive role as pollinators, decomposers, predators and environmental bioindicators, and have a negative impact as pests. Insects have a wide habitat distribution, such as the surface of the ground or underground, fresh water, air, mud, remains of organisms, and parasites on various plants and animals. The presence of insects can be influenced by environmental conditions as their habitat. Therefore, this study aims to determine the diversity of insects in the Dramaga Protected Forest. The study was conducted in the Dramaga Protected Forest with four research methods, namely Pitfall Trap, Sweep Net, Yellow Sticky Trap and Active Searching. Insect catch data were analyzed for diversity index, evenness index and dominance index. The results of this study were a total of 1359 insect individuals consisting of 14 families. The diversity of insects with the four research methods was relatively low because there were dominant families, namely Formicidae, Acrididae, Blattelidae and Cicadellidae. It can be concluded that the determination of insect diversity is more effective using the Sweep Net method. The results of abiotic measurements at the research location showed optimal conditions so that the Dramaga Protected Forest has a good habitat for insect life.

Keywords: diversity; Dramaga Protected Forest; forest; insect; methods

INTRODUCTION

Dramaga Protected Forest serves as a forestry development and research field laboratory located in the West Bogor region with an altitude of 244 meters above sea level. Based on geographical coordinates, Dramaga Protected Forest is located at 6033'8" - 6033'35" South Latitude and 106044'50" - 1060105'19" East Longitude. Dramaga Protected Forest is one of 34 research forests categorized as a Kawasan Hutan Dengan Tujuan Khusus (KHDTK) which has an area of 60 Ha (Christian *et al*., 2019). Hernawati *et al*. (2021) stated that Dramaga Protected Forest is surrounded by residential areas and is in the vicinity of educational institutions, such as schools, universities and hospitals. In addition to its main purpose as a research forest, the Dramaga Protected Forest area is also managed as a deer breeding ground, tourist and trade location, and green open space. The Dramaga Protected Forest area has a supportive ecosystem as a habitat for diverse flora and fauna, including various types of insects.

Insects are a group of animals from the phylum Arthropoda with the largest number of diverse species covering about 70% of all species on earth, estimated at more than 800,000 species that have been found (Samways, 2018; Septiadi *et al*., 2018; Kamila *et al*., 2022). Insects have a body consisting of three main parts, namely the head (caput), chest (thorax) and abdomen (abdomen), with the characteristic of the legs with brushes. The insect head has a pair of antennae with three pairs of legs on the chest and there are one or two pairs of wings in adult insects (Kurniawati, 2016). Insects have a wide habitat distribution.

Insects can be found on the surface of the soil or in the soil, fresh water, air, mud, remains of organisms, and parasites on various plants and other animals (Meilin & Nasamsir, 2016; Rosniar *et al*., 2019; Haneda *et al*., 2022). In addition, insects can also be found living in habitats such as mountains, forests, agricultural fields, residential areas and urban areas (Deltama *et al*., 2022; Ababil *et al*., 2023).

The existence of insects is inseparable from their role in the ecosystem. Insects have an important meaning for humans, both directly and indirectly, both beneficial and harmful (Tutiliana, 2016; Ahdiana *et al*., 2020). Insects have beneficial roles as pollinators, decomposers, predators (natural enemies), environmental bioindicators, and producers of materials that are useful in health and industry, while some types of insects are also detrimental, including pests or parasites on cultivated plants and insects that transmit diseases to humans (Taradipha *et al*., 2019; Azwir *et al*., 2019; Nurlaili *et al*., 2020). In some regions in Indonesia, insects are popular as an alternative food ingredient because they have a high protein content. In Sindukarto Village, Wonogiri Regency, insects have even been used as local food in their area (Umami, 2024). The results of Umami (2024) research, explain that the Sindukarto community has long utilized rice stink bug as local food or side dishes that are processed into chili sauce and botok. Some other areas on the island of Java, such as Jepara, Rembang, Blora, Gunung Kidul, Tuban and Bojonegoro, utilize teak worm and grasshoppers as processed foods by frying or stir-frying (Nuraeni & Anggraeni, 2020). In addition, grasshoppers can also be used as processed food products in other forms, namely instant noodles. The research conducted (Asthami *et al*., 2016), namely making instant noodles by adding wood grasshopper flour produces instant noodle products with higher quality and protein compared to instant noodles on the market. Based on the description above, the Dramaga Protected Forest area has the potential to support the life of various types of insects. Some types of insects have an important role for the environment and people's lives. Insects act as environmental bioindicators, decomposers, and are useful as a source of food. The Dramaga Protected Forest area also functions as a research forest and observation area for various types of flora and fauna. Research on insect diversity in the Dramaga Protected Forest area is still minimal. Therefore, this study aims to determine the diversity of insects in the Dramaga Protected Forest area.

