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RESEARCH ARTICLE

DIVERSITY OF ODONATA SPECIES IN WONOASRI RESORT MERU BETIRI NATIONAL PARK.

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Abstract

Meru Betiri National Park is part of Blambangan Biosphere located in East Java Indonesia that consisting of several zone, including core zone, wilderness zone, marine protection zone, utilization zone, traditional zone, rehabilitation zone, and special zone. Wonoasri Resort area included into the rehabilitation zone which consist of a converting forest land to agricultural land. This change of land function will effect on biodiversity included dragonfly. The level of biodiversity of dragonfly, Odonata orders can be used as indicator of quality of the environment. This research needs to be done to know the diversity of dragonfly in the rehabilitation area of Meru Betiri National Park. The results of this research revealed that the order of Odonata consist of 9 species that has been found, which consist of 4 species from famili Libellulidae, 1 species from famili Aeshnidae, 1 species from famili Platycnemididae, 1 species from famili Euphaidae, and 1 species from famili Calopterygidae. The result of the research are expected to be preliminary data for the conservation of biodiversity in Meru Betiri National Park.

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Introduction:-

One important dimension of community ecology is species diversity. The diversity of each community is largely a function of the number of species that may exist and the distribution of individuals between member species. Diversity remains a central theme in ecology. Diversity consist of two components, namely the variety and relative abundance. Diversity can be measured by recording the number of species, by describing their relative abundance or by using a measure that combines these two components is often seen as a good indicator of the ecological system (Khotimah *et. al.*, 2018)

Dragonfly have an important role for humans that is as an indicator to monitor water quality around the environment. Dragonfly nymphs can't survive in polluted water or those that are not vegetated (Hanum *et. al.*, 2013). The sensitivity of Odonata nymphs to environmental changes makes them part of bio-indicators most clearly visible from environmental health (Virgiawan *et. al.*, 2015).

Meru Betiri National Park is a nature conservation area which has a management zone of 52,626.04 Ha (Taman Nasional Meru Betiri, 2018). Meru betiri was appointed as a part of Blambangan Biosphere by UNESCO along with other regions that is Alas Purwo National Park, Baluran, Ijen Nature Reserve and Ijen Crater Tourism Park (Hakim *et. al.*, 2018). The location of Meru Betiri national Park includes Jember City and Banyuwangi, East Java Province.

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Meru Betiri National Park is divided into several Zones, including the Core Zone with an area of 28,707.70 Ha, Forest Zone with an area of 20,897.20 Ha, Maritime Protection Zone with an area of 2,603.00 Ha, Utilization Zone with an area of 273.30 Ha, Traditional Zone with an area of 285.30 Ha, Rehabilitation Zone with an area of 2,733.50 Ha, and a Special Zone with an area of 345.00 Ha (Direktorat Jenderal Konservasi Sumber Daya Alam dan Ekosistem, 2015).

This research needs to be done to determine the diversity of dragonfly in the rehabilitation area of Meru Betiri National Park. The diversity of dragonfly needs to know, because dragonfly has important roles in nature that is as bio-indicator of water quality. Dragonfly can be a bio-indicator of water quality because the nymph of dragonfly are very sensitive in changes of water quality. This roles of dragonfly connected to another component in ecology system. The results of the research are expected to be preliminary data for the conservation of biodiversity in Meru Betiri National Park.

Materials And Methods:-

Design of Research

This research used descriptive design by calculating the diversity of dragonfly species at the Wonoasri Resort, Meru Betiri National Park. This research was preceded by location survey at the Wonoasri Resort, Meru Betiri National Park. After the survey was conducted, the next step was determining the sampling area. Sampling procedure using a sweep net. Samples that had been taken, then were identified. The next process is analysing the diversity of dragonfly samples by using the Shannon-Wiener diversity formula. The obtained data then would be discussed.

Method

This research used Index Point Abundance (IPA) method. In this method, the researcher stopped at the determined location by using GPS for 10 minutes then recorded and calculated the number of dragonfly species that observed. Sample was collected on the river by marking the sampling area limit, 1 meter the right side of the river and 1 meter to the right of the river per 25 meters from 150 meters of the river length at location 1 and location 2. Sample are collected by using a sweep net.

