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Diversity of water insect types in various fish farming pond lands in Pekajang Village, Lingga Regency, Riau Islands Province

Abstract

The presence of insects in an ecosystem varies greatly, and the diversity of insects in various Fish Farming Pond lands can act as polydonatur insects, pests, parasites, or predators for other aquatic animals. Referring to the role of insects, this study aims to determine what insects are found in various Fish Farming Pond lands, to analyse the diversity of aquatic insects, and to analyses environmental factors that influence the existence of these aquatic insects. This research was conducted in Pekajang Village, Lingga Regency in July-August 2022. The sampling technique was carried out using pitfall traps, light traps, and sweep nets, and the data obtained were analysed using the Shannon-Wiener diversity index. The results showed that aquatic insects at the research location were from the families Acrididae, Coccinelidae, Libellulidae, Mantidae, Nymphalidae, Papiolinidae, Pieridae, and Tettigonidae, the highest diversity of the 11 families found with the highest value H`=1.34 and the lowest H`=0.26. The results of environmental parameter measurements at the research location showed that the air temperature in the morning, afternoon, and evening ranged from 260C-280C, 270C-310C, 250C-360C, and the air humidity around the fish farming pond area ranged from 60% -70%, soil pH ranged from 6 and soil humidity ranged from 2%.

Keywords: diversity, pitfall trap, light trap, sweep net, insects

Volume 9 Issue 4 - 2024

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Received: July 30, 2024 | **Published:** August 16, 2024

Introduction

Humans always see insects as organisms that cause losses rather than benefits in polydonatur fish farming ponds. Insects are one of the fauna diversities in the field found in various ecosystems. The diversity of insects can be seen from the similarities and differences in the morphological characteristics of insects which are marked by differences in colour, size, shape, type of food, and habitat.[1] The more places with various ecosystems, the more insects will be found. Where the Fish Farming Pond land in Lingga Regency is marked by Fish Farming Pond land that often experiences drought with a dry land area of 178,727 hectares (Central Statistics Agency of Lingga Regency, 2017).

Pekajang Village has dry Fish Farming Pond land that has the potential to be developed into various types of land that can provide benefits to the community.[2] One of the uses of Fish Farming Pond land is to plant crops consumed by the community such as vegetables, bananas, and papaya. Their insects have where a role in human life. Insects can be beneficial and also detrimental to humans. The problem in the Fish Farming Pond area is inseparable from the role of insects as pests that can affect the harvest, but in essence, not all insects are pests, on the other hand, the presence of insects is beneficial in the Fish Farming Pond area as pollinator insects and biological control agents.

The diversity of insects in an ecosystem varies, this is influenced by abiotic and biotic environmental factors in the environment that can support insect life, in addition to environmental factors, the presence of insects is influenced by the availability of food sources in the environment, and can have beneficial and detrimental impacts on the ecosystem.[3–5] With the problem of pests and diseases in agricultural production, people carry out pest control by using pesticide fertilizers which are considered easy to obtain and do not require a lot of labour, this causes high pesticide use in Fish Farming Pond areas. Excessive use of pesticides can cause damage to the Fish Farming Pond land, health problems, and a reduction in insects that cannot survive with pesticides. To increase productivity in Fish Farming Pond land, a study on the analysis of insect diversity in various Fish Farming Pond lands is important, so that it can provide information on the presence of an insect in the Fish Farming Pond land.

Research method

The research was conducted from January to April 2024 on the coast of Pekajang Village, East Lingga District, Lingga Regency with an area of 184.9 km2. Where the research was conducted in the Fish Cultivation Pond land of Pekajang Village, Lingga Regency. has a geographical location at -0.0555882095324295 South, and 104.55403360351765 East with an altitude of 363 meters above sea level and has a plain topography and land area of ± 12 ha, from January to April 2024 (Figure 1).

The tools used in this study were cameras, storage bottles, tweezers, stationery, crowbars, Thermo hygrometers, roll meters, raffia ropes, soil testers, pitfall traps, light traps, and sweep nets. The materials used were 70% alcohol and detergent. This study was conducted by collecting insects in each trap at each observation station, the trapped insects were taken and put into a storage bottle filled with 70% alcohol, then identified using a determination key. Furthermore, the data obtained were analyzed using the Shannon-Wiener diversity index for each insect. Data analysis used the Shannon-Wiener Diversity Index. The Shannon Wiener diversity index has the following criteria:

H' value > 3 indicates high diversity; H' value $1 \leq H' \leq 3$ indicates moderate diversity; and H' value < 1 indicates low species diversity.

