

DIVERSITY OF DRAGONFLIES (*Odonata*) IN SWAMP ECOSYSTEM UNIVERSITY OF LAMPUNG

Dian Iswandar*^{*}

Department of Forestry, Faculty of Agriculture, University of Lampung

*Corresponding author: univasahanpress@gmail.com

Abstract. Swamp is a unique wetland ecosystem with waterlogged conditions, overgrown with distinctive vegetation types. Swamp ecosystem in University of Lampung are freshwater swamps that are well watered throughout the year and overgrown with aquatic vegetation, making it ideal for the habitat of various types of dragonflies (*Odonata*). The life cycle of the dragonfly is in two environments, pre-adult phase is aquatic and adult life around the waters, so the dragonflies can be used as an environmental bioindicator. The study aims to find the species of dragonflies with conservation status and trading status, analyzing the relative abundance and diversity of dragonflies founded in the swamp ecosystem at the University of Lampung. This research conducted with exploration method or (field to field) in three locations (R1, R2, R3), the random exploration was done two times at morning and afternoon. The results showed that 12 species of dragonflies from 3 families encountered during study. The highest abundance of dragonfly species is *Orthetrum sabina* with 20.14% and the smallest was *Acisoma panorpoides* and *Zygomma obtusum* with 2.16%. Conservation status of the 12 species are Least Concern (IUCN), unprotected (UU / PP) and non-appendix (CITES). The value of diversity index shows a moderate scale with 2.26, which means the condition of swamp ecosystem in University of Lampung still has good productivity as a habitat to support the life of dragonfly.

Keywords: dragonfly, diversity, abundance, swamp ecosystem

INTRODUCTION

Wetland is a specific ecosystem. The wetland area in Indonesia is 40.5 million hectares consisting of various ecosystems (Partono, 2011, Ambarwati and Choesin, 2014). Swamp ecosystems are part of wetland ecosystems that are periodically or continuously inundated. According to Whitten *et al.* (1992); Suriana *et al.* (2014), freshwater swamps are present in areas that are occasionally inundated by mineral-rich freshwater with a pH of 6 or more and their surface water up and down in such a way that periodic drying of the soil occurs. This ecosystem is characterized by the dominance of herbaceous vegetation (not trees) capable of adapting to anaerobic environments and generally reproducing with rhizomes. Based on the condition, the swamp ecosystem at the University of Lampung is freshwater swamp that flooded throughout the year and overgrown with water vegetation.

The environment is an ideal habitat for the proliferation of dragonflies. The dragonfly is inserted into the *Odonata* order because it has a toothed jaw (Rizal and Hadi, 2015), a dragonfly is an attractive insect, has four webbed wings and many wings. According to Susanti (1998), dragonfly spends part of its life as a nymph that is highly dependent on aquatic habitats such as rivers, rice fields, lakes, swamps or ponds so that dragonflies are insects that can not be separated from water, because in its life cycle dragonflies require two environments, and air. Pre-adult phase of dragonfly stage is aquatic and adult individuals are usually found near the waters (Amir and Kahono 2003; Hanum, *et al.*, 2013). Dragonflies are also predators of agricultural pests. Dalia *et al.* (2014) states that the dragonfly *Orthetrum sabina* can prey on arthropod type insects. Including the type of needle dragonfly is also a natural predator of green leafhoppers (Yuliani, 2016).

Environmental factor, biotic and abiotic factors such as temperature, humidity, pH, availability of water and the availability of food in accordance with the habitat or ecosystem is needed by the dragonfly to support its life. Swamp ecosystems are unique and specific ecosystems with different ecosystem conditions. Based on that, then there will likely be differences in the type and number of individual dragonflies living on the swamp ecosystem as a result of differences in environmental conditions that make up the ecosystem. In addition, the dragonfly has a good adaptation rate, abundant in aquatic environments as well as has a high morphological specialization that distinguishes it from other winged insects (Mashkova *et al.*, 2018), so research needs to be done on the types of dragonflies that live in the swamp ecosystem at University of Lampung.

The purpose of this research is to know the species of dragonflies based on the morphological characteristics and conservation status based on IUCN and local regulation (Undang-Undang dan Peraturan Pemerintah) and trade status based on CITES, analyzing the relative abundance and diversity of dragonfly species found in swamp ecosystems at the University of Lampung.

