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Original Article

Diversity of Grasshopper Species in the Cirahab Waters Area, Curuggoong Village, Padarincang District, Serang Regency, Banten

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Abstract

Grasshoppers are ecologically important insects that can act both as agricultural pests and as bioindicators of environmental condition, yet data on their diversity in the agricultural landscape of Cirahab, Curuggoong Village, remain limited. This study aimed to examine the diversity of grasshoppers in the Cirahab area. A mixed-methods approach combining quantitative and qualitative descriptive techniques was employed to observe and measure the specimens. This method was used to identify the specific types of grasshoppers found in the Cirahab region, an area known for its abundant grasshopper populations, particularly within its agricultural environments. Grasshoppers play a vital role in maintaining ecological balance; biologically, they are herbivorous insects belonging to the suborder Caelifera within the order Orthoptera. The study identified several species, including *Atractomorpha* sp., *Caryanda spuria*, *Hierodula formosana*, *Oedaleus infernalis*, *Oxya japonica*, *Phaneroptera brevis*, *Phlaeoba fumosa*, *Stenocatantops angustifrons*, and *Trilophidia annulata*. The Cirahab area supports a diverse range of grasshopper species. A total of 136 individuals representing nine species were collected, and the calculated diversity index (H') value of 2.051639756 placed the area in the "Moderate" diversity category.

Keywords: Agricultural Land, Bioindicator, Insect Ecology, Orthoptera, Shannon-Wiener Index.

1. Introduction

The ability of grasshoppers to form dense, highly mobile swarms means these large herbivorous insects can become serious agricultural pests. They are short-horned grasshopper species that periodically form massive populations within dense migratory groups; individuals in these swarms differ in certain characteristics from those that live solitarily.

Grasshoppers belong to the order Orthoptera, comprising approximately 20,000 species (Borror et al., 1992). They are extremely numerous and exhibit a wide variety of types and colors, including green, blue, brown, white, and other hues found in the environment. Bhargava (1996) states that grasshopper species diversity can be influenced by various ecological factors, such as rainfall, temperature, atmospheric conditions, relative humidity, soil type, vegetation structure, and other factors.

The life cycle of grasshoppers contains a nymph stage, during which they hatch from eggs as wingless juveniles and mature in approximately ninety days. Some species may exhibit marked behavioral changes, becoming gregarious and forming massive swarms, particularly during dry periods that come after a flush of abundant vegetation. Because grasshoppers are known to consume vast quantities of plant matter, this swarming behavior can inflict extensive

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agricultural damage. Remarkably, even with their pest reputation, grasshoppers have formed part of human diets in numerous cultures, underscoring their place in both ecosystems and human nutrition.

Furthermore, grasshoppers play a role in maintaining environmental balance; in nature, they act as scavengers and decomposers of organic matter, while also consuming plant parts and smaller insects. Additionally, they serve as a food source for birds and other predators, thereby functioning as a link in the environmental or ecosystem food chain. Grasshoppers also serve as bioindicators of environmental pollution. Falahudin et al. (2015) note that insects can indicate environmental pollution, specifically identifying members of the order Orthoptera, which includes grasshoppers, as suitable indicators for this purpose.

In Indonesia, grasshoppers are also considered pests capable of causing significant damage to crops and harvests (Adnan, 2009). Recently, however, they have also been utilized as feed for livestock, and are even consumed by humans. Grasshoppers inhabit areas abundant in rice plants, grasses, and small trees, which serve as perches and foraging grounds. Anwar (2013) notes that grassy areas constitute the primary habitat for grasshoppers.

Previous studies have documented grasshopper and other Orthopteran diversity across a range of habitats in Indonesia, including rice field ecosystems (Irwanto & Gusnia, 2021), peatlands (Falahudin et al., 2015), mountain ecosystems (Erawati & Kahono, 2015), and tourist areas such as waterfalls and hot springs (Sandi et al., 2021; Wiguna et al., 2019). These studies indicate that Orthopteran composition and abundance vary with habitat type and vegetation structure (Bhargava, 1996; Erawati & Kahono, 2015), whereas others have used insects as indicators of environmental condition (Falahudin et al., 2015). Similar diversity assessments based on the Shannon-Wiener index have also been applied to insects associated with cultivated plants (Lubis et al., 2022).