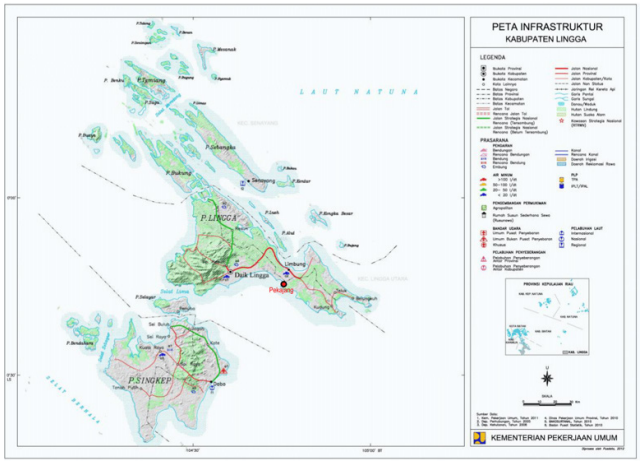

Figure 1 Research location of District Lingga.

Results and discussion

Based on the results of observations made in the Pekajang Village Fish Farming Pond, 8 families of insects were obtained with a total of 405 individuals. The largest number of insects caught were from the Coccinelidae family of 340 individuals, followed by the Libellulidae family of 18 individuals, and followed by Acrididae of 17 individuals, the Nymphalidae family of 11 individuals, the Tettigonidae family of 8 individuals, the Pieridae family of 8 individuals, the Mantidae family of 2 individuals and the Papiolinidae family of 1 individual (Table 1).

Table 1 List of insect families at the research location

No	Family	Stations				Total (individual)
		1	2	3	4	
1	Acrididae	4	2	11	0	17
2	Coccinelidae	180	20	95	45	340
3	Libellulidae	1	1	10	6	18
4	Mantidae	1	1	0	0	2
5	Nymphalidae	2	3	5	1	11
6	Papiolinidae	0	0	1	0	1
7	Pieridae	0	0	4	4	8
8	Tettigonidae	0	0	7	1	8
Total	(Individual)	188	27	133	57	405

Observations at station 1 found the most insects from the Coccinelidae family as many as 180 individuals, followed by the Acrididae family with 4 individuals, followed by the Nymphalidae family with 2 individuals, the Libellulidae family with 1 individual, the Mantidae family with 1 individual. At station 2 insects from the Coccinelidae family were 20 individuals, the Nymphalidae family 3 individuals, the Acrididae family 2 individuals, the Mantidae family 1 individual, and the Libellulidae family 1 individual. Station 3 found insects from the Coccinelidae family as many as 95 individuals, the Acrididae family 11 individuals, the Libellulidae family 10 individuals, the Tettigonidae family 7 individuals, the Nymphalidae family 5 individuals, the Pieridae family 4 individuals, and the Papiolinidae family 1 individual, and observation station 4 found the Coccinelidae family 45 individuals, the Libellulidae family 6 individuals, the Pieridae family 4 individuals, the Nymphalidae family 1 individual, and the Tettigonidae family 1 individual.

According to Soendjoto et al.,[6] an area can be used as a habitat and a place to fulfil food for wildlife depending on the landscape of the area. Fluctuations in the number and types of animal species are caused by habitat conditions, availability of food/nutrient sources, diversity and composition of vegetation, safety and comfort conditions in habitat types, proximity or continuity of habitat types on land areas, unique species characteristics, climate conditions (temperature, relative humidity, light intensity), human treatment and activities, and conditions and limitations of observers.[7] Environmental factors greatly influence the presence of insects in an ecosystem.[8] According to Ajuano & Neuenschwander;[9] states that the effective temperature range for insects in life development is between 150C - 40°C. The optimum temperature range for breeding is 25°C. Insects need water content in the air or a certain humidity to be active.[10] High humidity affects the distribution, activity, and development of insects. At appropriate humidity, insects are more tolerant to extreme temperatures.[11] According to Hardiansyah & Noorhidayati (2020), light intensity and air temperature affect the growth and development processes, physiology (metabolism), respiration, and reproduction of living things, as well as the physical structure of a habitat (Table 2).[12]

Measurement of environmental factors at the research location showed that the air temperature ranged from 250C - 360C, air humidity 47% - 70%, and pH 6, which greatly affects the presence of insects. According to Riefani & Soendjoto,[13] habitat conditions with various species of life (both plants, animals, and microorganisms) or interactions between life and interactions of life with the surrounding physical components (such as soil, water, and air) create an environment or habitat that makes animal species safe and comfortable. In general, insects can survive at an effective temperature range of a minimum temperature of 150C, an optimum temperature of 250C, and a maximum temperature of 450C (Handani, 2015). The Coccinelidae family is the most common family found at the research location which acts as a predator. at a temperature range of 150C - 350C this family can grow and develop, with a habitat on the stems, crowns, and leaves of plants, likes dry and wet places, and is active throughout the day.