METHOD

Location and Time of Research. The study was conducted in the swamp area at University of Lampung in September 2017. The study sites were swamp area in Experimental Garden (R1), swamp in Captive Deer (R2) and swamp in Integrated Field Laboratory (R3).

Materials and Equipment of Research. The object of the research is the dragonflies (*Odonata*) in their habitat. Equipment used in this research include insect net, sample bottle, tally sheet, DSLR camera and identification guide of dragonfly.

Method. The exploration method used in this study in the predetermined location. Data collection was done twice in one day: the morning at 07.00 - 09.00 o'clock and in the afternoon at 15.00 - 17.30 o'clock for 3 days at each observation station (R1, R2 and R3). Captured images with camera were performed on all of the dragonflies found in the study sites to facilitate direct identification in their natural habitat (Manwar, *et al.* 2012), for the types that are difficult to identify for direct capture using catch nets and then identified in the laboratory. Reference identification using the guidebook from Rahadi, *et al.* (2013), Setiyono, *et al.* (2017) and other literatures that support the identification process by considering the color, body shape, eye shape and wing position as well as flying behavior.

Data Analys. Calculation of diversity of dragonflies using the Shanon-Wiener diversity index (Magurran, 1988) with the following mathematical equations:

$$H' = - \sum_{i=1}^s (pi \ln pi)$$

With :

$$pi = \frac{ni}{N}$$

Information :

H' = Shanon-Wiener diversity index

pi = Proporcional abundance

ni = Number of individuals each species

N = Number of individuals total

Calculation of relative abundance using mathematical equations as follows:

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

Information:

KR = Relative abundance

ni = Number of individuals *ni*

N = Number of total individuals

RESULT AND DISCUSSION

Species of Dragonfly and Conservation Status. Results of research conducted on the swamp area of University of Lampung (3 swamp: R1, R2 and R3) found 3 families of dragonflies from 2 different subordos. Family libellulidae and gomphodae of *Subordo anisoptera* (dragonfly/capung) while the family *Coenagrionidae* from *Subordo zygoptera* (needle dragonfly/capung jarum) with total number of species is 12 species (Table 1). Cannings (2002) states that some types of dragonfly habitats are small lakes, ponds with floating vegetation, swamps and rivers.

Table 1

List of dragonfly species found in the swamp ecosystem of University of Lampung

Family	Species	Local Name	Location		
			R1	R2	R3
Libellulidae (Capung Sambar)	<i>Orethetrum sabina</i>	Capung-sambar hijau	√	√	√
	<i>Crocothemis servilla</i>	Capung-sambar garis-hitam	√	√	√
	<i>Brachythemis contaminata</i>	Capung-jemur oranye	√	√	√
	<i>Rhyothemis phyllis</i>	Capung-lebah garis-kuning	√	-	-
	<i>Potamarcha congener</i>	Capung-sambar perut-pipih	√	-	-
	<i>Diplacodes trivialis</i>	Capung-tengger biru	√	√	√
	<i>Acisoma panorpoides</i>	Capung-perut terompet	√	-	-
	<i>Lathrecista asiatica</i>	Capung-tengger ekor-darah	-	√	-
	<i>Zyomma obtusum</i>	Capung-senja putih	-	-	√
	<i>Neurothemis terminata</i>	Capung-jala lurus			√
Gomphidae (Capung ekor-gada)	<i>Ictinogomphus decoratus</i>	Capung-loreng tombak	√	√	-
Coenagrionidae (Capung-jarum kolam)	<i>Agriocnemis femina</i>	Capung-jarum centil	√	-	√

Source: Primary Data, year 2017

The table above shows that of the three families identified as 12 types of dragonflies are *Orthhetrum sabina*, *Crocothemis servilla*, *Brachythemis contaminata*, *Rhyothemis phyllis*, *Potamarcha congener*, *Diplacodes trivialis*, *Acisoma panorpoides*, *Lathrecista*

asiatica, *Ictinogomphus decoratus* and *Agriocnemis femina*. The twelve of dragonfly species above are common species of dragonflies found around the waters, both flowing and stagnant and calm, 4 of which can be found in all three locations (RI, R2 and R3). Different species of dragonfly in each observation station is caused by environmental condition and the difference of behavioral characteristic and behavior of dragonfly type. R2 located on the edge of the highway with relatively high motor vehicle activity; R2 and R3 have wet conditions that are not overgrown with water plants, the lack of variation of vegetation and more overgrown tall trees cause the type of dragonfly *Rhyothemis phyllis*, *Potamarcha congener*, *Acisoma panorpoides*.

