

Diversity of aquatic insects on the leaf litter of water lettuce (*Pistia stratiotes* L.) in an experimental fishpond

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ARTICLE INFO

Research Article

Article history:

Received June 12, 2023

Received in revised form December 3, 2023

Accepted July 3, 2024

DOI:

Keywords: macroinvertebrates, decomposition, macrophytes, tropical



ABSTRACT

Aquatic insects play a crucial role in ecological systems because they are sensitive to environmental changes, indicating whether an environment is healthy or polluted. The vast biodiversity in morphology, physiology, and adaptive behavior among insect species on Earth has led to numerous scientific studies using insects as models. Population dynamics studies, for instance, often rely on the evolution of insect populations. The objective of this research is to explore the types of aquatic insects present, as well as their diversity, evenness, and dominance levels. The study found 4 orders and 4 families totaling 180 individuals on the leaf litter of water lettuce. The diversity index of aquatic insects on the water lettuce leaf litter was categorized as low. The evenness index was categorized as small. The dominance index ranged from low to moderate to high categories.

INTRODUCTION

Public waters are areas of the Earth's surface that are continuously or regularly inundated with water, whether freshwater, brackish, or saline, flowing into from the lowest tidal line, and the body of water is formed naturally or man-made. These public waters include rivers, lakes, reservoirs, wetlands, marshes, and other bodies of water. Freshwater ecosystems are part of public waters that primarily function as habitats for aquatic biota, one of which is aquatic insects (macroinvertebrates).

Aquatic insects are a group of insects that spend part of their lives in bodies of water such as rivers and lakes. Their habitat is typically in sediment or the bottom substrate of rivers, with limited migration patterns and a tendency to settle (Plafkin et al., 1985). Aquatic insects play a crucial role in ecological systems because they are sensitive indicators of healthy or polluted environments (Trianto et al., 2020).

The available habitat on the substrate is leaf litter. Leaf litter consists of leaves that fall on the ground or water surface. Leaf litter plays an important role as a home for biota, including aquatic insects. Rocky and gravel substrates are more inhabited by aquatic insects because these substrates are relatively stable (less prone to movement) and provide better opportunities for survival and reproduction. In contrast, sandy and leaf litter substrates are less inhabited by aquatic insects due to their unstable living conditions (easily movable) and not all aquatic insects can adapt to these substrates.

Research on aquatic insects is beneficial for understanding environmental changes, but the limited information and data on colonization studies of aquatic insects on scientific leaf litter in Indonesia prompted the implementation of this research. The results of this study are expected to provide information on the colonization of aquatic insects on wood apple leaf litter (*Pistia stratiotes* L.), serving as a reference for future research. Colonization studies of aquatic insects on various types of substrates have not been widely

conducted, especially in tropical lentic systems. It is not yet clear how aquatic insects preferentially choose leaf litter substrates as their habitat, especially comparing aquatic plant and terrestrial plant leaf litter substrates. Given that wood apple trees are commonly found in our surroundings; this study will compare these two types in relation to the role of leaf litter from both types of leaves in providing habitats for aquatic insects.

METHODOLOGY

Research Time and Location

This research was conducted from October 13, 2022, to December 22, 2022. The research was conducted at the Experimental Pond Laboratory of the Department of Aquaculture, Faculty of Fisheries and Marine Sciences, Mulawarman University, East Kalimantan, Samarinda City. Identification of aquatic insects was carried out in the Experimental Pond Laboratory.



Figure 1. Study site

Research Procedure

Each net bag contained water lettuce leaves. The pond contained 6 floats tied to net bags, with each float having 2 types of plants, namely water lettuce, each type having 3 net bag pockets. Collection of aquatic insects on water lettuce leaf litter was carried out every 7th, 14th, 28th, 42nd, 56th, and 70th days (Reddy and DeBusk, 1991). The data used for sample collection in this study were primary data. Primary data consisted of collecting aquatic insects using hand picking method. The tools and materials used in this study were a basin to place net bags containing harvested leaf litter, a bucket for washing or rinsing harvested leaf litter, a net for filtering insects from water, a ladle for scooping water, plastic containers containing 70% alcohol to preserve the filtered results in plastic containers until the insects obtained were preserved. Each filtered leaf litter water was placed in a container containing 70% alcohol and then placed

in a different container according to the type of leaf litter. There were a total of 2 containers, each containing samples of aquatic insects successfully filtered from water lettuce leaf litter. Sample identification was performed using a microscope with magnifications of 10-45x according to identification book references (Borror et al., 1992) and the book "Aquatic Insects of North America" by R.W. Meritt, K.W. Cummins, M.B. Berg.

