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DIVERSITY OF ODONATA IN LANGSA URBAN FOREST, LANGSA, ACEH, INDONESIA

Sayed Latiful Asrori[1], Kartika Aprilia Putri[1], Siti Diniarsih[2], Pungki Lupiyaningdyah[3], and Herlina Putri Endah Sari[1*]

[1]Department of Biology, Faculty of Enginering, Universitas Samudra, Langsa, Aceh, 24416, Indonesia
[2] Indonesia Dragonfly Society, Yogyakarta, 55272, Indonesia
[3]Research Center for Biosystematics and Evolution, National Research and Innovation Agency, Jl. Raya Jakarta-Bogor Km. 46, Cibinong, Bogor, Indonesia
[*]Corresponding author: herlinaputriendahsari@unsam.ac.id

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ABSTRACT

Odonata is important as environmental bioindicator as well as pest control. Langsa Urban Forest (LUF) is a 10-ha green open space in Langsa City, Aceh Province which serves the purpose of tourism and support biodiversity conservation, in which Odonata (dragonflies and damselflies) is included. There is a lack of Odonata research in Langsa, especially at the LUF area, therefore this study offers a baseline information for wildlife management. Field observations had been conducted between February to March 2022 using line-transect method. As a result, this study recorded 19 Odonata species from four families, of which *Orthetrum sabina* (Libellulidae) became the most prominent species observed. Odonata diversity in LUF was medium (H' = 1.863-2.252) with population of each species presumed to be nearly even (J = 0.71-0.79). Odonata diversity in LUF serves as additional information on Odonata species found in Indonesia, especially Aceh Province. Also, the medium category of Odonata diversity index in LUF can be used as a reference for LUF management to support more ecosystems as Odonata habitat.

Key words: damselfly, dragonfly, ecology, ecosystem

INTRODUCTION

Langsa Urban Forest (LUF) is a 10-ha green open space of ecotourism icon in Langsa City, Aceh. The LUF area is located in Paya Bujok Seulamak Village, Langsa Baro Subdistrict, 6 km west from Langsa City or approximately 15 minutes from the city downtown. Aside from being an ecotourism object, LUF also functions to support the preservation of local biodiversity, including Odonata species.

Odonata serves as environmental bioindicator and pest controller. Their existence in an environment can indicate the level of quality of that habitat (Buchori et al., 2019). Odonate nymphs develop within the aquatic habitat, in which their absence can signify the polluted waterbody. Polluted water is not only unfavorable for nymph development, but also able to sink Odonata eggs due to no surface tension resulting from the pollutant contained (Rahadi et al., 2013). This condition leads to the disruption of Odonates' life cycle and eventually decrease their population (Abdillah et al., 2019). Some Odonates, such as coenagrionid and platycnemidid damselflies (suborder Zygoptera) and aeshnid dragonflies (suborder Anisoptera) are sensitive to the change of vegetation coverage, as they prefer to live under shaded environment (Buchori et al., 2019). Odonata also plays important role as predator either at the nymph stage that prey

on other aquatic organisms or on adult (imago) stage where their diet consists of terrestrial or aerial insects (Gullan & Cranston, 2010).

In Indonesia, there are 1,287 Odonata species, with 263 species recorded in Sumatra (Widjaja et al., 2014). Some studies on the diversity of Odonata had been carried out at various localities in Indonesia, including at the lakes of Universitas Indonesia, West Java (Akbar & Basukriadi, 2018), at Sabo Dam Complang Kediri (Susanto & Arianti, 2021); at Batubolong Lombok (Zulhariadi et al., 2022), in Tuban, East Java (Sonia et al., 2022), and around Universitas Andalas, West Sumatra (Janra, 2018). Odonata in Aceh region, on the other hand, has not been well documented. The only known research on Aceh's Odonata was conducted at Ketambe Forest, Gunung Leuser National Park (Wirjoatmodjo & Atmowidjojo, 1985). As for Langsa region, there is no information regarding its Odonata species. Therefore, this study aimed to determine the diversity of Odonata at the LUF area which in turn can be used as future reference for the conservation management in Langsa City.

MATERIALS AND METHODS

This research took place at Langsa Urban Forest (LUF) in Paya Bujok Seulamak Village, Langsa Baro District, Langsa City (4°29'25" N, 97°56'44" E, 7 m elevation) with the temperatures of 28°C - 31°C and the humidities of 60% - 80%. Data collection was conducted along 400 - 600 m transect lines established at 3 stations, i.e. (1) Pond Area, (2) Mini Zoo Area, and (3) Open Area (Fig. 1). These stations were based on habitat characteristic of each station. Station 1 has an artificial pond surrounded by trees and shrubs. Station 2 is area filled with trees and there is a mini zoo with a small stream. Station 3 is an open area surrounded by shrubs and herbs with water flowing from an artificial pond. Each station was surveyed for 5 times within the period of February to March 2022. Observation was initiated from 09.00 - 12.00 in the morning and 15.00 - 17.00 in the afternoon during sunny days. Odonata species that were not readily identifiable were caught using insect net for identification purpose based on their morphological characteristics. Identified Odonata species were released after its data was recorded.

Morphological characters used to identify Odonata species included measurement and coloration of head, thorax, abdomen, legs, and wings, which were then compared to identification guides (Orr, 2003, 2005; Rahadi et al., 2013; Irawan & Rahadi, 2018). Ecological indices used to assess the ecology of Odonata in study site, which included diversity index using Shannon-Wiener Diversity formula ($H' = - \Sigma$ pi ln pi; Krebs, 1998) and species population evenness ($J = H'/\ln S$; Magurran, 2004). Category of diversity and evenness index values (Krebs, 1998; Magurran, 2004; Latumahina, 2020) using the criteria in Table 1.