Data Analysis

The data analysis of dragonfly diversity used the Shannon-Wiener diversity index. Shannon-Wiener diversity index could be calculated through the formula:

$$H' = \sum p_i \ln p_i$$

Note:

H = Shannon-Wiener Index

Pi = Individual proportion found in the species number (Magurran, 2018)

The result of the analysis will then be discussed and concluded.

Results And Discussion:-

Based on the result of the research on the diversity of Odonata species at the Wonoasri Resort Meru Betiri National Park conducted in February 2018, 9 insect species belonging to the Odonata order were found. The samples were taken by using sweep net. The species that have been identified is presented in Table 1.

Table1:-The Identification Result of Odonata Species

Order	Suborder	Famili	Genus	Species	Amount
(2)	(3)	(4)	(5)	(6)	(7)
Odonata	Anisoptera	Libellulidae	<i>Neurothemis</i>	<i>Neurothemis ramburii</i> (Brauer, 1866)	7
Odonata	Anisoptera	Libellulidae	<i>Neurothemis</i>	<i>Neurothemis terminata</i> (Ris, 1911)	5
Odonata	Anisoptera	Libellulidae	<i>Orthetrum</i>	<i>Orthetrum chrysis</i> (Burmeister, 1839)	15
Odonata	Anisoptera	Libellulidae	<i>Orthetrum</i>	<i>Orthetrum sabina</i> (Drury, 1770)	39
Odonata	Anisoptera	Aeshnidae	<i>Gynacantha</i>	<i>Gynacantha</i>	3

				<i>subinterrupta</i> (Rambur, 1842)	
Odonata	Zygoptera	Platycnemididae	<i>Copera</i>	<i>Copera marginipes</i> (Rambur, 1842)	130
Odonata	Zygoptera	Euphaeidae	<i>Euphaea</i>	<i>Euphaea variegata</i> (Rambur, 1842)	44
Odonata	Zygoptera	Calopterygidae	<i>Vestalis</i>	<i>Vestalis luctuosa</i> (Burmeister, 1839)	9
Total			252		

From Table 1. Index of diversity can be calculated by using Shannon-Wiener formula, to determine the level of dragonfly diversity at the Wonoasri Resort Meru Betiri National Park. Dragonfly diversity index is presented in Table 2.

Table 2:-Dragonfly Diversity Index

No.	Species	Amount	Proportion (pi)	Ln (pi)	H
(1)	(2)	(3)	(4)	(5)	(6)
1.	<i>Neurothemis ramburii</i> (Brauer, 1866)	7	0,02	-3,91	0,07
2.	<i>Neurothemis terminata</i> (Ris, 1911)	5	0,01	-4,60	0,04
3.	<i>Orthetrum chrysis</i> (Burmeister, 1839)	15	0,05	-2,99	0,14
4.	<i>Orthetrum sabina</i> (Drury, 1770)	39	0,15	-1,89	0,28
5.	<i>Gynacantha subinterrupta</i> (Rambur, 1842)	3	0,01	-4,60	0,04
6.	<i>Copera marginipes</i> (Rambur, 1842)	130	0,51	-0,67	0,34
7.	<i>Euphaea variegata</i> (Rambur, 1842)	44	0,17	-1,77	0,30
8.	<i>Vestalis luctuosa</i> (Burmeister, 1839)	9	0,03	-3,50	0,10
Total			252		1,31

Based on the results of the research conducted at Wonoasri Resort Meru Betiri National Park, were found 9 species of the Odonata order which consisted of 4 species from Libellulidae family, 1 species from Aesnidae family, 1 species from Platycnemididae family, , 1 species from Euphaeidae family, and 1 species from Calopterygidae family. The result of diversity index (H') based on the Shannon-Wiener criteria showed the number that categorized into medium criteria. The range of diversity index were divided into three that were $H' < 1$ = Low, $H' 1-3$ = Medium, $H' > 3$ = High. The higher the H' value showed, indicated the higher the diversity index at that place (Fitriani, 2016). The total dragonfly found were 8 species with the total number of 252 individuals. The total number of individuals between species were not the same, there were species found with the large number of individuals and there were also species found with the small number of individuals. The high and low value of diversity was influenced by the number of individuals in each species and the total number of the whole individuals.

