

Species Diversity of Dragonfly in Rawa Danau Nature Reserve Serang Banten as a field Guide Book Based Conservation Education

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ABSTRACT

This research aims to determine species diversity of dragonflies at the Rawa Danau Nature Reserve. The methodology of this research is an exploration of collecting data techniques using the sweeping net. This research was held in January to December. Sampling was done with 2 sessions are 09.00-11.00 WIB and 15.00-17.00 WIB with three times repetition each session. Sampling was done at two places especially in Sukatani and Cikedung. The procedures of this research are samples were taken by insect net and the abiotic components were calculated such climatic (humidity, air temperature, light intensity, wind velocity) edaphic (soil moisture, soil Ph). Based on the results, Sukatani obtained a diversity index was 1.98 and Cikedung was 2.46 with both categories are medium. Then, Sukatani obtained an evenness index was 0.67 and Cikedung was 0.87 with both categories are high. Environmental conditions are in the optimal range for the life of dragonflies. The final results of this research were made as a field guide book based on conservation education species diversity of dragonfly at Rawa Danau Nature Reserve with a score of expert test assessment obtained 80,39% with the category is good as an educative reading source.

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1. INTRODUCTION

Indonesia is a country that has a very high abundance of flora and fauna. This is mainly because Indonesia is located in a tropical region that has a stable climate and geographically is an archipelago located between two distinct continents, Asia and Australia, this position makes Indonesia rich in a variety of species, both plants and animals. Starting from vertebrates such as fish, mammals, birds, amphibians, and reptiles to invertebrates, especially insects. This is encouraged by the regional conditions in Indonesia that have a good environment for insect growth (Rahadi et al., 2013).

Insects are the most dominant animals on earth with 80% of the total number of animals. Indonesia has about 250,000 insect species out of 751,000 total insects. Insects in the ecosystem have various roles, for example in agricultural land there are pests, predators, parasites and natural enemies. Although some insects have negative roles including as pests and parasites (Amrullah, 2019). It turns out that insects also have many positive roles for the ecosystem including as pollinators, decomposers, and as bioindicators of water pollution because Odonata larvae (Dragonfly Group) are very sensitive to changes in water quality (Meilin & Nasamsir, 2016). This is in accord with the research journal conducted by Virgiawan et al. (2015) who utilized dragonflies as biomonitoring of water quality in the Brantas River.

Dragonflies are a group of insects that range in size from medium to large and are often attractively colored. Dragonflies also have slender bodies with two pairs of wings, and have mesh-shaped blood vessels. In addition, dragonflies also have short hair-shaped antennae, well-developed legs, chewing-type mouthparts, large compound eyes, long and slender abdomen (Ansori, 2012). According to Baskoro et al. (2018) Dragonflies are categorized in the Ordo Odonata which comes from the Greek Odontos (tooth). The naming is due to the characteristics possessed by dragonflies on the mandibles that have sharp protrusions (spina) resembling teeth. Usually, the existence of dragonflies is related to water areas because dragonflies lay eggs in water. After the dragonfly nymphs hatch, the nymphs will live in water for a long time. Dragonfly nymphs typically live in fresh water, which is why dragonflies are commonly used as bioindicators of clean water, usually in rivers, swamps or freshwater.

Related to the presence of dragonfly nymphs that live in the water. This research will be conducted in the Rawa Danau Nature Reserve. The selection of the location is because many Banten residents do not know the existence and biodiversity in the Rawa Danau Nature Reserve, especially dragonflies which act as bioindicators of water quality in the Rawa Danau Nature Reserve. Thus, this research was conducted so that the general public, especially the community around the Lake Swamp Nature Reserve, can know the local potential of their area and have the awareness to maintain and preserve nature. The goal is to no longer view dragonflies as pests so that many are captured which causes the dragonfly population to decline. These environmental changes have also led to a decline in dragonfly populations, as they depend on clean water for their survival (Maharani et al., 2023). This research was also performed because there is no secondary data on dragonfly diversity in the Rawa Danau Nature Reserve.

Geographically, Rawa Danau Nature Reserve is located on the 6°8' - 6°11' South latitude and 105°56' - 106°04' East longitude. Rawa Danau Nature Reserve is the the largest freshwater lake in Banten which has high biodiversity (Information on Conservation Areas within the scope of BKSDA Jabar, 2016). The Environmental and Forestry Service of Banten Province (2018: 5) said that the Rawa Danau Nature Reserve has potential for flora and fauna. Flora potential includes mountain rainforest vegetation, swamp vegetation and lake water vegetation. Lake Swamp Nature Reserve has potential fauna including mammals, reptiles, pisces, aves and others but there is no data on insect data, especially dragonflies. So it is necessary to collect data on dragonflies in the Lake Swamp Nature Reserve. The aim is that people can know the diversity of dragonflies and participate in conserving dragonflies that act as bio indicators of water in the Lake Swamp Nature Reserve. Based on research by Harahap et al (2022), 23 species of dragonflies were found in Leuwiliang, Bogor Regency. Research conducted by Silaturahim (2023) showed that the number of dragonflies found was 15 species from several waters in the South Tangerang area, Banten. For this reason, this research is necessary in order to know the types of dragonflies that exist in the Lake Swamp Nature Reserve.