METHOD

The methods used in this study consisted of four methods, namely Pitfall Trap, Yellow Sticky Trap, Sweep Net and Active Searching. The Pitfall Trap method was used with the aim of capturing insects that live and move on the ground. Yellow Sticky Trap is used with the aim of capturing flying insects that are attracted to the yellow color, because the yellow color describes young plant parts. Sweep Net is used with the aim of capturing as many insects as possible that land on plant parts by swinging the net. While the Active Searching method is a method used with the aim of capturing insects directly in the environment around the research site with a wider range, both on the ground and on plant parts.

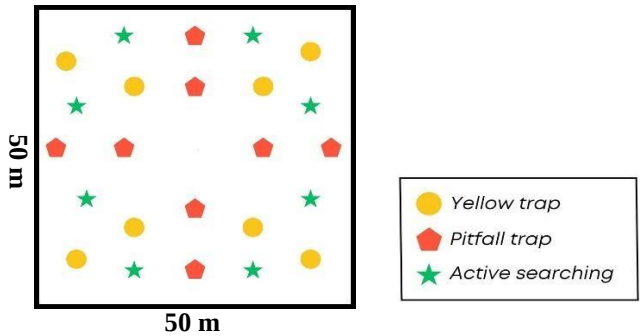

Figure 1. Design research traps

Data collection of insects using the Pitfall Trap method by making a 10 m transect line in a quadrant area at each station. Data collection was carried out by installing pitfall traps in the form of plastic cups containing a mixture of ethylene glycol, liquid soap and water immersed in the ground with the mouth of the glass parallel to the ground surface. Eight traps were set according to the placement point (Figure 1) at each station with a duration of 24 hours for 3 days. Insects trapped in the traps were collected and put into plastic bottles for identification. Insect data were collected using the Yellow Sticky Trap method by setting traps made of yellow paper (measuring 20 x 25 cm) and coated with adhesive glue. The yellow sticky trap was attached to a 2 m long bamboo sticking into the ground. Eight traps were set according to the placement point (Figure 1) at each station (24 traps in total) with a duration of 12 hours for 3 days. Insects that stick to the trap glue will be taken for identification.

Insect data collection uses the Sweep Net method by sweeping or swinging the net over the plant surface around the quadrant area. Data collection was carried out twice in the morning and evening with a duration of approximately 4 hours for 3 days. Insect data collection uses the Active Searching method by walking around the quadrant area according to a predetermined point (Figure 1). Insect data was taken by capturing directly by hand or tweezers on litter habitat, soil surface and under leaves. The insects obtained were put into plastic bottles for identification. The duration of direct search was conducted in the morning for 3 hours. This study was conducted to describe the diversity of insects in Dramaga Protected Forest. The research location was in the Dramaga Protected Forest area, West Bogor District, West Java Province. Determination of the research location by purposive sampling method based on the condition of the Dramaga Protected Forest area which has characteristics in accordance with the optimal conditions of insect life. The location for collecting insect data is divided into 3 stations with a quadrant area of each station measuring 50 x 50 m which aims to make data collection easier and the results obtained are more accurate. The research location of Dramaga Protected Forest has the characteristics of a humid environment with various types of vegetation and there is a small stream that illustrates the beauty of the research location.

Figure 2. Research location map

The collected insect data were identified using Borror's Identification Book (1992) based on morphological characteristics and habitat observations. Insect data were analyzed quantitatively using biological indices consisting of Diversity Index (H'), Evenness Index (E) and Dominance Index (D). Measurement of abiotic parameters was carried out during insect data collection, namely in the morning and evening for 3 days. Abiotic parameters measured include humidity, light intensity, temperature and pH.

RESULT AND DISCUSSION

Based on the results of research and identification conducted in Dramaga Protected Forest Area, Bogor, 1359 individuals were obtained using four variations of capture methods namely Pitfall Trap, Yellow Sticky Trap, Sweep Net and Active Searching.