Odonata species mostly found was *Copera marginipes* from Platycnemididae family as much as 130 individuals (see Table 1), with the small size body, this dragonfly could easily hide from the predator. Dragonfly is a predator insects but some large dragonfly also prey other small dragonfly. *Copera marginipes* has the less good flying ability, therefore this species is not difficult to catch. Besides, the body size and colorless body color, except in the leg part that is yellow, allows this species to avoid predators. The whole species that had been found consisted of 8 species that were *Neurothemis terminata*, *Neurothemis ramburii*, *Orthetrum chrysis*, *Orthetrum Sabina*, *Gynacantha subinterrupta*, *Copera marginipes*, *Euphaea variegata*, and *Vestalis luctuosa*.

Libellulidae family that was found in the research were 4 species, including *Neurothemis terminata*, *Neurothemis ramburii*, *Orthetrum chrysis*, *Orthetrum sabina*. Dragonfly belonging to the Libellulidae family are dragonfly that easy to find. The main colors are red, blue, yellow, and many other species experience pruinescence (there is a gray or bluish wax powder on certain parts of the body of an adult dragonfly). Many species have distinctive patterns on their wings. Abdomen is wide and flat. Pale, yellowish, or brownish female (Setiyono *et. al.*, 2017). Libellulidae members are easily found in open environments such as rice fields, and active in the morning to noon.

Aeshnidae family that was found in the research was only one species that was *Gynacantha subinterrupta*. This family is large in size. It has a large eye with a slim abdomen and round base. The color of its body is dark with blue or green stripe, and they rest hanging (Rizal *et. al.*, 2015). During the research, it found only one species of this family because they have a high vigilance and they can fly well so that difficult to catch. Moreover, this species usually perches in a branch or inside the leaves and their body color makes them difficult to find.

Platynemididae family was found in one species with total 130. The individual founded was *Copera marginipes*. This dragonfly is small and has yellow color on its legs. This species likes to fly around waters. The less flying ability makes this species is easy to catch. However, because of its small body, this dragonfly can easily enter and shelter in a leaves interstice that makes them spared from predators.

Euphaidae family was found in one species that was *Euphaea variegata*. This species can be found in some places around waters (Herlambang *et. al.*, 2016). During the research, this individual was easily found around the waters. This species was easily detected in a field because it has typical striking wings. The back wings, especially on the dorsal part, are black with quite oval metallic green stripe, while in the ventral part is metallic purple. The flying ability of this dragonfly is quite good, therefore there needs the shrewdness to catch it.

A species, *Vestalis luctuosa* was found one species and categorized into Calopterygidae family. The dragonfly that are in this family do not have stigma on their wings (Suriana *et. al.*, 2014). The species found during the research was male individual with black wings in which there was blue metallic beam if they were exposed to light. Its body is in blue-metallic. It has the ability to fly quite well and likes to fly around the plants near the water. Therefore, this dragonfly is difficult to catch.

Factors affecting the variety of dragonfly are the source of water, food, predators and human activity. The environmental factors such as temperature, pH, humidity, the availability of water and food which is suitable to certain habitat or ecosystem is needed to support its life (Rizal *et. al.*, 2015). These factors affects the existence of dragonfly and its spread of the variety of dragonfly (Hanum *et. al.*, 2013). The measurement result of environmental factor in research location showed that every species or dragonfly had its tolerance range to the environmental factor. The obtained average results were approximately 35°C for the temperature, 61% of humidity, and the light intensity was 351 x 100 Lux. The organism in Anisoptera suborder was easy to find in the environmental at the temperature of 35-39°C, humidity in the range between 51 to 57%, and intensity was in between 433x100 Lux and 667x100 Lux, whereas the dragonfly that belongs to Zygoptera suborder is easy to find in the environment which had the temperature of 29-35°C, the range of humidity was in 63-74% and the light intensity was in 162x100 Lux – 281 x 100 Lux.