Based on interviews with community leaders in Rawa Danau Nature Reserve and BKSDA staff in Rawa Danau Nature Reserve and conducting a needs analysis at SMAN 3 Serang City. According to the BKSDA region 1 of Serang City who said that every year there are counseling activities held in elementary and junior high schools around the Lake Rawa Nature Reserve area and held cooperation with Krakatau Tirta Industri and formed MMP (Masyarakat Mitra Polhut) which aims to help preserve the Lake Rawa Nature Reserve. The community around the Lake Rawa Nature Reserve needs to be educated that the dragonflies there do not disturb agricultural land so there is no need to destroy them. Based on the results of the teacher needs analysis, it is stated that student learning outside the classroom is not equipped with a guidebook while in the field with a total percentage of 85.72%. Thus, based on the results of the needs analysis, the background of this research is to create a field guidebook because learning activities carried out by students outside the classroom must be given a guidebook so that learning outside the classroom becomes directed. It is also hoped that the community can be educated about the role of dragonflies in the ecosystem as bioindicators so that people have the awareness to participate in protecting them. Therefore, researchers will conduct research on dragonfly diversity in the Serang Banten Lake Swamp Nature Reserve and then implement it in education in the form of a Conservation Education-Based Field Guidebook.

2. RESEARCH METHOD

This research was conducted from January to December. The research was conducted in the Danau Serang Swamp Nature Reserve Banten and continued with the production of a Field Guide Book at Sultan Ageng Tirtayasa University.

a. Tools and Materials

The tools used in this research are insect net, lup, collection box or temporary specimen holder, insect needle no. 1, oven, sterofom, stationery, digital camera, thermometer, lux meter, hygrometer, altimeter, anemometer, soil tester, pH meter, specimen box, while the materials used are cotton, acetone, triangular paper / papilot paper, label paper and camphor.

b. Working method

The method of work in this study is divided into 6 ways of working including:

Determination of Research Location using purposive sampling method, namely, sampling that is not based on strata, random or region but based on certain considerations and intended research objectives (Fachrul, 2008). The research location is divided into 2 locations that represent the Lake Swamp Nature Reserve area, namely Sukatani and Cikedung. The two research stations were selected because they corresponded to dragonfly habitat types and types of natural wetlands (including swamps and lakes) and artificial wetlands (including reservoirs, rice fields and irrigation). Sampling of Odonate Dragonflies. Dragonfly sampling was conducted using Survey or cruising method with Sweeping net sample collection technique. Dragonfly sampling was conducted in two sessions 09.00-11.00 am and 15.00-17.00 pm based on the active time of dragonflies. Dragonfly sampling at 2 locations was repeated 3 times. Climatic and Edaphic Factor Measurements. Climatic factor measurements include light intensity, temperature, water pH, air humidity, wind speed, and altitude. Edaphic factor

measurements are measured using a soil tester useful for measuring soil moisture and soil pH. Estimation of Population Size. This research also calculates the number of populations that are included in the criteria, namely if the number of 1-9 heads is included in the small category, if the number is 10-50 heads, then it is in the medium category and if the number is more than 51 heads then it is in the large category. Sample Treatment. After the dragonfly sample is obtained, the dragonfly sample is put in a temporary specimen box. The dragonfly sample is killed by putting the dragonfly into a jar that already contains acetone, after that, it is stored in papilot paper / oil paper which is useful for storing dragonflies temporarily so that the dragonfly wings remain intact. After that, the dragonfly is pierced with a needle (pinning) in the center of the wing until the tip of the pin appears between the tips of the first and second legs and then dried by heating in a 45°C oven for three days. After that, the dragonflies were stuck on sterofom/cork and stored in a storage box. Samples were documented with a camera and then continued with the identification stage. Identification of dragonfly samples found. The dragonfly samples were then identified. The dragonfly identification process uses the field guidebook (Rahadi et al. 2013). Wendit Flying Dragon: Dragonfly Diversity of Wendit Waters and Irawan, A. & Rahadi, W., S. (2018). Dragonflies of Sumba. Susanti, S. (1998). Getting to know dragonflies, and various journals and scientific articles that support the identification process.

3. RESULT AND DISCUSSION

Data analysis of dragonfly diversity analyzes relative abundance, diversity with Shannon Wiener index and evenness with the formula:

1. Relative abundance

$$KR = \frac{ni}{N} \times 100\%$$

Description:

KR = relative abundance

Ni = number of individuals of the i-th dragonfly

N = total number of individuals of all dragonfly species

2. Dragonfly Diversity

Data analysis was conducted using the Shannon Wiener Index. The formula for calculating dragonfly diversity is as follows:

$$H' = -\sum Pi \ln Pi$$

$$Pi = \frac{Ni}{n}$$

Description:

H = Shannon-Wiener diversity index

pi = proportional abundance

N = Number of individuals of all species

3. Evenness of Species

Evenness was calculated to determine the degree of evenness of species at the research site (Odum, 1993: 176).

