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The Abundance of Odonata Insect in Lebak Swamp, Bukit Baru, Palembang, Indonesia

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Abstract. Lebak swamp in Bukit Baru has been lost largely degraded and lost through reclamation activity. Lebak swamp plays important role as land resource in Bukit Baru, Palembang. The study was sonducted to study the composition of Odonata in lebak swamps in Bukit Baru, Palembang, Indonesia. The transect line (1 km) was used to collect odonata in the study area. This study recorded 8 species during the study period. 8 species were found at Site A1, 6 species at site A2, 3 species at site A3, and 6 species at site A4. The highest diversity of odonata was found in site A1, however the other sites have lower odonata diversity. The highest abundance of odonata was recorded at site A2 and A4 and dominated by *Ceriagrion coromandelianum* and *Orthetrum sabina*. *Neurothemi*s *ramburii* had the lowest abund ance at site A1 and A2, but absent at site A3 and A4. The occurrence of odonate species are lower at site around anthropogenic activity suggests the need to protect the lebak swamp so that such uncommon species will not go into local extinction. *Neurothemi*s *ramburii* can become potential species to evaluate the rate of disturbed environment.

Keywords: *Diversity, lebak swamp, insects, palembang*.

INTRODUCTION

Deforestation in Indonesia has attracted worldwide attention due to its high rate, more than half of the forestation occurred in lowland forest (Shivakoti, et al. 2017). Indonesia is facing problem of deforestation due to increasing anthropogenic activity. The deforestation has caused various ecosytem loss and degradation in faster rate. The higher habitat loss has occurred in wetland. The wetland ecosystem loss increased, around 2.6 million hectares during 2000-2012 (Margono et al., 2012).

South sumatera has various wetland ecosystem, lebak swamp is one of important land and covers half of south sumatera, especially Palembang. Lebak swamp in South Sumatra covers an area of 1.1 million ha and has been utilized approximately 368.690 hectares and the rest is around 731.310 hectares (Direktorat Rawa dan Pantai, 2009). Lebak swamp in Bukit Baru is located adjoining to Palembang city, therefore Bukit Baru receives direct impact from the infrastructure development of Palembang. The high development of Palembang causes some issues, such as an inefficient use of lebak swamp land, complexity of land ownership status, landfills, land speculation and commercialization of uncontrolled land prices (Busri, 2014, Wildayana and Armanto., 2017).

The lebak swamp in Palembang have been largely lost through reclamation efforts. Landfilling and converting lebak swamp, will change biotic and abiotic factor in ecosystem. It causes habitat loss, degradation, pollution, and impact on biodiversity in the ecosystem. The anthropogenic activity in lebak swamp will decrease biodiversity.

Odonata has a role as an important organism of the food web in wetlands (Bried and Ervin, 2005; Ramani et al. 2020). Odonata existence indicates that the environment has good natural conditions (Qayyimah et al. 2014), and the quality and function of wetlands (Foote and Rice Hornung 2005). The change in environment will affect odonata species in

lebak swamp. The loss and degradation of local ecosystem can influence the sturcture of odonate insects (Krausman and Cain, 2013; Aguilar, 2008).

Macroinvertebrate including odonata, have been recognized as most reliable bioindicator for wetland environment (Herdersen, 2001; Calting, 2005). Odonate adult are relatively easy to identify and well known taxonomically (Simaika & Samways, 2012; Kutcher & Bried, 2014). Odonata is the order of insect, which have high fiversity and wide distribution. Odonata have a range of alternative for different biotopes, from emporary pools to permanent shaded sites (Corbet, 2004). Loss and Degradation of habitat have caused a decrease in the abundance of odonate species, which make them in the target of conservation (Kadoya et al. 2009).

Among threatened lebak swamp organisms, Odonate species have been used frequentlyy as bioindicators of the ecosystem quality. It was hypothesized that Odonata structure, diversity, distribution and community assemblage have the tendency to disclose the fitness of stream ecosystem to sustain members of the community (Adu and Ogbogu, 2011). It is important to investigate the composition of Odonata in different habitat conditions of lebak swamp and odonata species as potential tools to determine the quality of lebak swamp in Bukit Baru, Palembang.

MATERIAL AND METHODS

Description of the Study Site

This research was conducted in Bukit Baru, located in Palembang City, South Sumatra, Indonesia (Figure 1). In order to compare the biological diversity indicator in Lebak swamp. The study area is divided into 4 research sites, consisting of site A1 as natural swamp (control site), Site A2 and Site A3 as the site located around residential areas (Site A3 is more crowded human area and less vegetation), and Site A4 as the site located around highway.