Water sources are one of the important factors that influence the diversity of dragonfly. Water is an important habitat for dragonfly because it is closely related to its life cycle (Herlambang *et. al.*, 2016). The life phase of dragonfly in the nymph phase is in the aquatic habitat. Dragonfly nymph will not be able to live in polluted water or waters with no plants. In conditions of waters that have been polluted, the life cycle of dragonfly is disrupted and the population number is decreased. It showed that dragonfly are insects that are sensitive to environmental changes, especially waters environment when these individuals are in the nymph phase. Due to this sensitivity, dragonfly can be used as a bio-indicator of water quality. During the research, dragonfly were found around the river, and near the water source of rice fields. The water conditions in the river where dragonfly sample taken, is still clean, and flow not strong, makes it suitable for dragonfly habitat.

The availability of food in nature will greatly affect the diversity of dragonfly. Dragonfly have a role as predators for insects that has smaller size than dragonfly its self, so the dragonfly food is small insects and includes other dragonfly that have smaller size. Dragonfly nymph eat various species of aquatic animals (Ansari *et. al.*, 2016). Besides that, dragonfly food while still in the nymph phase is tadpoles, small fish, and water insects (Woodward,

2010). Food availability factors for dragonfly are related to other factors. If the availability of food in a habitat area is small, the diversity of dragonfly will also decreased. This is because there's competition for getting food with other insects and other dragonfly. In fact, dragonfly can prey on other dragonfly that has smaller size, which can cause the dragonfly diversity in the area dominated by dragonfly that big in size. During the research, dragonfly were found eating small insects. The presence of other small insects around the sampling site is still overflowing, like mosquitoes, small flies, and other small flying insects.

Enemies of dragonfly or natural predators also influence the diversity of dragonfly. As a biotic component of the environment, dragonfly also have natural enemies. Natural enemies of dragonfly during the egg phase and nymph inside the water or vegetation around the waters are aquatic or semi-aquatic species, such as water beetles and frogs or toads. Natural enemies in the imago phase are birds and lizards (Soendjoto *et. al.*, 2016). The appearance of enemies or predators of dragonfly in the egg phase and nymphs will reduce the population of dragonfly before reaching the adult phase, which caused in a reduced number of imago dragonfly. The appearance of enemies or predators in the adult phase will reduce the diversity of dragonfly (Setiyono *et. al.*, 2017). During the research, lizard and frogs were found at the first point of the dragonfly sampling location. Which become one of the predators for dragonfly, while at the second point fish were found in the river which could prey on dragonfly when dragonfly flew near the surface of the water on when the dragonfly would lay eggs on the water surface.

Environmental conditions favoured by dragonfly are environments close to the water source. Dragonfly life cannot be separated from the water and vegetation cover that is used to lay eggs on plants in the waters, moulting, mating, and for adult dragonfly when resting (Irawan *et. al.*, 2017). At the location of the sampling site during the research there was a lot of vegetation around the river body, and rocks that become the place for dragonfly to perch.

Human activity can affect the diversity of dragonfly. There are dragonfly that are very depend on aquatic habitat and the presence of vegetation (Khotimah *et. al.*, 2018). The existence of humans usually changes the structure of vegetation, because humans will sometimes cut some vegetation to make access tracks and others. At the research location included in the rehabilitation zone, which in these locations there are various human activities. At the first point, the human activities that take place is agriculture. Near the sampling location, there were agricultural field planted with rice, and some herbs. This greatly affects the diversity of dragonfly at this point, because human activities here, besides removing the vegetation and opened field and then converted into rice field, caused this fields have a little shade or shades plants. It makes the dragonfly that found at this location were mostly dragonfly from the Anisoptera suborder that had a large body and better flight ability, so they were able to survive even though the condition of the water source was not optimal, and was better able to avoid predators with better flight ability that the dragonfly from Zygoptera suborder. However, the existence of this rice field area also contributes to the bird population which can be a predator for dragonfly. Whereas at the second point where the sampling took place, human activity that occurs was not too much in the river. However, during the research there was an activity from villagers who cut the vegetation in the body of river to reduce the vegetation. It caused the vegetation that used by dragonfly to perch is reduced. Besides that, the vegetation that has been trimmed, is thrown into the river, which disrupts the flow of the river. There is also at one point of river body is used for some activities like washing, and other daily activities, so that makes the dragonfly disturbed.

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