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

Description:

E = Species evenness index

H' = Shannon-Wiener diversity index

S = Number of species found

Biological Science Implications for Education

The research results of Dragonfly Diversity in Lake Swamp Nature Reserve Serang Banten will be made into a field guide book based on conservation education. The purpose of making a field book on dragonfly diversity in the Lake Swamp Nature Reserve is to educate the public about dragonflies in the Lake Swamp Nature Reserve and know the role of dragonflies for the ecosystem. The Conservation Education-based field guide book has 5 aspects that are used as objectives for the achievement of the KD on conservation education,

namely knowledge, awareness, attitudes, skills, and participation. Before the Field Guidebook is used for the community, a validation process is carried out on media aspects and material aspects. The assessment results obtained are entered into the feasibility or validity test formula used to perform calculations based on the scores obtained:

$$NP (\%) = \frac{R}{SM} \times 100\%$$

Description:

NP = Expected percent score

R = Score obtained

SM = Total maximum score

100% = fixed value constant

(Purwanto, 2013: 102).

The percentage obtained is then translated qualitatively based on the range value obtained according to Table 1.

Table 1. Criteria for E-module Validity and Practicality Results

No.	Eligibility criteria (%)	Description
1.	0- 20	Very Low (Not worth using)
2.	21- 40	Low (Less feasible to use)
3.	41- 60	Enough (Worth using)
4.	61- 80	High (Worth using)
5.	81- 100	Very High (Very feasible to use)

(Riduwan, 2015: 89; modification)

Based on the results of dragonfly diversity in Lake Swamp Nature Reserve can be seen in Table 2.

Table 2. Dragonfly Species in Lake Swamp Nature Reserve

No.	Species	Family	Sukatani		TOTALLY	Cikedung		TOTALLY
			PP	PS		PP	PS	
1.	<i>Gynacantha dravida</i>	Aeshnidae	1	-	1	-	-	-
2.	<i>Agriocnemis pygmaea</i>	Coenagrionidae	2	2	4	32	2	34
3.	<i>Neurothemis fulvia</i>	Libellulidae	2	1	3	-	-	-
4.	<i>Neurothemis ramburii</i>	Libellulidae	2	1	3	6	1	7
5.	<i>Gynacantha subinterrupta</i>	Aeshnidae	1	-	1	-	-	-
6.	<i>Onychargia atrocyana</i>	Coenagrionidae	7	3	10	-	-	-
7.	<i>Nososticta insignis</i>	Protoneuridae	15	1	16	-	-	-
8.	<i>Prodasineura autumnalis</i>	Coenagrionidae	1	-	1	5	-	5
9.	<i>Orthetrum sabina</i>	Libellulidae	69	32	101	89	19	108
10.	<i>Brachythermis contamina</i>	Libellulidae	11	2	13	-	-	-
11.	<i>Neurothemis</i>	Libellulidae	34	20	54	32	13	45

No.	Species	Family	Sukatani		TOTALLY	Cikedung		TOTALLY
			PP	PS		PP	PS	
	<i>terminate</i>							
12.	<i>Rhodothermis rufa</i>	Libellulidae	16	3	19	29	6	35
13.	<i>Paragomphus reinwardtii</i>	Gomphidae	1	-	1	-	-	-
14.	<i>Vestalis luctuosa</i>	Calopterygidae	1	-	1	15	20	35
15.	<i>Copera marginipes</i>	Platycnemididae	6	1	7	21	5	26
16.	<i>Orthetrum testaceum</i>	Libellulidae	-	2	2	-	-	-
17.	<i>Potamarcha congener</i>	Libellulidae	-	4	4	9	-	9
18.	<i>Orthetrum chrysis</i>	Libellulidae	-	1	1	-	-	-
19.	<i>Agriocnemis femina</i>	Coenagrionidae	-	9	9	11	2	13
20.	<i>Euphaea variegata</i>	Euphaeidae	-	-	-	19	15	34
21.	<i>Heliocypha fenestrata</i>	Chlorocyphidae	-	-	-	6	31	37
22.	<i>Pseudagrion rubriceps</i>	Coenagrionidae	-	-	-	78	13	91
23.	<i>Libellago lineata</i>	Chlorocyphidae	-	-	-	44	25	69
24.	<i>Pseudagrion proinosum</i>	Coenagrionidae	-	-	-	2	1	3
25.	<i>Crocothermis servillia</i>	Libellulidae	-	-	-	12	7	19
26.	<i>Tholymis tillarga</i>	Libellulidae	-	-	-	-	25	25
TOTAL			169	82	251	410	185	595

Description:

PP: Morning Observation

PS: Afternoon Observation

- : No dragonflies found Graphs

Based on Table 2, it can be seen that the dragonfly species found in the Lake Swamp Nature Reserve have two suborders, namely Anisoptera and Zygoptera. Dragonflies of the Anisoptera suborder are dragonflies that are medium to large in size, while the Zygoptera suborder is a group of dragonflies that are slender in shape and are generally called needle dragonflies. There were 19 species of dragonflies found in Sukatani with a total of 251 individuals. The second dragonfly research location is in Cikedung with 17 species included in 6 families and a total of 595 individuals obtained. Based on Table 4.1, the most common species found in both research locations is the Libellulidae family. According to Meidyna Putri et al. (2019) said the Libellulidae family is a group of predatory dragonflies. The Libellulidae family is aggressive and eats almost all types of insects ranging from aquatic insects, pests in food crops and plantation pests whose body size is smaller, such as Anopheles mosquito larvae, small Sogatella, and other insects (Siregar, 2016).