Figure 1. Research station located in lebak swamp in Bukit Baru, Palembang City consisting of 4 sites

Collection of sample

This samples were collected using sticky trap, light trap, insect net, along line transect (1 km) which passed through different habitat types. Adults of odonata spesimens were sampled once every month for four months. All samples then photographed for further off-field

identification and preserved in 70% ethanol solution, labelled with local name of odonata species, location/station, date of collection, collector's name, and other information required.

The identification was conducted in the Laboratory of biology, departemen of biology education, Sriwijaya University, Palembang, Indonesia. Microscope are also used to observe odonates species that were difficult to reach

Data analysis

Data analysis was measured using one-way anova analysis. The analiysis was perfomed using SPSS 24. This analysis is used statistically to examine significant differences between two or more independent variables. The Data analysis was carried out through the application of several equations to find out the existence and structure of Odonata communities in Lebak Swamp.

Data analysis were statistically analyzed using descriptive statistics, the Shannon diversity index (H') and Simpson domination index (D) to get the composition of odonata. The data is presented into table and graphic

Dominance index is important to evaluate the species dominantion in communites. The greater the value of the dominance index (D), the greater the tendency for certain types to dominate. Dominance index was calculated according to Simpson's index in Krebs (1989), using the following equation:

$$D = \sum(\frac{ni}{N})^2$$

Note,
D : The Simpson's index,
ni : The number of individuals(i species),
N : The individuals total in community

The diversity and richness of species are of important components to evaluate the health of ecologic system. Odonate adult was calculated using the Shannon and Wiener index (Odum and Barrett, 2009),

$$H' = - (\sum pi \ln pi)$$

Note,
Pi : The ratio of individuals of species i to all individuals of all species (ni/N).

According to Wilhm and Dorris (1986), The criteria is divided into 3 categories:

H` < 1 : Low diversity
1 < H` < 3 : moderate
H` > 3 : High

The evenness index (E) describes the individual evenness among odonate species. It is essensial for assessing enviromental quality, with this formula :

$$E = \frac{H'}{H'Max}$$

Note,
H′max : (In S),
S : Total number of species.

The criteria is divided into 3 categories :
e < 0,4 : The evenness of species is low
0,4<e < 0,6 : The evenness of species is moderate
e > 0,6 : The evenness of species is high

RESULTS AND DISCUSSION

The diversity of insect in the Lebak Swamp

This study was found 8 species of odonate in the lebak swamp, consisting of 2 families, Libellulidae and Coenagrionidae. The odonate from Libellulidae were found more frequently than family of Coenagrionidae. In total, there were 6 species of Libellulidae, and 2 species of Coenagrionidae recorded in lebak swamp, Bukit Baru. Some researches recorded that

Libellulidae were most abundant family of odonata in some study areas (Cai et al. 2018; Aziz and Mohamed, 2019). Table 4.3 shows that at site 8 species were recorded at site A1, 6 species at site A2, 3 spesies at site A3, and 6 species were collected at site A4. for more details presented in Table 1.

Table 1. Diversity of insect species in Lebak swamp, Bukit Baru, Palembang

No.	Species name	The abundance of Odonate insect				Total
		Site A1	Site A2	Site A3	Site A4	
1	*Ceriagrion coromandelianum*	4	8	7	8	27
2	*Ischnura* sp.	1	0	1	5	7
3	*Crocothemis servilia*	1	2	0	3	6
4	*Neurothemis ramburii*	1	1	0	0	2
5	*Orthetrum sabina*	7	7	5	2	21
6	*Pantala* sp.	3	0	0	3	6
7	*Rhyothemis phyllis*	1	2	0	0	3
8	*Trithemis* sp.	1	2	0	1	4
	Total	19	22	13	22	76

All of study areas were consisted of 2 families. The highest diversity of species were recorded at Site A1 which has 8 Species, followed by site A2 and A4, 6 species and the lowest diversity was found at the site A3 consisting of 2 families and 3 species. *Ceriagrion coromandelianum* and *Orthetrum sabina* were recorded at all research sites, these species are more adapted to disturbed environment and commonly found at disturbed sites in this study.

The highest diversity was recorded at site A1. The site A1 is lebak swamp as control site with small anthropogenic activity. Therefore the site supported by abiotic factors, natural prey and habitat that are appropriate for the growth and development of dragonfly life. This is confirmed by Virgiawan, et al. (2015) that the suitable habitat for the life of odonate community is influenced by various factors namely anthropogenic activity and environmental factors.

