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Dragonfly Diversity in Cibodas Botanical Garden in West Java

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ABSTRACT

The dragonfly (Odonata) is a flying insect that plays an important role in the food chain and acts as a bioindicator of water health. This is due to its biological characteristics which include spending most of its life stages in the water and preying on smaller insects. This study is aimed to investigate the level of dragonfly diversity in Cibodas Botanical Garden, West Java. The method used in this research was direct observation using catch and release technique. The research was carried out from May to July 2018. A total of 1,510 individuals belonging to eight dragonfly species were found in the four sampling locations. These were divided into two Sub-Orders: 1) Anisoptera (Orthetrum pruinosum, Pantala flavences, Orthetrum sabina, Neurothemis fluctuans, Neurothemis terminata, and Orthetrum glaucum); and 2) Zygoptera (Ischnura senegalensis, dan Ceoliccia membranipes). The highest values of species diversity index (H') and evenness index (E) were found in Ciismun Waterfall (1,45 and 0,88, respectively). The dominance index (D) in the four sampling sites ranged between 0.25 - 0.32. The highest species richness index (R) was found in Sakura Garden (0,99).

Keywords: Diversity, Odonata, Cibodas Botanical Garden, West Java

INTRODUCTION

The dragonfly and damselfly from the Order Odonata are mostly found flying in the forest, farming land, wetland or the river (Kanaujia et al. 2015). Indonesia hosts 700 species out of 5,000-6,000 dragonfly species around the world (Rhd et al. 2013). Kalita and Ray (2015) stated that there were 39 species in Deepor Beel Bird Sanctuary in Assam, India; while in Kerala, South India, MV Vincy et al. (2016) found 36 species.

The level of dragonfly diversity in Indonesia is not yet certain, but it is estimated at 15% of around 5,680 species of dragonfly worldwide or around 900 species (Sigit, 2013). This is due to the lack of studies conducted in Indonesia. Odonata is an insect order that is relatively large in size and often has beautiful colors. The dragonfly has a large head with large eyes made of many smaller eyes (ommatidium), also called compound eyes (Susanti, 1998).

Dragonfly plays an important role in the food chain and act as a bioindicator of environmental changes (Painkra et al. 2016). Adult dragonflies lay eggs in clean water so

that larvae could grow well by preying on the nymphs of other insects. Therefore, the right natural habitat is needed to support their lives.

One of Indonesia's natural habitats for dragonfly is Cibodas Botanical Garden (CBG). The CBG was founded on April 11th 1852, by Johannes Ellias Teijsmann under the name *Bergtuin te Tjibodas* (Cibodas Mountain Garden). It was then included as a branch of the Bogor Botanical Gardens and was named Cibodas Botanical Garden Branch Office. In 2003, the Cibodas Botanical Gardens was assigned the role of a Technical Management Unit for Plant Conservation under the Bogor Botanical Gardens Plat Conservation Center and the Life Science Center of the Indonesian Institute of Sciences (LIPI). The CBG is situated on the slopes of Mount Gede-Pangrango Mountains and covers 84.99 hectares of land.

A search on the web using Google search engine for a study of dragonfly diversity in CBG did not yield any result. Furthermore, in a 2017 interview, CBG researcher Yati Nurlaeni said that the Garden actually focuses on compiling data of the plant species and there has been no research on insect population in the site, particularly that of dragonflies. Therefore, research on dragonfly diversity in CBG needed to be conducted.

METHODS

This research was conducted from May to July 2018 in Cibodas Botanical Garden specifically in four sampling sites; Sakura Garden, The Fountain, Ciismun Waterfall, and Guest House. Catch and release technique was used in these sampling sites. Dragonflies were caught using an insect net (Mapi-ot et al. 2013) and after they were identified, they were released into the air. The dragonflies that were already identified were only counted for and taken picture of during subsequent samplings. Observation was done in the morning 09.00 AM until 04.00 PM WIB in the afternoon when dragonflies are mostly active (Renner et al. 2015; Khan 2017).