Relative Abundance

Dragonfly abundance is the presence of a species with a certain amount of presence. Relative abundance describes the number of individuals of a species in a community. The more abundant a species is, the more dominant it will be in a habitat. The relative abundance of dragonflies can be seen in Figures 1 and 2.

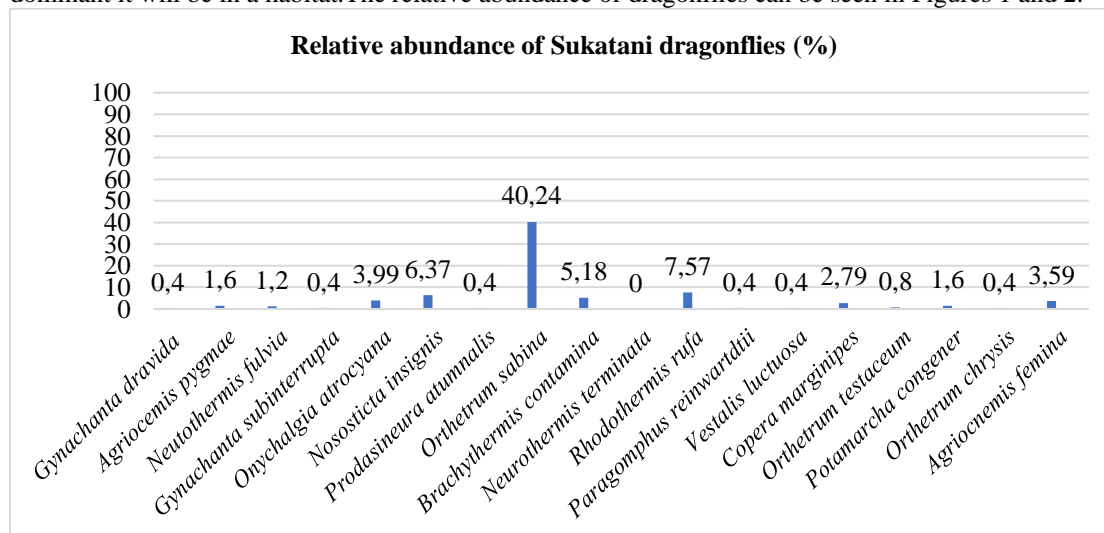


Figure 1. Relative abundance of Sukatani dragonflies

The relative abundance of dragonflies in Cikeding can be seen in Figure 2.