Based on the results of identification and search of the literature shows that 12 types of dragonfly found in the three observation stations according to IUCN in (www.iucnredlist.org) belong to the Least Concern (LC) category version 3.1 2018 which means the population or species of dragonfly is not threatened by extinction or the category of barely or almost threatened (Indrawan *et al.*, 2010). According to Indonesian National Regulation (Undang-Undang) No. 5 of 1990 on the Conservation of Biological Natural Resources and Ecosystems and Government Regulation (Peraturan Pemerintah) no 7 of 1999 on the Preservation of Plants and Wildlife, from 12 species of dragonfly found in the category is not protected. According to CITES on (www.checklist.cites.org), 12 species of dragonflies found are also not listed in the appendix list (appendix) 1, 2 and 3 which means the dragonfly trades mentioned above have not been regulated in international treaties. The list of protection status and trade status of dragonflies observed in all observation stations is presented in Table 2.

Table 2

Conservation Status (IUCN, UU/PP) and Trading Status (CITES) of dragonflies in the swamp ecosystem of University of Lampung

Species	Local Name	Conservation Status		
		IUCN	UU/PP	CITES
<i>Orthetrum sabina</i>	Capung-sambar hijau	LC	-	-
<i>Crocothemis servilla</i>	Capung-sambar garis-hitam	LC	-	-
<i>Brachythemis contaminata</i>	Capung-jemur oranye	LC	-	-
<i>Rhyothemis Phyllis</i>	Capung-lebah garis-kuning	LC	-	-
<i>Potamarcha congener</i>	Capung-sambar perut-pipih	LC	-	-
<i>Diplacodes trivialis</i>	Capung-tengger biru	LC	-	-
<i>Acisoma panorpoides</i>	Capung-perut terompet	LC	-	-
<i>Lathrecista asiatica</i>	Capung-tengger ekor-darah	LC	-	-
<i>Zyomma obtusum</i>	Capung-senja putih	LC	-	-
<i>Neurothemis terminata</i>	Capung-jala lurus	LC	-	-
<i>Ictinogomphus decoratus</i>	Capung-loreng tombak	LC	-	-
<i>Agriocnemis femina</i>	Capung-jarum centil	LC	-	-

Source: Primary Data, year 2017.

Relative Abundance. Based on the results of the relative abundance analysis (RA) species of dragonfly found in the swamp ecosystem can be seen in Table 1, showing that the type of dragonfly with the highest abundance is *Orthetrum sabina* 20.14% (28 head), followed by *Crocothemis servilla* 17.27 % (24), *Brachythemis contaminata* 14.39% (20), *Rhyothemis phyllis* 9.35% (13), *Ictinogomphus decoratus* 8.63% (12), *Diplacodes trivialis* 7.91% (11), *Potamarcha congener* 6.47% (9 heads), *Neurothemis terminata* 4.32% (6 tails),

Agriocnemis femina 4.32% (6 tails), *Lathrecista asiatica* 2.88% (4 tails), *Acisoma panorpoides* 2.16% (3 tails), and *Zyxomma obtusum* 2.16% (3 tails). These results indicate that the species of dragonfly *Orthetrum sabina* is the most common species, because this species can be found throughout the year. This is reinforced by Susanti (1998) which states that the dragonfly *Orthetrum sabina* live soliter with a wide spread. In addition, the dragonfly *Orthetrum sabina* has the ability to adapt well and a high level of tolerance to the surrounding environment. According Rahadi, *et al.* (2013) dragonfly *Orthetrum Sabina* has a high tolerance to environmental changes, including the condition of polluted waters. *Orthetrum Sabina* is also a cannibal dragonfly because it is often observed to eat the same type or dragonfly of other species (Setiyono, 2017). This is stated also by Dalia and Leksono (2014), that the dragonfly type *Orthetrum Sabina* prey on other insects such as walangsangit (*Leptocoris oratorius*) and a kind of butterfly (*Pelopidas conjunctus*).