The Cirahab area in Curuggoong Village, Padarincang District, is characterized by an abundance of grass and surrounding rice plants, creating an environment where various grasshopper species thrive. The area boasts diverse vegetation ranging from large banyan trees to the grasses favored by grasshoppers. This rich plant diversity attracts grasshoppers to the area, encouraging them to congregate and breed, particularly due to the plentiful food sources available. However, few studies have examined grasshopper diversity in the Cirahab area, particularly within its agricultural landscape, and no baseline data on species composition and diversity are currently available for this location. This study contributes site-specific data that can support future monitoring of grasshopper populations and environmental condition in the area. This study aims to examine the diversity of grasshopper species in the Cirahab area, Curuggoong Village, Padarincang District, Serang Regency, Banten, using the Shannon-Wiener diversity index.

2. Methods

The study employed both quantitative and qualitative descriptive methods. It was conducted in the Cirahab Sumber area, Curuggoong Village, Padarincang District, Serang Regency, Banten, over a two-month period in June and July 2026. Subsequently, the grasshoppers were identified by species on-site. The equipment used included nets, writing instruments, a camera, plastic bottles, and a ruler. The material used was 70% alcohol. The functions of the tools and materials used are as follows:

Material used in this research is 70% alcohol which is used to clean the grasshopper specimens collected in the field. Then the equipments consist of writing instruments for recording the types of grasshoppers collected; a container to hold the grasshoppers and

prevent escape; a ruler for measuring the grasshoppers; a camera to document the specimens; and a net for capturing them.

The study employed a descriptive method combining quantitative and qualitative approaches, involving the observation and measurement of the grasshoppers. The data obtained were presented in tabular form, accompanied by a description of the findings. Data analysis utilized the Shannon-Wiener Diversity Index (H') formula to assess diversity.

2.1. Research Data Analysis

The collected grasshoppers were identified using reference books and online resources. Subsequently, data analysis was performed by calculating the Diversity Index (H') for each plot:

$$H = -\Sigma (ni/N) \log (ni/N)$$

Where:
H' = Diversity Index.
ni = Number of individuals of each species.
N = Total number of individuals across all species.
The criteria used to interpret Shannon-Wiener diversity (Magurran, 1988) are as follows:
H' < 1: diversity is classified as low
H' = 1–3: diversity is classified as moderate
H' > 3: diversity is classified as high

The results of the calculations based on the collected data were then analyzed using Microsoft Excel to assess the diversity of grasshopper species in the Cirahab Sumber area.

2.2. Ethical Considerations

This study did not involve human participants, personal data, or protected or endangered species, so approval from a research ethics committee was not required. Grasshoppers were collected using hand nets from a publicly accessible agricultural area in Cirahab, Curuggoong Village. Collection was limited to the number of specimens needed for identification, and no protected species were targeted. Specimens were handled carefully, and no habitat was deliberately damaged during the fieldwork.

3. Results and Discussion

3.1. Research Results

Nine species were identified through the research conducted in the Cirahab area, comprising a total of 136 individual grasshoppers. Six legs (three on each side of the thorax) stand among the key anatomical features, along with two pairs of wings, in which the hard forewings act as protective covers for the membranous hindwings used for flight; ears positioned on or near the legs; and compound eyes. Belonging to the order Orthoptera, grasshoppers are jumping insects that encompass a wide variety of species; however, not all grasshoppers are locusts.

Antenna length constitutes the primary distinction separating locusts from other grasshoppers. Other grasshoppers (family *Tettigoniidae*) bear longer antennae than locusts (family *Acrididae*), which possess shorter ones. Long, slender hind legs featuring large thighs account for their remarkable jumping ability, with each jump capable of spanning a distance many times the length of the insect's body.

Large, straight, smooth hindwings that make flight possible are also found on most grasshoppers. These wings are folded when the insect rests and are shielded by robust

forewings that completely cover them. With the exception of northern Canada, Greenland, northern Asia, northwestern Africa, Western Australia, and the Arctic and Antarctic regions, grasshoppers are distributed across most of the globe. Presented in Table 1 below are the results regarding the nine grasshopper species:

Table 1. Grasshopper Species

No.	Species Name	Amount	Location
1.	*Atractomorpha sp.*	20	Cirahab
2.	*Caryanda spuria*	10	
3.	*Hierodula formosana*	7	
4.	*Oedaleus infernalis*	15	
5.	*Oxya japonica*	27	
6.	*Phaneroptera brevis*	30	
7.	*Phlaeoba fumosa*	10	
8.	*Stenocatantops angustifrons*	5	
9.	*Trilophidia annulata*	12	
Total Amount of Grasshopper		**136**	