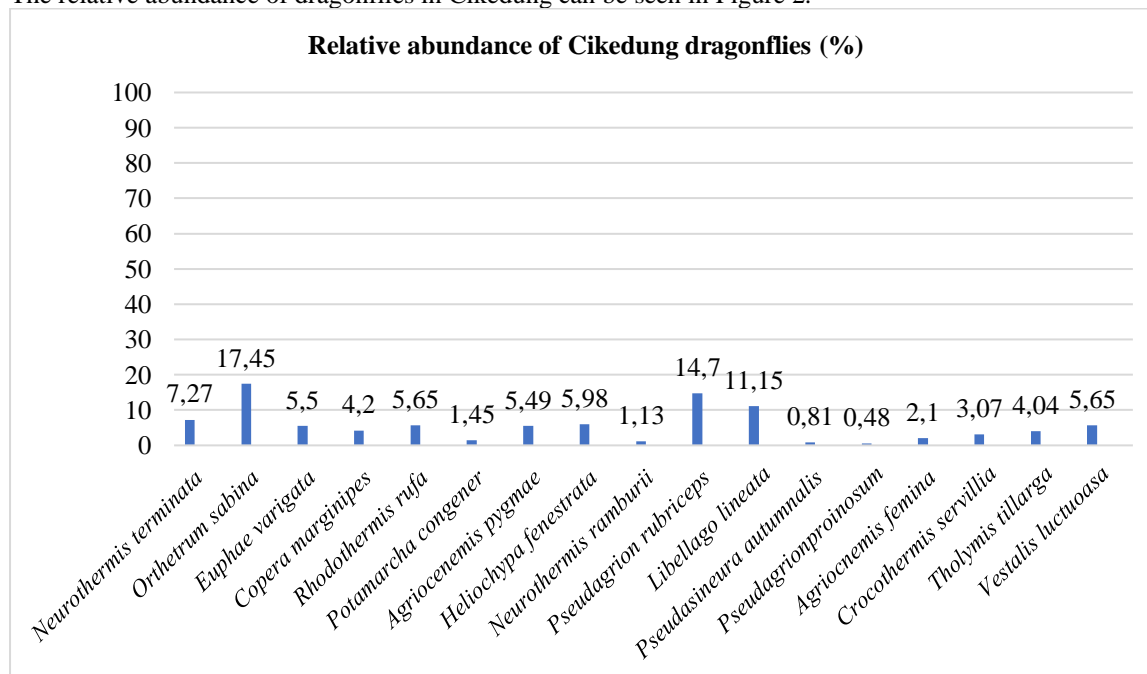


Figure 2. Relative abundance of Cikeding dragonflies

Based on the two research locations, the species found most is the Green Sambar Dragonfly (*Orthetrum sabina*) species because the Green Sambar Dragonfly (*Orthetrum sabina*) is a dragonfly that can live in various habitat types so that its distribution is wider. This statement is supported by the theory of Rahadi et al. (This dragonfly is very fierce as a predator, often found preying on other insects such as grasshoppers and flies, as well as dragonflies of its own kind. This type of dragonfly can be found in many places, almost in all locations. Based on the theoretical explanation, in accordance with the situation during the exploration of the research location, the habitat of bushes and rice fields was found with the intensity of sunny weather, so that many *Orthetrum sabina* species were found. Thus, the high abundance of *Orthetrum sabina* is due to the Lake Swamp Nature Reserve having several supporting factors to live in its habitat such as food, light intensity Cikeding which is suitable for its development. Dragonflies live in environments with sufficient sunlight intensity to bask. Dragonflies are animals that love to sunbathe to strengthen their wings so that they can increase their flying

power (Sonia et al., 2022). The amount of relative abundance in each species is different due to the species' suitability for the habitat it occupies, food availability and other factors.

According to Herlambang et al. (2016) state that the number of individuals of each species determines the relative abundance value. This is because habitat suitability, food sources, differences in the ability of each species to compete in a habitat can affect the individuals and dominance of a species. This means that the stronger the species competes both in food fulfillment and territoriality to live, the relative abundance value tends to be high compared to species that cannot fulfill their food needs, so they choose other habitats to live. Thus, the population of the species decreases which causes its relative abundance value to be lower.

Measurement Of Environmental Parameters

Climatic and Edaphic (soil) factors are determining factors for the survival of dragonflies in an ecosystem. The average magnitude of environmental factors in the research location can be seen in Tables 3, 4 and 5.

Table 3. Climatic Factors of Sukatani

Mean temperature (°C)	Average Light Intensity (Lux)	Average water pH	Average wind speed (m/s)	Average Altitude (m dpl)	Average Humidity (%)
31, 33	297, 3 X 100	6, 16	1,01	135, 16	76,2

Table 4. Climatic Factors of Cikedung

Mean temperature (°C)	Average Light Intensity (Lux)	Average water pH	Average wind speed (m/s)	Average Altitude (m dpl)	Average Humidity (%)
28,15	168,83 X 100	6, 16	0,31	132, 5	74, 56

Table 5. Edaphic Measurement in Sukatani

Research Location	Average Soil pH	Average Soil Moisture
Sukatani	5, 71	3, 24
Cikedung	6, 1	2, 6

Based on Tables 3 and 4, climatic factors at the Sukatani and Cikedung research sites can be seen that environmental factors affect the survival of dragonflies in nature. The effect of temperature will affect the physiological process of insects. Generally, the minimum temperature range is 15°C, the optimum temperature is 25°C, and the maximum temperature is 45°C. Light intensity affects the presence of dragonflies. The parameter of insect light intensity is a supporting factor for insect survival. Wing venation can function properly if environmental factors are favorable. Sufficient light intensity can move or pump the dragonfly's thoracic and wing muscles to prepare for flight. The humidity of a place is influenced by the presence of water. The presence of dragonflies in a habitat is closely related to water conditions in an area. According to Herlambang et al. (2016) state that habitat has a major effect on the endemicity of a dragonfly species, each habitat will have a specific type of dragonfly according to its habitat. Habitat is directly proportional to the physical condition of environmental parameters in a place, which is also influenced by several factors such as vegetation density, canopy cover, and altitude.

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Diversity Analysis Dragonflies

Table 6. Diversity and rankness values

No.	Location	H'	E
1.	Sukatani	1.98 (Medium)	0.67 (High)
2.	Cikedung	2.46 (Medium)	0.87 (High)

Description:

H' : Shannon Wiener Diversity Index

E : Evenness Index

Based on Table 6, it can be seen that the diversity of dragonflies in the Lake Swamp Nature Reserve, namely in the Sukatani and Cikedung locations, shows a medium category. Moderate diversity indicates that the Lake Swamp Nature Reserve has an ecosystem with sufficient productivity, balanced ecosystem conditions and low ecological pressure. Alikondra (2012) The factors that influence the value of species diversity (H') are environmental conditions, the number of species and the distribution of individuals in each species.

Based on Table 6, it can be seen that the diversity in Cikedung is higher than that in Sukatani. The cause of the difference in diversity value in Cikedung is higher due to several factors including food factors, habitat conditions in Cikedung and several other factors. Habitat in Cikedung mostly has several waters that become the habitat of dragonflies. According to Wahyuni (2017), a community has high diversity if all species have relatively the same or almost the same abundance and no large dominance is found. Based on this opinion, it proves that the moderate diversity in Sukatani and Cikedung is because the relative abundance in Sukatani has a dominating species, namely *Orthetrum sabina*, so that the difference in relative abundance of species is very significant.