Table 1. Insect Catch Results

No.	Methods	Famili	Number of Individuals
1.	Pitfall Trap	Formicidae	325
		Tettigoniidae	100
2.	Yellow Trap	Blattellidae	35
		Dolichopodidae	7
		Coccinellidae	2
		Gryllidae	9
3.	Sweep Net	Acrididae	451
		Pieridae	50
		Nymphalidae	38
		Cicadellidae	77
		Platycnemididae	2
		Hesperiidae	42
		Chrysomelidae	22
		Arctiidae	10
4.	Active Searching	Cicadellidae	50
		Coccinellidae	2
		Acrididae	125
		Chrysomelidae	12
	Total		**1359**

Insects that have been identified from the catches of the 4 research methods are classified into 14 famili, namely the Formicidae, Tettigoniidae, Blattellidae, Gryllidae, Dolichopodidae, Coccinellidae, Acrididae, Pieridae, Nymphalidae, Cicadellidae, Platycnemididae, Hesperiidae, Chrysomelidae and Arctiidae famili. The Sweep Net method was the method with the most insect catches, namely 692 individuals from 8 famili, and the Yellow Sticky Trap method was the method with the least insect catches, namely only 53 individuals from 4 famili. Insects obtained by the Sweep Net method are more numerous than the other methods, namely 692 individuals consisting of 8 famili, including the Acrididae, Pieridae, Nymphalidae, Cicadellidae, Platycnemididae, Hesperiidae, Chrysomelidae and Arctiidae famili. This is because the Sweep Net method can capture insect species that are actively flying or perching on plant parts. Insects caught on this swing net are types of insects that have high activity in the morning and afternoon, in accordance with the time of data collection, namely during the day. The results of this catch are reinforced by research conducted by Pebrianti *et al*. (2024), in which the most insect individuals were caught with Sweep Net traps, as many as 1936 individuals and the order Diptera became the most caught order. Based on insect catch data obtained with Sweep Net, the Acrididae famili was the most common, totaling 451 individuals. This is related to the condition of the study site which is favorable for the life of the Acrididae famili.

The Pitfall Trap method also captured a large number of insects, namely 425 individuals consisting of 2 famili, including the Formicidae and Tettigoniidae famili. Pitfall Trap is the most effective method used to capture insects that are active on the ground or in the soil. The Formicidae or ant famili is the most common insect famili trapped in pitfall traps, totaling 325 individuals. Ants are a type of insect that has high mobility on the ground, so ants are easily trapped in traps that contain a mixture of liquids. This is supported by the statement Ikhsan *et al*. (2020) which explains that the use of Pitfall Trap traps is effective and widely used to trap ants. Insects obtained by the Active Searching method were 189 individuals consisting of 4 famili, including the famili Cicadellidae, Coccinellidae, Acrididae and Chrysomelidae. Active Searching was carried out by exploring the research site and taking insects found directly using hands or tweezers. The types of insects obtained are flying insects that have striking body shapes and colors, and usually perch on plant parts. The Acrididae famili or grasshoppers were the most common insects found, with 125 individuals. Locusts usually perch on the leaves of plants, so they are easy to find and catch.

The Yellow Sticky *Trap* method captured the least number of insects, namely 53 individuals consisting of 4 famili, including the Blattellidae, Dolichopodidae, Coccinelidae and Gryllidae famili. The Blattellidae or small cockroach famili was the most captured insect, with 35 individuals. Cockroaches are a type of insect pest that likes to live in an environment with good humidity, as in the research location has humidity and vegetation that supports the life of cockroaches. This is supported by research conducted by Ilhamiyah & Zuraida (2016) where the installation of Yellow Trap for pest control of vegetable crops successfully captured leaf pest insects. Traps with yellow color are more contrasting and shiny, so pest insects are more easily attracted because the yellow color describes the shape of young leaves or ripe fruit in the vision of pest insects (Ilhamiyah & Zuraida, 2016).