The data collected was then analysed descriptively in order to understand the species diversity, evenness, dominance and richness of the dragonfly in CBG. Diversity analysis was done using the Shannon-Wiener diversity index ($H' = -\Sigma Pi \ln Pi$) (Odum, 1998). Evenness analysis was done using the Pielou evenness index ($E = H'/ \ln S$). Dominance analysis was done using the Simpson dominance index ($C = \Sigma(ni/ N)^2$). While richness analysis was done using the Margalef richness index ($R = ((S-1)) / (\ln N)$) (Suheriyanto 2008).

RESULT AND DISCUSSION

A total of 1,510 dragonfly individuals belonging to eight species, three families, and five genus were found in the four sampling sites (Ciismun Waterfall, The Fountain, Sakura Garden, and Guest House) of Cibodas

Botanical Garden. The details can be seen in the table below:

Table 1. Species Composition of Dragonfly Cibodas Botanical Garden

No	Dragonfly Species	Sampling Sites				Total	Relative Abundance (%)
		Ciismun Waterfall	The Fountain	Sakura Garden	Guest House		
I	**Sub-Order Anisoptera**						
	A. Family Libellulidae						
	Orthetrum pruinosum	109	141	135	134	519	34,37
	Pantala flavences	95	101	193	144	533	35,30
	Orthetrum glaucum	10	14	18	15	57	3,77
	Neurothemis terminata	0	0	4	0	4	0,26
	Orthetrum sabina	63	56	66	87	272	18,01
	Neurothemis fluctuans	0	0	5	0	5	0,33
II	**Sub-Order Zygoptera**						
	B. Family Coenagrionidae						
	Ischnura senegalensis	0	19	0	0	19	1,27
	C. Family Platycnemididae						
	Ceoliccia membranipes	86	5	10	0	101	6,69
	Total individuals	**363**	**336**	**431**	**380**	**1510**	**100**

As shown in the Table 1. the samplings in CBG found individuals from the Sub-Order Anisoptera (as many as 75% of the total individuals sample, to which the dragonfly belongs, comprising of the Family Libellulidae and six species (*Pantala flavences, Orthetrum pruinosum, Orthetrum glaucum, Orthetrum sabina, Neurothemis terminata, and Neurothemis fluctuans*). The samplings also found insects from the Sub-Order Zygoptera (25%), to which the damselfly belongs, comprising of two families, one is Coenagrionidae with one species (*Ischnura senegalensis*), and the other is Platycnemididae with one species (*Ceoliccia membranipes*). Harisha (2016) stated that in the Komaranahalli Lake were found individuals from the Sub-Order Anisoptera (as many as 73% of the total individuals sampled) and from the Sub-Order Zygoptera (27%).

The number of species found in this observation is higher than that of Rizal and Hadi (2015) who found five dragonfly species in the rice field areas of Punderanum village in Demak Regency. They found *Orthetrum sabina, Crocothemis servillia, Agriocnemis femina, Agriocnemis pygmea,* and *Pantala flavescens.* It is also higher than that of Patty (2006) who only found six species comprising *Orthertum testacium, O. sabina, O. caledonicum, O. pruinosum, Brachytemis contaminata,* and *Agnionemis femina*.

However, it was lower than that of Khan (2017) who mentioned the existence of 76 dragonfly species belonging to 9 families in Bangladesh; of Shukla et al. (2016) who found 37 species belonging to 7 families in Jabalpur India; of Dimapinto et al. (2015) who found 21 species with 218 individuals in Lanao Del Sur, Philippines; of Harisha (2016) in Kondajji Lake, Karnataka India, who found 33 species belonging to 24 genus and six families; of Villanueva and Mohagan (2010) in Mt. Hamiguitan Wildlife Sanctuary with 31 species and 11 families; of Aspacio *et al.* (2013) in Buru-un areas of the Philippines with 26 species, seven families dan 21 genus; of Renner *et al*. (2015) in Taquari River valley region, Rio Grande do Sul, Brazil with 50 species, 29 genus dan seven families; and of Lamptey *et al.* (2013) in Ghana Legon University with 1,212 individuals, 26 species, dan three families.