A total of 136 individual grasshoppers representing nine species is shown by the data in Table 1 above. Included among them are *Atractomorpha sp, Caryanda spuria, Hierodula formosana, Oedaleus infernalis, Oxya japonica, Phaneroptera brevis, Phlaeoba fumosa, Stenocatantops angustifrons,* and *Trilophidia annulata*. These grasshopper species are commonly found among grasses and rice plants in the Cirahab area.

At full maturity, grasshoppers reach lengths of one to eight inches. Some species undergo seasonal color shifts, showing green at certain times and red, olive, or brown at others. The grasshopper's body, like that of other insects, is divided into three sections: the head, the thorax (middle section), and the abdomen (rear section). On the head sit the antennae, which serve a sensory purpose.

Every grasshopper possesses a pair of compound eyes with multiple lenses, positioned at the front of its head. Three pairs of legs extend from the thorax as well. Jumping is made possible by the hindmost pair, which is significantly larger and longer than the rest. The diet of grasshoppers consists of the leaves, roots, and stems of grasses, herbaceous plants, and shrubs, and they chew with strong mandibles (jaws) that move from side to side to break down their food.

Pale, wingless nymphs emerge from eggs in the spring. Over the course of ninety days, they develop into adults, undergoing four to five molts during the process. The adults mate, and about a week later, the females lay eggs for the next generation. They die a few weeks afterward. In autumn, grasshoppers such as the Rocky Mountain locust (*Melanoplus spretus*) lay their eggs in holes in the ground. The eggs hatch in spring, and the young grasshoppers reach maturity by July or August. Long-horned grasshoppers, such as the common meadow katydid (*Orchelimum vulgare*), lay their eggs in low-growing shrubs or in crevices within tree bark.

In dry periods after a rainy season characterized by abundant vegetation, grasshoppers congregate and release pheromones. These insects subsequently enter a "gregarious phase," living together in groups, changing color to yellow or pink, and altering their mating patterns and other behaviors. The swarms that result can devastate vegetation over vast areas, as each grasshopper in the swarm can consume an amount of plant matter equal to its own body weight daily.

For centuries, humans have eaten grasshoppers, and consuming human crops is not the only thing grasshoppers do. For example, grasshoppers and similar insects are exempted by

Talmudic law from the prohibition against eating flying or creeping creatures that "walk on all fours." In addition, Shakespeare's play *Othello* mentions food that is "luscious as locusts." Candied grasshoppers are consumed throughout China and the Philippines.

In North Africa, dried and powdered grasshoppers are mixed into flour used for making bread. Grasshopper species diversity in Cirahab remains relatively high; the species found there exhibit color variations ranging from green to brown. This aligns with Suin (2002), who noted that the frequency of an organism's presence in a habitat indicates how often that species occurs in that specific environment. Relative frequency represents the proportion of a specific species' frequency against the total frequency of all species; from this, it can be inferred that as the grasshopper population thrives, environmental pollution levels decrease. The calculated values for grasshopper species diversity are presented in Table 2 below.

Table 2. Grasshopper Species Calculation Results

No.	Species Name	Amount	Diversity Index Value (H')
1.	*Atractomorpha sp.*	20	-0.281900384
2.	*Caryanda spuria*	10	-0.191916897
3.	*Hierodula formosana*	7	-0.152700097
4.	*Oedaleus infernalis*	15	-0.243154928
5.	*Oxya japonica*	27	-0.32098593
6.	*Phaneroptera brevis*	30	-0.333409744
7.	*Phlaeoba fumosa*	10	-0.191916897
8.	*Stenocatantops angustifrons*	5	-0.1214418
9.	*Trilophidia annulata*	12	-0.21421308
Total Amount of Grasshopper		**136**	**2.051639756**

Based on Table 2 above, it can be concluded that the grasshopper diversity in the Cirahab Area comprising 9 species and 136 individuals falls into the "Moderate" category, with a calculated Diversity Index (H') of 2.051639756. The data indicates that the species *Phaneroptera brevis* and *Oxya japonic*a are the most dominant, with 30 and 27 individuals recorded, respectively.