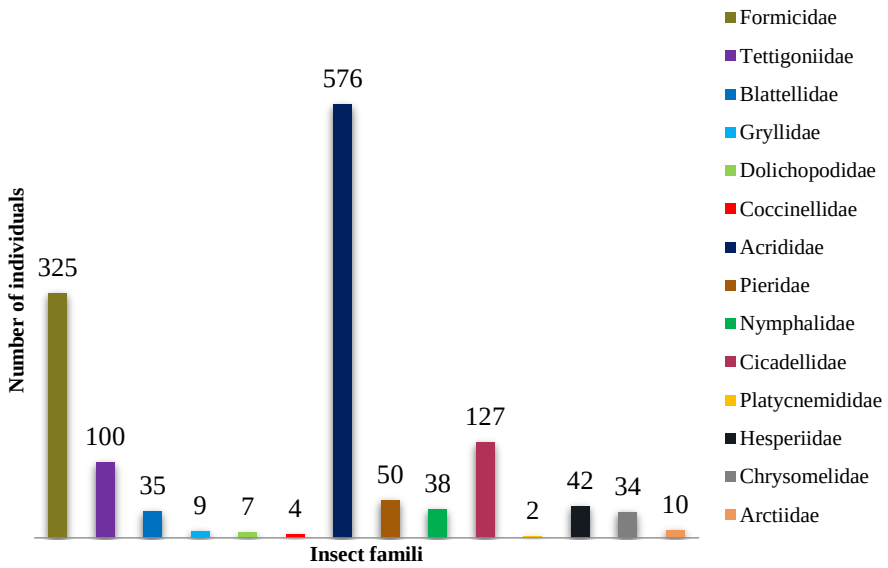

Figure 3. Insect famili

Overall, the Acrididae famili became the most common insect famili during the study, totaling 576 individuals. The Acrididae famili or called the short-snouted grasshopper obtained has the characteristics of a shorter snout than a body with a brownish green color. According to Sugiarto (2018), the Acrididae famili is found in rice field ecosystems with shrub, grass and shrub vegetation. This is in accordance with the forest research location which is dominated by grass vegetation. Diverse vegetation types affect the abundance of grasshoppers in a habitat, where the higher the diversity of vegetation in a habitat, the higher the food source for grasshoppers (Prakoso, 2017). Grasshoppers are herbivorous insects that act as carrion eaters, decomposers of organic material from plant parts and predators for other insects that are smaller

in size. The abundant presence of locusts in the ecosystem can be used as bioindicators of environmental pollution and land management Falahudin *et al*. (2015) stated that one type of insect that can be used as an indicator of environmental pollution is insects from the Orthopthera order.

The Platycnemididae famili is the least insect famili found at the research site with a total of 2 individuals. The famili Platycnemididae or needle dragonflies were obtained using the Sweep Net method in the grass around the study site. This dragonfly has a medium body size with a length of 28 mm, black in color with yellow patterns. Generally, the natural habitat of dragonflies is in high mountainous areas, fresh waters (lakes, rivers, ponds, swamps), rice fields, gardens and forests, and can be found in residential yards or urban areas (Gultom, 2022). The presence of dragonflies in the research location close to the lake indicates that the lake is still in good condition. Dragonflies can be used as bioindicators of clean water, this is because dragonflies breed in unpolluted water areas, where dragonfly nymphs can only live in clean water areas (Putri *et al*., 2019; Gultom, 2022).

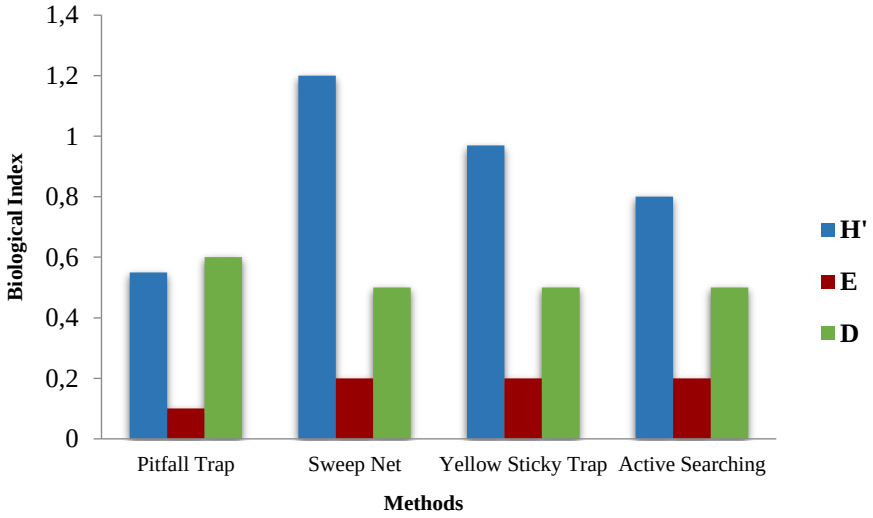

Figure 4. Comparison of Biological Index

Insects obtained from the Dramaga Protected Forest area using the Pitfall Trap method are categorized as having a low diversity index with a value of 0,55, a low evenness index with a value of 0,1 and a moderate dominance index of 0,6. Furthermore, insects obtained using the Sweep Net method are categorized as having a low diversity index with a value of 1,2, a low evenness index with a value of 0,2 and a medium dominance index of 0,5. Insects obtained using the Yellow Sticky Trap method are categorized as having a low diversity index with a value of 0,97, a low evenness index with a value of 0,2 and a medium dominance index of 0,5. Finally, insects obtained using the Active Searching method are categorized as having a low diversity index with a value of 0,8, a low evenness index with a value of 0,2 and a medium dominance index of 0,6.