CBG is a natural habitat for dragonflies as it provides an ideal, clean environment for

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the insects. Dragonfly nymphs live in clean water, hence, its existence could be used as a bioindicator of healthy water (Harisha 2016; Painkra et al. 2016).

Table 2. Indices of Species Diversity, Evenness, Dominance, and Richness

Index	Sampling Sites			
	Ciismun Waterfall	The Fountain	Sakura Garden	Guest House
Diversity Index (H')	1,45	1,37	1,32	1,21
Evenness Index (E)	0,88	0,76	0,68	0,87
Dominance Index (C)	0,25	0,30	0,32	0,32
Species Richness Index (R)	0,68	0,86	0,99	0,51
Number of Species	**5**	**6**	**7**	**4**

In terms of species diversity index, there was no significant difference between the four sampling sites in Cibodas Botanical Garden. It ranged between 1,21-1,45 which is categorized as a moderate biodiversity level. Villaneuva and Mohagan (2010) mentioned that the value of dragonfly diversity index in the wildlife sanctuary in the Hamiguitan mountain was quite high (H'= 3,056) as the place was located in the mountain top some 1,000-2,000 meters above sea level. The lowest sampling site was in an agro-ecosystem located 100-400 meters above sea level. The value of 2.28 Odonata diversity index (H') was found in Panekan subdistrict, Magetan Regency, East Java (Pamungkas and Ridwan, 2015).

Ciismun Waterfall diversity index was higher than that of Guest House. This was due to the fewer number of species found in the site. A total of four species were found with a higher dominance level (0.32). Of the four dragonfly species found in the Guest House, two species dominated the bunch, they were *Orthetrum pruinosum* (134 individuals) and *Pantala flavences* (144 individuals). Dragonfly species richness index (R) in Sakura Garden was the highest compared to the other three locations. A total of seven species were found in this site. There were two dragonfly species which were only found in Sakura Garden, they were *Neurothemis terminata* and *Neurothemis fluctuans.*

Community Similarity Index of Dragonfly

The highest value of community similarity index in Cibodas Botanical Garden was gained by calculating the similarity between Sakura Garden and Guest House (89%), while the lowest value was the similarity between Sakura Garden and Ciismun Waterfall (72%). The values of dragonfly community similarity index in Cibodas Botanical Garden was categorized as high level as there was no significant difference between the four locations.

Table 3. Community Similarity Index of Dragonfly in Cibodas Botanical Garden

Sampling sites	Ciismun Waterfall	The Fountain	Sakura Garden	Guest House
Ciismun Waterfall		0,79	0,72	0,74
The Fountain	0,79		0,81	0,85
Sakura Garden	0,72	0,81		0,89
Guest House	0,74	0,85	0,89	

Sakura Garden and Guest House sites had a similarity in that they share the same characteristics of having clean and calm water ponds, which were a good habitat for dragonfly nymphs to grow. As for the Ciismun waterfall, the swift water in the location was not ideal for the life of dragonfly nymphs. But in this sampling site, some steady waters were found between the rocks. These plots could support the life of dragonfly nymphs such as those of damselflies Zygoptera

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(*Ceoliccia membranipes),* which can often be found perching dan copulating on water droplets on leaves. Suheriyanto (2008) says that if changes occur in the structure of a community within an area, the species that can be found will vary from one site to the other.

CONCLUSION

The research in dragonfly diversity in the Cibodas Botanical Garden (CBG) with four sampling sites found 8 (eight) species that belong to two suborders, they are:

1. Anisoptera, comprising the species Orthetrum pruinosum, Pantala flavences, Orthetrum sabina, Neurothemis fluctuans, Neurothemis terminata, and Orthetrum glaucum; and
2. Zygoptera comprising the species Ischnura senegalensis and Ceoliccia membranipes.

There were a total of 1,510 individuals that were sampled. The highest dragonfly species diversity index (H') and species evenness index (E) were recorded in the Ciismun Waterfall at 1.45 and 0.88 accordingly. The dominance index of the four sampling sites ranges from 0.25 – 0.32, while the highest Species Richness Index was recorded in the Sakura Garden at 0.99.

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