The Abundance of odonate insect

A total of 76 individuals of odonata species were found at lebak swamp in Bukit Baru. The highest abundance (22 individuals) was found at site A2 and site A4, and the lowest was found at site A3 (13 individuals). *Ceriagrion coromandelianum* and *Orthetrum sabina* had the highest number individuals and had the lowest of 2 individuals was recorded for the species *Neurothemis ramburii*. The other species are more sensitive and not commonly recorded in disturbed sites. The occurrence of *Neurothemi*s is an evidence of the better environment quality at site A1 and A2.

However, the highest abundance was found at site A2 and A4, not at the A1 as control site, the environment is still there is more vegetation and little human activity. The dominance of certain species of Odonata in A2 and A4 is higher, especially in the family Coenagrionidae and Libellulidae, besides species evenness in A2 and A4 lower than A1. This shows that the A2 and A4 only able to support fewer species of life, compared to the control station (A1). Site A2 and A4 have less vegetation and food sources insects Odonata than site A1.

Odonata Assemblage in Bukit Baru Lebak Swamp

The assemblage of odonata at lebak swamp is presented into species diversity, dominance and evenness index in figure 2

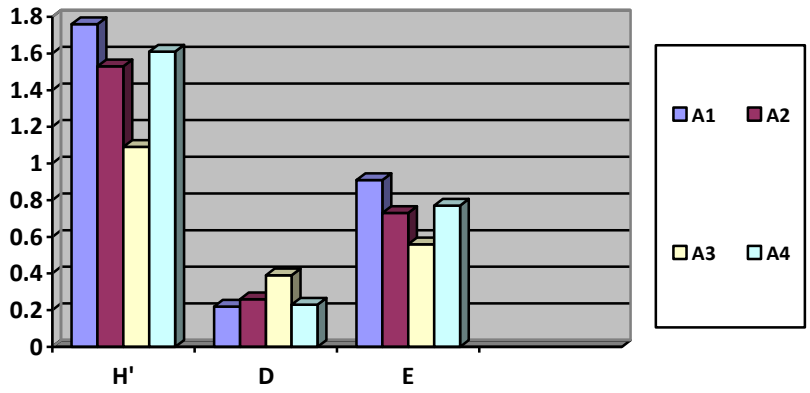

Figure 2. The Diversity, dominance and evenness index of odonata assemblage in lebak swamp

The value of diversity index at all of the study areas still have moderate value. However, the evenness index at 3 study area (Site A1, A2 and A4) show the high evenness of odonate species (E value > 0.6 is high evenness), only the value at site A3 show moderate evenness (E value = 0,4 < E < 0,6). The site A3 is study areas which has more crowded human area and less vegetation than the other site.

Site A1 had the highest diversity index, evenness index and the lowest dominance index. These data is an evidence that site A1 had a better environment quality than the other sites. In contrast, site A3 had the lowest diversity index, evenness index and the highest dominance index.

Site A1 has higher diversity of plant and vegetation. The vegetation is the most important component and has many benefits and function for odonate life. Therefore, Site A1 has more richness of odonata. The vegetation influence the occurence of odonate species, as a nest, protect from predators, perch, rest, breed and food resource (Qayyimah et al. 2014). The vegetation was recorded lower and rare in other sites (Site A2, A3 and A4) but the lowest existence of vegetation was found at site A3. Vegetation existing in lebak swamp required to be sustained with planting other types of plants which can provide habitat, food and support life of odonata.

Furthermore, Site A3 also has higher dominance index. It describe that a or some species dominate the study area. Site A3 was dominated by *Ceriagrion coromandelianum*, followed by *Orthetrum sabina* and *Ischnura* sp. Previous researches on evaluating of tropical Odonata, found that Coenagrionidae were rate as highly tolerant (Tennessen, 2019; Adu and Ogbogu, 2011).

Orthetrum sabina were recorded more abundant after *Ceriagrion coromandelianum*. Both families had thermal tolerances, but Libellulidae had a greater tolerance than Coenagrionidae (Makaure et al. 2015). It also indicated that the lebak swamp provide enough prey for the family. According to Dalia et al. (2014) found that *Orthetrum sabina* can prey on arthropod type insects.

The study are can still provide habitat for a few tolerant odonate soecies, but the other species were absent or rare in study area. *Neurothemis ramburii* had the lowest abundance at lebak swamp in Bukit Baru and absent in some sites in this study area. Although this species was known as tolerant species and the member of Libellulidae, habitat loss will affect the occurence of this species.