Data Analysis

All specimen data obtained were analyzed using Diversity Index (H'), Evenness Index (E), and Dominance Index (C). The formulas used to calculate each index are as follows:

1. Diversity Index (H')

The diversity index used to calculate the diversity of insect families is the Shannon-Wiener Diversity Index (Brower, et al., 1998). The formula used is:

$$H' = -\sum_{i=1}^n p_i \ln p_i$$

H'	= Diversity index
p_i	= Number of individuals of each species
\ln	= Natural logarithm
P_i	= Calculation of the # of individuals of a species divided by the total number of species
Jika $H' > 3$	= High diversity
Jika $1 < H' < 3$	= Medium diversity
Jika $H' < 1$	= Low diversity

2. Evenness Index (E)

The evenness index is used to determine the balance of the community. It is calculated using the formula according to Soegianto (1994):

$$E = \frac{H'}{\ln S}$$

E	= Evenness index
H'	= Diversity index
S	= Number of species
Jika $E < 0,4$	= Species distribution is uneven
Jika $0,4 > E < 0,6$	= Species distribution is fairly even
Jika $E > 0,6$	= Species distribution is even

3. Dominance Index (C)

The dominance index is used to calculate the dominance of aquatic insects using Simpson's Index (Odum, 1993):

$$C = \sum (n_i/N)^2$$

C	= Simpson's dominance index
N	= Total number of individuals

ni	= Number of individuals of each species
Jika $C \leq 0,50$	= Low dominance
Jika $0,50 \geq C \leq 0,75$	= Moderate dominance
Jika $C \geq 0,75$	= High dominance

RESULT AND DISCUSSION

Types of Aquatic Insects on water lettuce Leaves (*Pistia stratiotes* L.)

Aquatic insect sampling was conducted 6 times on days 7, 14, 28, 42, 56, and 70 in the Aquaculture Experiment Pond. Subsequently, aquatic insects were sorted, and the identified types of aquatic insects were recorded. The table below shows the types of aquatic insects found:

Table 3. Classification of Aquatic Insects on water lettuce Leaves

Substrate	Order	Family	Observation Day						Quantity
			7	14	28	42	56	70	
Water lettuce	Ephemeroptera	Batidae	87	1	2	-	-	-	90
	Diptera	Chironomidae	3	2	-	-	-	-	5
		Corixidae	34	8	22	-	-	-	64
	Hemiptera	Belostomatidae	2	-	-	-	-	-	2
		Pleidae	2	-	-	-	-	-	2
	Odonata	Libellulidae	-	17	-	-	-	-	17
Total			128	28	24	-	-	-	180

Based on the table above, sampling of water lettuce leaves from day 7 to day 70 resulted in the identification of 6 families of aquatic insects. These families originate from the orders Ephemeroptera (family Batidae), Diptera (family Chironomidae), Hemiptera (families Corixidae, Belostomatidae, and Pleidae), and Odonata (family Libellulidae). A total of 180 individuals were found. water lettuce leaves on days 42, 56, and 70 had completely decomposed, hence no aquatic insects were found.

Diversity Index, Evenness Index, and Dominance Index of Aquatic Insects

Based on the results of the research and observations at different times, the values of the diversity index, evenness index, and dominance index of aquatic insects on water lettuce leaves were obtained as follows:

Table 2. Diversity Index, Evenness Index, and Dominance Index of aquatic insects on leaf litter

Substrate	Observation Day	H'	E	C
Water lettuce	7	0,833	0,167	0,534
	14	0,968	0,242	0,457
	28	0,287	0,143	0,847
Keterangan		Low - Medium	Low	Low - High

The diversity index for water lettuce on days 7, 14, and 28 is low with values of 0.83, 0.96, and 0.28. According to Krebs (1985), if the diversity index is low, the evenness index will also be low. Meanwhile, on days 7, 14, and 28, water lettuce is in the small category with values of 0.16, 0.24, and 0.14. If the evenness index is uneven, the dominance index will be high. On day 7, water lettuce is in the moderate category with a value of 0.53, then on day 14, it is in the low category with a value of 0.45, and on the last day, day 70, it is in the high category with a value of 0.84. Since the number of aquatic insects found is uneven, this will affect the results of the dominance index of aquatic insects obtained.

CONCLUSION

In the leaf litter of water lettuce, a total of 4 orders and 6 families were found, comprising 180 individuals. The diversity index in the leaf litter of water lettuce overall is low, with a Shannon-Wiener index (H') below 3. The evenness index in the leaf litter of water lettuce overall is low, with an evenness index (E) below 0.4. The dominance index in the leaf litter of water lettuce overall ranges from low to high categories.

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