Field Guidebook

Field Guidebook Based on Conservation Education which has Basic Competencies (KD) of conservation education which are derived into 5 aspects of conservation education including knowledge, attitude, awareness, skills and participation. Based on Media and Material Aspect Tests The feasibility test of this Field Guidebook product was carried out by material experts and media experts consisting of three lecturers and a staff of BKSDA (Natural Resources Conservation Center) Region 01 Rawa Danau Nature Reserve. The following are the results of validation with an average score of 80, 39% which is included in the category Worth using.

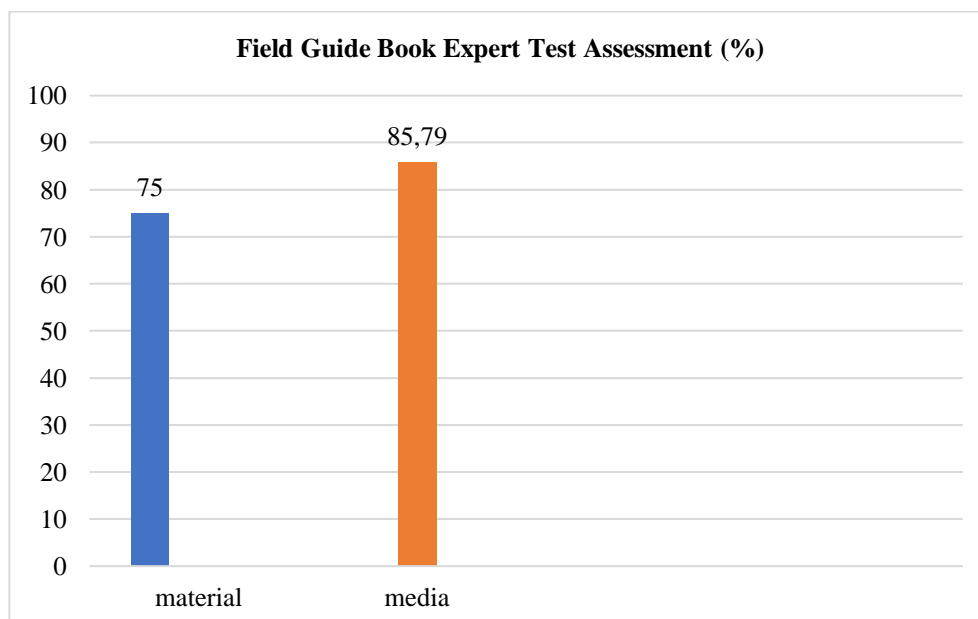


Figure 3. Expert Test Assessment

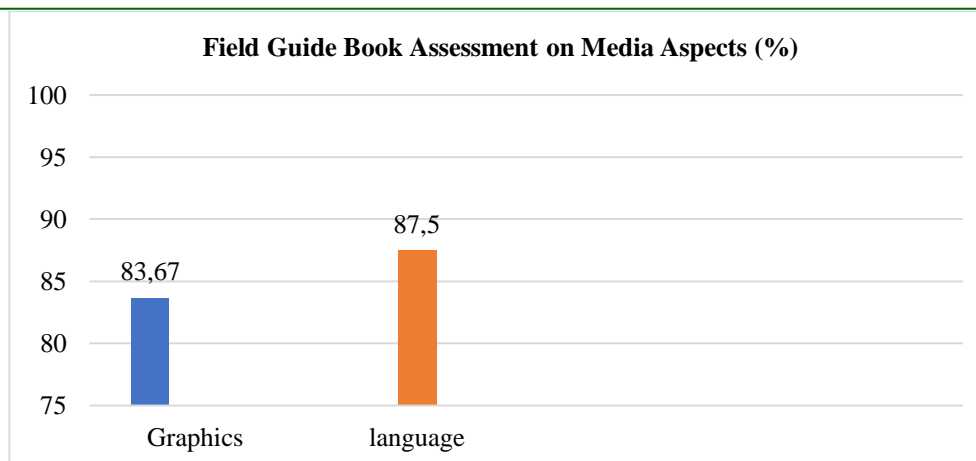


Figure 4. Media Aspect Assessment

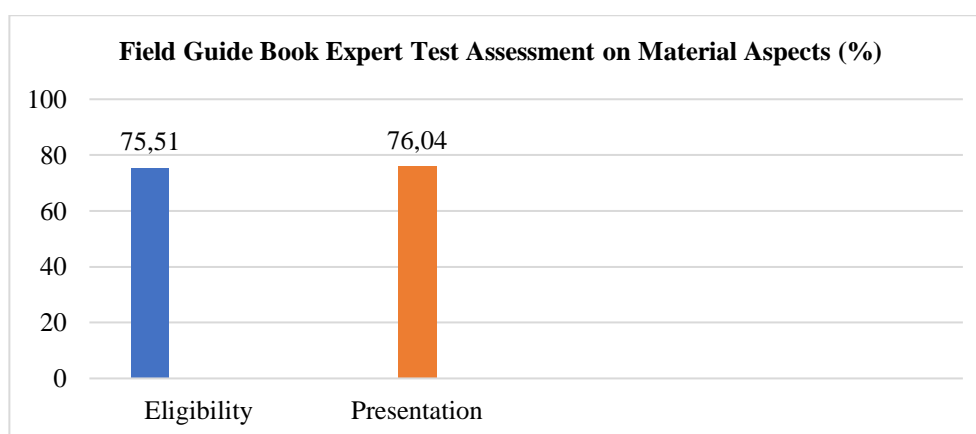


Figure 5. Material Aspect Assessment

According to Mulia et al. (2022), the importance of Field Guidebooks as a means of guidance that is used when outdoors as a source of educational reading and identification purposes. The following is an assessment of the media aspects and material aspects based on the assessment sub-aspects that have been made so that the Field Guidebook can be used.

Discussion

The most common species found in both study sites were the Libellulide family. According to Kndibane et al. (2005) said that the Libellulidae family is a group of predatory dragonflies. The Libellulidae family is aggressive and eats almost all types of insects ranging from aquatic insects, pests in food crops and plantation pests whose body size is smaller, such as Anopheles mosquito larvae, small Sogatella, and other insects (Siregar, 2016). Based on this theory, it proves that the abundant presence of the Libellulidae family in nature is due to its predatory nature. Based on observations at the research site, *Orthetrum sabina* was preying on other insects, which proves that the Libellulidae family is predatory. Another supporting factor for the presence of the Libellulidae family in the Lake Swamp Nature Reserve is that it has a suitable habitat type for its life. This is confirmed by the theory according to Suriana et al. (2014) said that dragonflies of the Libellulidae family can fly swiftly and perch on tree stalks, or rocks. Dragonflies of the Libellulidae family are very dependent on bright sunlight intensity conditions. The Libellulidae dragonfly group likes the intensity of bright sunlight to bask. Based on this theory, it is in accordance with observations in both locations, that many dragonflies of the Libellulidae family were found perching on tree branches, besides that they were found actively flying and then stopping in bushes, tree branches, and rice fields with strong sunlight. The predatory nature of the Libellulidae family and the habitat of Lake Swamp Nature Reserve, which is suitable for the Libellulidae family, caused the Libellulidae family to have the highest number of individuals in both research locations. Lake Swamp Nature Reserve has a suitable habitat for dragonflies of the Libellulidae family, so they can survive.

Based on species, dragonflies in Sukatani have more species, namely 19 species with a total number of 251 individuals, while dragonflies found in Cikedung are 17 species with a total of 595 individuals. Based on the