Table 2 Environmental factors

Measure	Temperature (oC)			Humidity (%)		
(Weekly)	Morning	Afternoon	Night	Morning	Afternoon	Night
M1	26	27	25	69	67	70
M2	27	31	25	66	47	60
M3	27	31	25	65	50	61
M4	28	31	25	65	48	62
Average	26-28	27-31	25	65-69	47-67	60-70

Citation: Eddiwan K. Diversity of water insect types in various fish farming pond lands in Pekajang Village, Lingga Regency, Riau Islands Province. *MOJ Eco Environ Sci.* 2024;9(4):174–176. DOI: 10.15406/mojes.2024.09.00323

The presence of the Libellulidae family can be used as an indicator to monitor water quality in the surrounding environment.[14] This family can be found in flooded places, has strong flight ability, and is very difficult to catch.[15] In general, it can survive in a temperature range of 150C - 450C.[15] The Mantidae family has cannibalistic behaviour during mating.[15] The presence of Mantidae in Fish Farming Ponds is very beneficial because this animal acts as a predator.[16] The presence of Nymphalidae in an ecosystem is influenced by food sources, host plants, and shelter, environmental conditions and Nymphalidae has a polyphagous nature.[17] According to Riefani,[18] habitat inequality is caused by factors, such as food resource availability (quantity and quality) and competition between fauna in resource utilization (space and time).

Environmental factors that influence the presence of the Nymphalidae family include humidity, temperature, and altitude. According to Riefani & Soendjoto,[13] the presence of animals in a habitat is influenced by factors of water availability and quality, altitude, food availability, shelter, and predators. Maubeli has a humidity ranging from 26% - 31%, and temperatures ranging from 290C - 32oC. In a study conducted by Nadra et al.[19] on the Nympalidae family, they can survive at temperatures ranging from 290C - 350C, looking for food in the morning to evening and doing high activity during the day.[20]

The Papilionidae family is an insect that has a very small number, the activity of this insect is greatly influenced by environmental conditions, food conditions, and host plants. This family can survive at temperatures of 300C, and when flying the temperature ranges from 50C - 100C above the ambient temperature. Searching for food at low temperatures will require a lot of energy. The diversity of ecosystem types also affects the existence of this family. The Pieridae family can live and be active at an average air temperature range of 28.9oC - 33.0oC and an average daily air humidity of 68.6% - 81%.[16] The Tettigonidae family is a pest on plants, Tettigonidae is active at night or nocturnal.[21] If the population of this insect explodes, it can cause quite severe damage to plants because it sucks plant fluids.[22]

Based on the results of calculations using the Shannon-Wiener diversity index, the level of diversity of 11 families found the highest value H`= 1.34 and the lowest H`= 0.26 of all families found. The H` value with a low category indicates that the level of diversity at the location is low, this is influenced by the use of pesticide fertilizers, while if the diversity is in the medium category, it indicates that environmental conditions are good. According to Odum (1993), the more species there are, the higher the diversity, conversely, if the value is small, the community is dominated by one or a few species. Communities and species diversity are influenced by the distribution of individuals in each species,[23] although there are many species, if the distribution of individuals is uneven, the diversity is low (Hardiansyah & Noorhidayati, 2020).[24,25]

Conclusion

A total of 405 insects were caught, which were classified into 8 families, namely Coccinelidae as many as 340 individuals, Libellulidae 18 individuals, Acrididae 17 individuals, Nymphalidae 11 individuals, Tettigonidae and Pieridae 8 individuals, Mantidae 2 individuals, and Papiolinidae 1 individual. Environmental factors air temperature ranges from 250C - 360C, and air humidity ranges from 47% - 70%, such conditions can support the existence of insects in an ecosystem. For further researchers, further research should be conducted on the diversity index in different areas using other trap models, and the need to pay attention to factors that influence the development of pests and natural enemies in Fish Farming Ponds.

Acknowledgments

This gratitude is given to the Regent of Lingga who has supported the cost of this research. Then gratitude is given to the Secretary of Lingga Regency, the Head of the Marine and Fisheries Service, and all research staff who helped and facilitated the implementation of this research activity while in the field.

Funding

None.

Conflicts of interest

Author declares that there are no conflicts of interest.

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