Grasshoppers remain abundant and evenly distributed throughout the Cirahab Area, largely because the region still offers an ample food supply for these insects. Grasshoppers favor areas rich in grasses and agricultural land, where they can feed on foliage and even agricultural crops.

3.2. Discussion

This study aimed to examine grasshopper diversity in the Cirahab area, and the results show a moderate diversity level (H' = 2.05; Magurran, 1988), with nine species and 136 individuals recorded. The evenness index (J' = H'/ln S) was 0.93, indicating a fairly even distribution among species. *Phaneroptera brevis* (22.1%) and *Oxya japonica* (19.9%) were the most abundant, whereas *Stenocatantops angustifrons* (3.7%) and *Hierodula* formosana (5.1%) were the least abundant.

This pattern is likely related to the vegetation structure of Cirahab, which combines grasses, rice plants, and larger trees such as banyan that provide food, perches, and shelter. This agrees with Anwar (2013) and Bhargava (1996), who noted that grassy areas and vegetation structure shape grasshopper diversity. The high abundance of *O. japonica* is consistent with its close association with rice and other grasses.

The diversity in Cirahab (H' = 2.05) is higher than that reported by Irwanto and Gusnia (2021) in a paddy field ecosystem in Bangka (six Acrididae species, H' = 1.70) and by Sandi et al. (2021) in the Curug Lawe forest area (nine species, H' = 1.48). Wiguna et al. (2019) did not

report H' but recorded ten *Ensifera* species in the Sauman hot spring tourist area. These differences may reflect variation in habitat type, vegetation complexity, and human disturbance (Erawati & Kahono, 2015). Some species were also shared among sites, namely *P. fumosa* in Bangka and *P. brevis* in Sauman, suggesting tolerance to a range of habitats.

Falahudin et al. (2015) suggested that Orthopterans can serve as indicators of environmental condition. However, this study did not measure environmental parameters, so the results cannot be used to conclude that pollution levels in Cirahab are low and are better treated as baseline data. The presence of crop-associated species such as *O. japonica* and *Atractomorpha sp*. also warrants population monitoring (Adnan, 2009).

This study is limited to two months of sampling at one site, and H' is sensitive to sampling effort. Future studies should extend the sampling period, compare several habitats, and record abiotic factors. Despite these limitations, this study provides the first species list and diversity index for grasshoppers in Cirahab, which can support biodiversity documentation and pest monitoring.

4. Conclusion

This study recorded nine grasshopper species and 136 individuals in the Cirahab area, with a Shannon-Wiener diversity index (H') of 2.05, which falls into the moderate category. Individuals were distributed fairly evenly among species (J' = 0.93), with *Phaneroptera brevis* and *Oxya japonica* being the most abundant. The diversity is likely supported by the availability of grasses, rice plants, and other vegetation that provide food and shelter. These findings provide baseline data on grasshopper diversity in the area and can support biodiversity documentation and pest monitoring in its agricultural land. However, this study was limited to two months of sampling at one site and did not measure environmental parameters. Future studies should extend the sampling period, compare several habitats, and record abiotic factors such as temperature, humidity, and soil conditions.

4.1. Conflict of Interest Statement

Regarding the publication of this paper, the authors state that there is no conflict of interest.

4.2. Author Contributions

H.H.: Conceptualization, Investigation, Data Curation, Formal Analysis, Visualization, Writing – Original Draft.
A.N.: Methodology, Validation, Supervision, Writing – Review & Editing.
Y.K.: Resources, Project Administration, Writing – Review & Editing.

4.3. Funding Statement

No funding was received for this research.

4.4. Informed Consent

Studies not involving human subjects, informed consent was not required.

4.5. Ethical Approval

The authors performed no research on human participants in connection with this article.

4.6. Data Availability

The data that support the findings of this study are available from the corresponding author [H.H.] upon reasonable request.

4.7. Declaration of Generative AI and AI-assisted Technologies

In the course of preparing this manuscript, the authors drew on Claude (Anthropic) for language editing, for enhancing grammatical clarity, and for refining the structure of several sections. The authors rigorously and critically reviewed all outputs generated by the AI tool and edited them thoroughly, thereby ensuring factual accuracy, improving clarity of expression, and confirming adherence to established academic standards. The integrity and content of this manuscript remain the full responsibility of the authors.

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