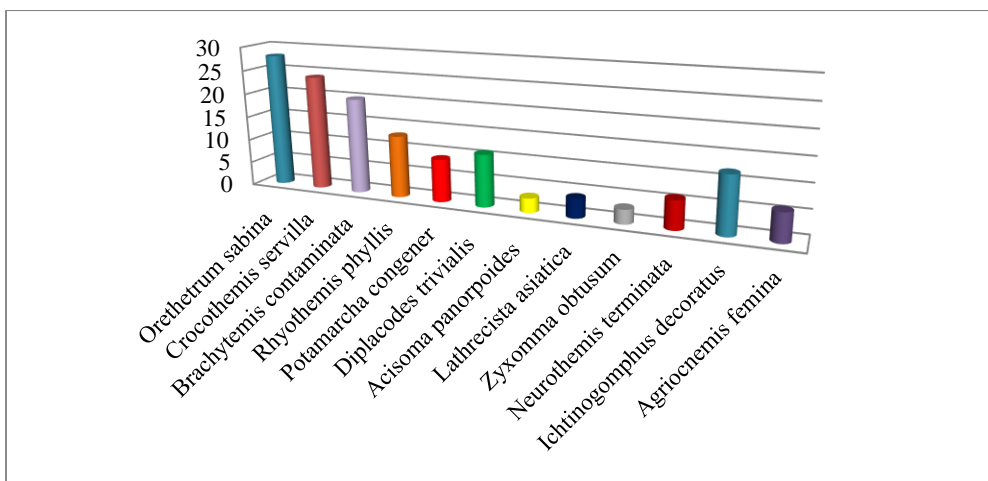
Table 3

Comparison of relative abundance the dragonflies of each location (R1, R2, R3) and all location

Species	Relative Abundance (%)			RA*
	R1	R2	R3	
<i>Orthetrum sabina</i>	16.46	26.09	23.68	20.14
<i>Crocothemis servilla</i>	12.66	21.74	23.68	17.27
<i>Brachytemis contaminata</i>	18.99	8.70	7.89	14.39
<i>Rhyothemis Phyllis</i>	16.46	-	-	9.35
<i>Potamarcha congener</i>	11.39	-	-	6.47
<i>Diplacodes trivialis</i>	6.33	8.70	10.53	7.91
<i>Acisoma panorpoides</i>	3.80	-	-	2.16
<i>Lathrecista asiatica</i>	-	17.39	-	2.88
<i>Zyxomma obtusum</i>	-	-	10.53	2.16
<i>Neurothemis terminata</i>	-	-	15.79	4.32
<i>Ichtinogomphus decoratus</i>	10.13	17.39	-	8.63
<i>Agriocnemis femina</i>	3.80	-	7.89	4.32

Source : Primary Data, 2017

Abundance analysis results (Table 3) also shows differences in abundance of species of dragonflies of each species thought to be influenced by solar radiation intensity and vegetation conditions. The same state is expressed by Hartika, *et al.* (2017) that is the difference of abundance species of dragonfly influenced by the intensity of sunlight. Meanwhile, according to Suriana, *et al.* (2014) differences in the number and species of dragonflies (Figure 1) are caused by ecosystem conditions such as the presence and type of vegetation.



Source : Primary Data 2017 is processed

Fig. 1. Number of individuals dragonflies founded in swamp ecosystem University of Lampung

Diversity. Based on the scale of the species diversity index according to Magurran (1988), the value of the diversity index (H') in all observation stations ie R1, R2 and R3 (Figure 2) shows medium scale ($1.5 < 1.72; 1.85; 2.07 < 3.5$) which means ecosystem condition is still relatively good and does not experience any significant pressure in supporting the life of dragonflies. In addition, the value of diversity index also indicates that the condition in environment of round lampung university is still maintained. This is supported by Siregar (2014) which states that the dragonfly serves as the bioindicator of a polluted environment, where dragonflies are very fond of the clean water environment and the category of insect that is pollutant. It can also be attributed to the role of the dragonfly as a controlling insect population that is harmful such as tree borer borer which is a prey of *Ortherum sabina* (Ledheng *at al.*, 2016)