number of species found, Sukatani obtained more species, namely 19 compared to 17 species in Cikedung. Based on the number of individuals obtained, the dragonflies found in Cikedung were more because the total number of dragonflies obtained was 595 individuals, compared to 251 individuals in Sukatani. Based on the types of dragonflies found, there is also a significant difference. The dragonflies found in Sukatani were more in the Anisoptera suborder compared to the Zygoptera suborder (needle dragonflies). The results of the study in Cikedung were inversely proportional, namely the dragonflies in Cikedung were more in the Zygoptera suborder (needle dragonflies) compared to the Anisoptera suborder. This difference can be caused by differences in habitat types of the two locations. The research site in Sukatani has an uphill and then downhill range. The uphill area found primary forest and secondary forest habitat types with dense canopy cover, while the downhill exploration area found many bushes and rice fields. The location in Sukatani is highland because it is close to various mountains including Mount Tukung Gede, while the habitat type in Cikedung is forest with less dense canopy cover than in Sukatani, more open land, many water sources, both springs that are dammed for irrigation of rice fields and rivers. Cikedung has a large swamp area and rice fields. The large number of dragonflies found in Cikedung is due to the location of more water sources. Dragonflies are closely related to the presence of water. Dragonflies spend part of their lives as nymphs that are highly dependent on aquatic habitats including mating, foraging and laying eggs for female dragonflies (Susanti, 1998: 18). Based on this theory, it is evident that there are more dragonflies in Cikedung than in Sukatani where the water conditions are less.

Based on the results of the study, it can be seen that the diversity of dragonflies in the Rawa Danau Nature Reserve, namely in the Sukatani and Cikedung locations, shows a moderate category. Diversity is defined as the number of species and the distribution of individuals in each species. The magnitude of the species diversity index according to Shannon-Wiener shows that species diversity in an area is moderate because it is in the H' 1-3 category (Fachrul, 2008; Odum, 1993). Moderate diversity indicates that the Lake Swamp Nature Reserve has an ecosystem with sufficient productivity, balanced ecosystem conditions and low ecological pressure (Magurran 1988). According to Alikondra (2012), the factors that influence the value of species diversity (H') are environmental conditions, the number of species and the distribution of individuals in each species. Species diversity according to Odum (1990) says that species diversity is determined by the number of individuals of a species with the number of individuals of other species found in the area. Community structure can be categorized as stable if it is supported by high biotic diversity. High biotic diversity generally has a longer and more complex food chain so that there is a greater chance for interactions such as predation, parasitism, competition, commensalism, mutualism and so on. The negative feedback control of these interactions can control the shocks that occur so that the ecosystem is stable (Krebs, 1989).