According to Ilhamdi et al. (2020) *Neurothemis ramburii* is highly disturbance tolerant. *Neurothemis ramburii* was absent at site A3 and A4, it is an evidence of the highly distrubed environment. *Neurothemis ramburii* is highly tolerant to disturbance environment, the lower abundance and the absence of this species indicated that lebak swamp in Bukit Baru is highly disturbed (habitat loss). Habitat loss is the only threat to this species, and not a serious one across much of its range at present, but it

may become one with increased urbanization and industrial farming (Dow, 2009).

However, *Neurothemi*s *ramburii* was found at site A1 and A2, it indicated that these site had better environment than the other site. It also proved that the site are still able to support the odonate insect at site A2 as disturbed site, but with just a species represented at the lebak swamp, it cannot prove that the lebak swamp is heavily distrubed. One important outcome of this study is that *Neurothemi*s *ramburii* can become potential odonate species for evaluating the rate of disturbed environment.

Anthropogenic activity and inefficient use of lebak swamp land such as land converting, landfills, industry, and settlement on large scale, will affect the biodiversity of odonate species. Converting swamp land into settlement, landfills and the other antrophogenic activity in large scale will affect the biodiversity in lebak swamp (Teristiandi, 2020). Purba (2002) suggests that activity in settlement and agriculture made a change of physical and chemical factor in environment and the effect on the composition and the number of odonata.

Tabel 2. One way anova analysis for the abundance of odonata species in study area

Study Area	Comparation of study area	Significance
Site A1	Site A2	0,992
	Site A3	0,944
	Site A4	0,992
Site A2	Site A1	0,992
	Site A3	0,839
	Site A4	1,000
Site A3	Site A1	0,944
	Site A2	0,839
	Site A4	0,839
Site A4	Site A1	0,992
	Site A2	1,000
	Site A3	0,839

Tabel 2 present the comparation significance value among study area using one way anova analysis. All of The significant value is greater than 0,05. It suggest that there are no significantly different abundance of odonate species among the study area. However, the odonate community in study area consist of different species composition,. The richness and evenness tend to decrease in disturbed site especially site A3.

It is necessary to observe periodically to know the change in biotic and abiotic factor in lebak swamp including population and its dynamics of life of odonate community, environmental factor, and to study the potential of neurothemis ramburii for biomonitoring and bioindicator in lebak swamp, bukit baru, palembang, indonesia.

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REFERENCES

Adu, B. W. and Ogbogu, S. S. 2011. Diversity of dragonflies and damselflies (Insecta: Odonata) in obafemi awolowo university, Ile-Ife, Southwestern Nigeria. *Agrion* 15(1): 24-31.

Aguilar, A. C. 2008. Dragonflies and Damselflies: Model Organisms for Ecological and Evolutionary Research. Oxford University Press.

Aziz, M. A. A. A., and Mohamed, M. 2019. Annotated checklist of odonates (Insecta: Odonata) in Sungai Bantang Recreational Forest, Bekok, Johor, Malaysia. *IOP Conf. Series: Earth and Environmental Science* 269 (2019) 012002.

Bried, J. T. and Ervin, G. N.. 2005. Distribution of adult Odonata localized among wetlands in east-central Mississippi. *Southeastern Naturalist*, 4: 731-744.

Bried, J.T. & Samways, M.J. 2015. A review of odonatology in freshwater applied ecology and conservation science. *Freshwater Science*, 34: 1023–1031.

Busri, A. S. 2014. Pemanfaatan dan penataan lahan basah sebagai upaya pembangunan berwawasan lingkungan di Jakabaring Sumatera Selatan. *Disertasi*. Program Pascasarjana, Universitas Sriwijaya, Palembang.

Cai, Y., Ng, C. Y., and Ngiam, R. W. J. 2018. Diversity, distribution and habitat characteristics of dragonflies in Nee Soon freshwater swamp forest, Singapore. Gardens' Bulletin Singapore 70 (Suppl. 1): 123–153.

Calting, P. C. 2005. Potential for the Use of Dragonfly (Odonata) Diversity as a Bioindicator of the Efficiency of Sewage Lagoons. Canadian Field Naturalist 119(2): 233-236.

Carchini, G., AG Solimini and A. Ruggiero. 2005. Habitat characteristics and odonate diversity in mountain ponds of central Italy. Aquatic Conservation: Marine and Freshwater Ecosystems 15: 573-581

Corbet, P.S. (2004). Dragonflies: behaviour and ecology of Odonata, Harley Books, Colchester, 829 pp.