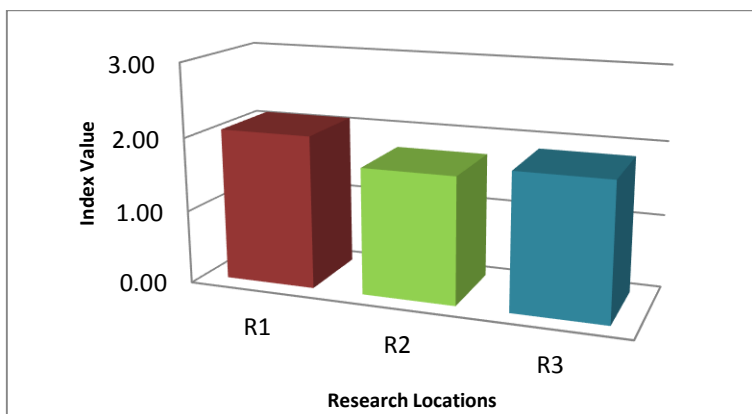


Fig. 2. Value of diversity index dragonflies in swamp ecosystem of University of Lampung

The results of the Shonon-Wiener variety index analysis showed that the value of dragonflow diversity in the swamp ecosystem ranged from 1.72 to 2.07 (Table 4). It is known that the diversity index at R1 is 2.07 and in R2 the index of diversity is 1.72, while the diversity index at R3 is 1.85. The experimental field swamp (R1) obtained the highest

biodiversity index value compared to the swamp in deer breeding (R2) and swamp in field profitor (R3). This is due to the lack of human activity and is supported by abiotic factors that are appropriate for the growth and development of dragonfly life. This is reinforced by Virgiawan, *et al.* (2015) that the most suitable habitat for the life of dragonflies is influenced by various factors namely human activity and environmental abiotic factors such as water temperature, air temperature, light intensity. This condition indicates that R1 has good ecosystem productivity as dragonfly habitat and does not experience pressure. In addition, differences in diversity of dragonflies according to (Herlambang, *et al.*, 2016) are influenced by the number of species encountered, the more species encountered the higher the number of diversity.

Table 4

Comparison of diversity index value of dragonflies in the each location (r1,r2,r3) and all location

No.	Species	H'			
		R1	R2	R3	Total
1	<i>Orethrum sabina</i>	0.30	0.35	0.34	0.32
2	<i>Crocothemis servilla</i>	0.26	0.33	0.34	0.30
3	<i>Brachytemis contaminata</i>	0.32	0.21	0.20	0.28
4	<i>Rhyothemis phyllis</i>	0.30	-	-	0.22
5	<i>Potamarcha congener</i>	0.25	-	-	0.18
6	<i>Diplacodes trivialis</i>	0.17	0.21	0.24	0.20
7	<i>Acisoma panorpoides</i>	0.12	-	-	0.08
8	<i>Lathrecista asiatica</i>	-	0.30	-	0.10
9	<i>Zyxomma obtusum</i>	-	-	0.24	0.08
10	<i>Neurothemis terminata</i>	-	-	0.29	0.14
11	<i>Ictinogomphus decoratus</i>	0.23	0.30	-	0.21
12	<i>Agriocnemis femina</i>	0.12	-	0.20	0.14
		2.07	1.72	1.85	2.26

Source: Primary Data, year 2017

CONCLUSION

The results showed that there are 12 types of dragonflies from 3 families. Conservation status of 12 types is Least concern (IUCN), unprotected (Local Regulation: UU/PP) and non-appendix (CITES). The highest abundance was recorded on the type of dragonfly *Orthetrum sabina* with 20.14% and the smallest was *Acisoma panorpoides* and *Zyxomma obtusum* respectively 2.16%. The Shannon-Wiener diversity index value for the three locations shows medium scale of 2.26, which means that the condition the swamp ecosystem in the University of Lampung still has good productivity as a habitat while supporting the life of dragonfly.

Suggestion. It is necessary to preserve the wetland ecosystem at the University of Lampung so that the value of the diversity of the dragonflies (*Odonata*) can increase and not decrease. It is necessary to observe periodically to know the population and its dynamics and various aspects of life of dragonflies (*Odonata*).

Acknowledgement. Thank you are given to the dean of the Faculty of Agriculture and staff who have provided support in this research, especially to Puja Angriana who has assisted in documenting (photo) for *Lathrecista asiatica*.

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