Based on the observations, it can be seen that the diversity in Cikedung is higher than in Sukatani. The cause of the difference in the value of diversity in Cikedung is higher due to several factors including food factors, habitat conditions in Cikedung and several other factors. Habitat in Cikedung is mostly several waters that become the habitat of dragonflies. Dragonflies are closely related to the presence of water. Dragonflies spend part of their lives as nymphs that are highly dependent on aquatic habitats including mating, foraging and laying eggs for female dragonflies (Susanti, 1998). Based on this theory, it proves that the diversity in Cikedung is higher than that in Sukatani because there are many waters found in Cikedung. The species evenness index (E) at the Sukatani location is 0.67 and Cikedung 0.87, so it is included in the high species evenness category because it is > 0.6 . The evenness of species in the high category indicates that the sampling locations of dragonflies in Sukatani and Cikedung have a suitable habitat for dragonfly life. According to Widodo (2009), habitats that are in good condition and far from human disturbance and in which there are many food sources that make dragonflies can continue their lives. Based on this theory, it is proven that the research location is in the Nature Reserve Area which is far from human disturbance because its natural preservation is protected by law. According to Herlambang et al. (2016) said that there are several studies to determine the structure of the dragonfly community including diversity and evenness of species. Additional studies can be carried out by measuring the physical conditions of the environment including temperature, humidity, light intensity, and wind speed as well as the correlation between biotic and abiotic factors. The theory according to Lawton (1983) states that the ability of dragonflies to survive is largely determined by their environmental conditions. A large diversity of dragonflies supported by plant succession and factors of stable temperature, pH, relative humidity and the presence of plant vegetation can be an indication that dragonflies can survive and reproduce in communities in their environment. Based on this theory, the diversity in Sukatani and Cikedung shows a diversity index that falls into the medium category so that the two research locations are in the category of quite balanced between biotic and abiotic factors. According to Soegianto (1994) a community is said to have high species diversity if the community is composed by many species with the same or almost the same species abundance. Conversely, if the community is composed of very few species and only a few dominant species, then the diversity of species shows that the community has high complexity, because in the community there are high interactions as well. Based on this theory, it is proven that the value of diversity in Sukatani and Cikedung is in the medium category because the calculation of the relative abundance value of each individual value tends to be very different and very few species dominate. Based on the results of the calculation of the relative

abundance value in Sukatani and Cikedung previously described, it can be seen that the dominating species with the largest number is only the green sambar dragonfly (*Orthetrum sabina*).

Educational implications based on the results of research on dragonfly diversity in the Lake Swamp Nature Reserve are made in the form of a Conservation Education-Based Field Guidebook. Field Guidebook is a book that contains information sources or as a reference tool. The Field Guidebook aims as a guide while in nature (outdoors) which is usually used to facilitate the identification process (Lawrence & Hawthorne, 2006: 3-4). The Field Guidebook Based on Conservation Education for Dragonfly Diversity in Rawa Danau Nature Reserve contains information and introduces Rawa Danau Nature Reserve, procedures for obtaining a permit to enter a conservation area (SIMAKSI), routes and accessibility to Rawa Danau Nature Reserve, knowing data collection techniques in the field, recognizing dragonfly species obtained during research, as well as efforts to educate and conserve dragonflies, the closing section contains a glossary and index.

Field Guide Book Based on Dragonfly Diversity Conservation Education in Lake Swamp Nature Reserve is a book made because there are still very few dragonfly identification books in Indonesia. Before making the Field Guidebook, researchers made a design or story board of the Field Guidebook as a guide to the preparation by dividing it into three important parts of the book, namely the introduction, content and end. The introduction includes a preface, acknowledgments and table of contents. The content section includes chapters of material contained in the Field Guidebook, namely getting to know the Lake Swamp Nature Reserve, getting to know dragonflies, dragonfly data collection techniques in the field, types of dragonflies found in the Lake Swamp Nature Reserve and dragonfly conservation efforts. The assessment of this Field Guidebook according to BSNP is modified according to the cognitive development of the community as the target reader. The assessment is carried out for media aspects and aspects of the material. The media assessment includes aspects of graphical feasibility and aspects of linguistic feasibility. The material assessment aspect includes aspects of content feasibility and presentation feasibility aspects.

4. CONCLUSION

Based on the research of dragonfly diversity in Lake Swamp Nature Reserve Serang Banten with 2 research locations that represent Lake Swamp Nature Reserve namely Sukatani and Cikedung. Dragonfly diversity in Sukatani $H' = 1.98$ with categories according to Shannon Wiener included in the diversity of moderate abundance. The evenness value in Sukatani $E = 0.67$ is classified as high-level evenness, Cikedung diversity index $H' = 2.46$ which is included in the medium category and evenness $E = 0.86$ is in the high category. Field Guide Book assessment based on material experts amounted to 75% which is included in the feasible category, while media experts 85.79% are included in the very feasible category. Based on the assessment of material and media experts, the final score is 80.39% which is included in the feasible category, so that the Dragonfly Diversity Field Guide Book is suitable for use as an educational reading resource.

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