Insect diversity in Dramaga Protected Forest obtained from 4 data collection methods is categorized as low with values between 0,55 – 1,2. Low diversity is due to the dominating famili from the capture results, namely the Formicidae famili dominates in Pitfall Trap, Acrididae dominates in Sweep Net, Blattelidae dominates in Yellow Sticky Trap and Cicadellidae dominates in Active Searching. This is supported by the statement Maesyaroh *et al*. (2023) that the low diversity value is due to the presence of one species with a greater number than other species. Insect famili that dominate or are found in large numbers indicate that the distribution of insect species at the research site is uneven Ambeng *et al*. (2023) stated that low species diversity indicates low productivity as an indication of heavy pressure on unstable ecosystems. The research location is a research forest that also functions as a tourist area, so it is visited

by many people. The high level of human activity is one of the factors causing the insect diversity obtained from the research location to be categorized as low.

The evenness index value of insects in Dramaga Protected Forest is categorized as low with a value between 0,1 – 0,2. Low evenness indicates that the distribution of insect species in the study site is unbalanced or uneven and there are dominating insect species (Lestari *et al.,* 2020; Rostikawati *et al*., 2024; Supratman *et al*., 2024). According to Supit *et al*. (2020), if the evenness index value is close to 0, it indicates low evenness due to the presence of dominating species and if the evenness index is close to 1, it indicates high evenness, meaning that there is no dominating species. The uneven distribution of insect individuals is indicated by the dominance index value in Dramaga Protected Forest which is categorized as medium with a value between 0,5 – 0,6. There are 4 insect famili obtained from the four research methods that dominate, namely Formicidae, Acrididae, Blattelidae and Cicadellidae. The number of insect famili obtained can be influenced by the availability of food and their suitability for environmental conditions at the research site. The environmental conditions at the study site are favorable for the life of the Formicidae, Acrididae, Blattelidae and Cicadellidae famili, namely there is a lot of litter with diverse vegetation, and humid environmental conditions.

Table 2. Mean values of environmental parameters

Time	Humidity (%)	Light Intensity (Lux)	Temperature (℃)	pH
Morning	89	1511	23	7
Afternoon	87	317	25	7

Low insect diversity with moderate dominance is influenced by environmental factors during research in Dramaga Protected Forest. Insects have a level of tolerance to the temperature in their environment. The effective temperature for insect life development is in the range of minimum temperature of 15°C, optimum temperature of 25°C and maximum temperature of 45°C (Basna *et al*., 2017). The temperature at the research site is considered optimal for insect growth and development with a range of 23°C – 25°C. Optimal temperature can affect insect activity and food availability for insects at the research site. Soil temperature is one of the factors determining the presence and density of soil organisms. Soil temperature greatly determines the level of decomposition of soil organic matter, where if the process of decomposition of soil material is faster, the vegetation in the environment is more fertile, thus inviting insects to come (Putra *et al*., 2021).

The soil in the Dramaga Protected Forest area has a pH of 7, which is neutral, where soil conditions with a neutral pH support insect life. soil pH affects the life and activities of insects on the soil surface (Setiawati *et al*., 2021). This is supported by research Putra *et al*. (2021) which explains that soil pH affects the density of soil fauna, one of which is ants, if the soil pH is not suitable, the ability of ants to survive and reproduce is less than optimal. soil pH becomes a limiting factor for insect life, if the pH is too acidic or alkaline, insect life will be disrupted. In addition, insect life is also influenced by soil moisture and light intensity. Soil moisture affects the distribution, activity and development of insects, and affects the availability of soil organic matter used as a source of nutrients for insects on the soil surface (Sundari *et al*., 2018; Putra *et al*., 2021). Soil moisture at the research site ranged from 87 – 89%, where soil conditions are moist and not dry can support insect breeding development. Light intensity at the research site ranged from 317 – 1511 Lux, where shady environmental conditions are highly favored by insects. This is supported by research conducted by (Manueke, 2022) that light affects insect activity (diurnal, nocturnal) and insect behavior (attracted or avoiding light).

CONCLUSION

Based on the results of the study of insect diversity in the Dramaga Protected Forest area, 1359 individuals were obtained which were classified into 14 families. The Acrididae family is the most abundant insect family found in the Dramaga Protected Forest, while the least abundant is the

Platycnemididae family. Insect diversity in the Dramaga Protected Forest is included in the low category with a value between 0.55 - 1.2. The evenness index is low with a value of 0.1-0.2 and dominance is included in the moderate category with a value of 0.5-0.6. Abiotic conditions at the research location are included in the optimal category to support insect life. This research is useful for the nation because it can be used as a source of information and as a guideline or literature review for other research on insect diversity and the Dramaga Protected Forest.

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