Dalia, B.P.I. and Leksono, A.S.(2014). Interaksi Antara Capung dengan Arthropoda dan Vertebrata Predator di Kepanjen Kabupaten Malang.Jurnal Biotropika, 2(1), 26 – 30.

Direktorat Rawa dan Pantai. 2009. Potensi dan tantangan pengembangan rawa indonesia. makalah pada seminar lokakarya pengelolaan rawa dalam mendukung ketahanan pangan nasional. departemen pekerjaan umum. Hotel Nikko Jakarta.

Dow, R. A. 2009. *Neurothemis ramburii*. *The IUCN Red List of Threatened Species* 2009: e.T163690A5636459. Downloaded on 10 June 2020.

Foote, A. L., and Hornung, C. L. R. 2005. Odonates as biological indicators of grazing effects on the Canadian prairie wetlands. *Ecological Entomology* 30: 273-283.

Hedersen, S. 2001. The role of behavioural ecology of damselflies in the use of fluctuating asymmetry as a bioindicator of water pollution. *Ecological Entomology* 25(1):45 – 53.

Ilhamdi, M. L., Idrus, A. A., Santoso, D, and Hadiprayitno G. 2020. Short communication: community structure and diversity of odonata in suranadi natural park, west lombok indonesia. *Biodiversitas*, 21(2): 718-723.

Kadoya, T., Suda, S., and Washitani, I. 2009. Dragonfly crisis in Japan: A likely consequence of recent agricultural habitat degradation. *Biological Conservation*, 142 (9):1899-1905.

Krausman, P. R. and Cain, J. W. 2013. Wildlife Management and Conservation: Contemporary Principles and Practices. The John Hopkin University Press, Published The Affliliation with The Wild Society, Batlimore Maryland.

Krebs CJ. 1989. Ecological Methodology. University of British Columbia, Harper Collins Publisher, New York.

Kutcher, T.E. & Bried, J.T. 2014. Adult Odonata conservatism as an indicator of freshwater wetland condition. *Ecological Indicators*, 38: 31–39.

Margono, B.A., Turubanova, S., Zhuravleva, I., Potapov, P., Tyukavina, A., Baccini, A., et al., 2012. Mapping and monitoring deforestation and forest degradation in Sumatra (Indonesia)

using Landsat time series data sets from 1990 to 2010. *Environmental Research Letters*, 7 (3), 16.

Odum EP, Barrett GW. 2009. Fundamentals of Ecology. 5th ed. Cengage Learning, Belmont, CA.

Purba, Ika Rosenta. 2002. Effect of Agricultural and settlement activities on the Quality of Water and Biodiversity macrozoobenthos (Case Study District of Purba Simalungun). Thesis. Terrain: University of North Sumatra.

Qayyimah, F. D., L. Nisrina, R. Aulunia, Rosnaeni, Y Baskoro. 2014. Fnal Report: Odonata Diversity Relationship with Plant Vegetation Diversity in Palimanan Quarry, Cirebon, West Java. University Al-Azhar Of Indonesia; Jakarta.

Ramani, S., Mohanraj, P., Yeshwanth, H. M. 2020. Indian Insects: Diversity and Science. CRC Press, Taylor and Francis Group.

Simaika, J.P. & Samways, M.J. (2012). Using dragonflies to monitor and prioritize lotic systems: a South African perspective. *Organisms Diversity & Evolution*. 12(3): 251–259.

Shivakoti, G. P., Pradhan, U., & Helmi, H. (Eds.) (2017). Sustainable natural resources management in dynamic Asia. Waltham, MA: Elsevier.

Tennessen, Kenneth. 2019. Dragonfly Nymphs of North America: An Identification Guide. https://dx.doi.org/10.1007/978-3-319-97776-8

Teristiandi, Novin. 2020. Komparasi Kelimpahan Serangga Di Kawasan Rawa Yang Dikonversi Di Jalan Soekarno Hatta Palembang. *Jurnal Biologi Tropis*, 20 (1): 22 – 28.

Virgiawan, C., Hindun, I., Sukarsono.(2015). Studi Keanekaragaman Capung (Odonata) Sebagai Bioindikator Kualitas Air Sungai Brantas Batu.

Wildayana, E. and Armanto, M. E. 2017. Agriculture Phenomena and Perspectives of Lebak Swamp in Jakabaring South Sumatra, Indonesia. *Jurnal Ekonomi dan Studi Pembangunan*, 9 (2), 157-166.

Wilhm, J. L., and T.C. Doris. 1986. Biologycal Parameter for water quality Criteria. *Bio. Science*: 18.