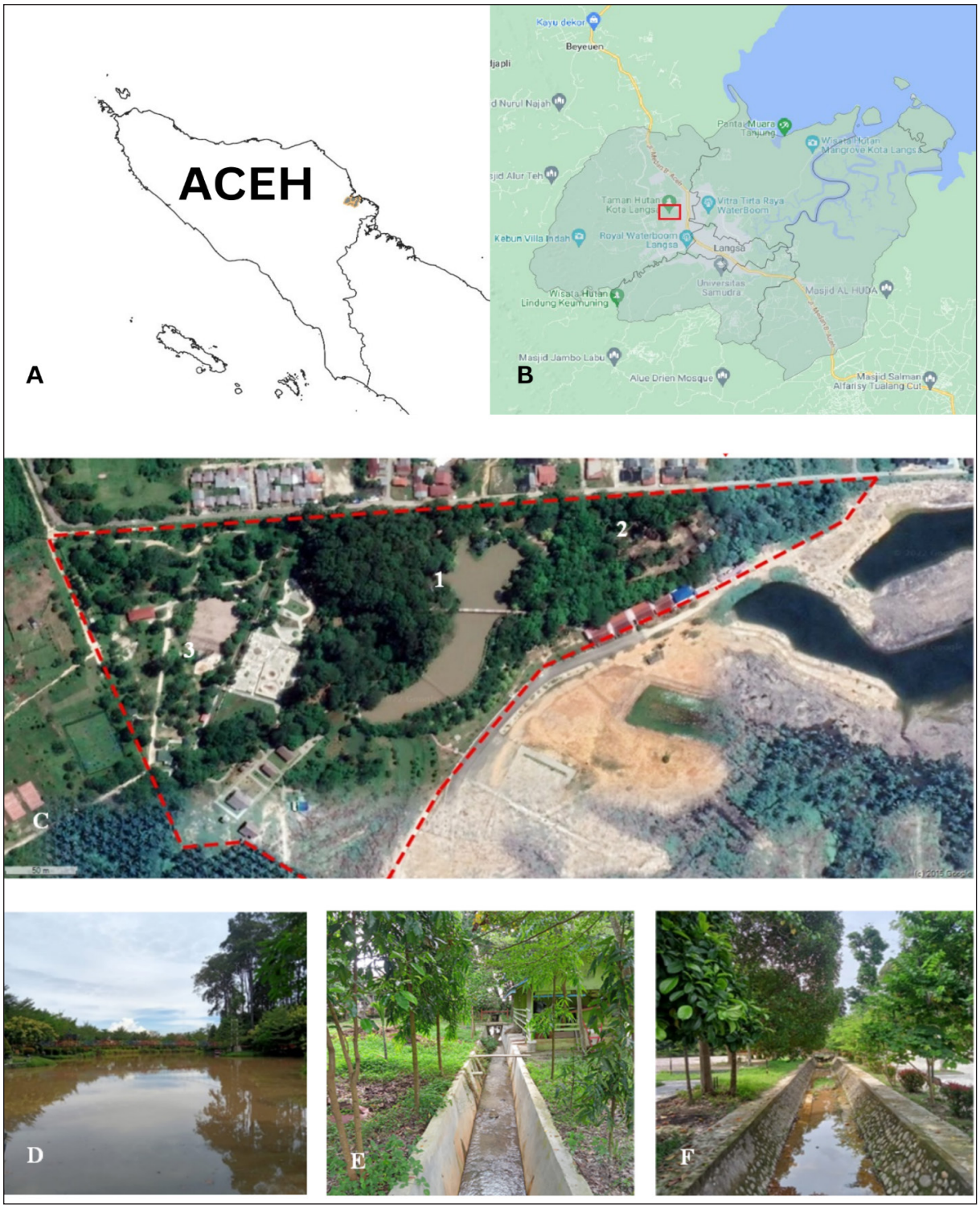

Figure 1. Map of study site: A. Aceh; B. Langsa (QGis, 2023); C. Langsa Urban Forest (Google earth, 2022); D. Station 1; E: Station 2; F: Station 3 (photograph by Asrori, 2022).

Table 1. Diversity and evenness index category

Index	**Index value**	**Category**
Diversity index	H' < 1	Low diversity
	1 < H' < 3	Medium diversity
	H' > 3	High diversity
Evenness index	J approaches 0	Uneven/unequal distribution among species Unstable condition
	J approaches 1	Evenly distributed among species Stable condition

RESULTS

There were 19 Odonata species that belong to four families identified from 1,406 individuals recorded at LUF. Fourteen species (73.68%) were from suborder Anisoptera while five other species (26.31%) were from suborder Zygoptera (Fig 2; Table 2). The LUF area was assessed to have moderate Odonata diversity (H' = 1.86-2.25) while the dragonfly community seemed to have near evenly population among species (J = 0.71-0.79) (Table 3).

Table 2. Odonata species recorded at LUF area

No	**Taxonomy**	**Station**			**Total**
		1	**2**	**3**	
	Suborder Anisoptera				
	Gomphidae				
1	*Ictinogomphus decoratus* (Selys, 1854)	37	-	2	39
	Libellulidae				
2	*Brachydiplax chalybea* Brauer, 1868	4	-	33	37
3	*Brachythemis contaminata* (Fabricius, 1793)	139	-	12	151
4	*Diplacodes trivialis* (Rambur, 1842)	8	9	27	44
5	*Lathrecista asiatica* (Fabricius, 1798)	-	1	2	3
6	*Neurothemis terminata* Ris, 1911	16	21	34	71
7	*Orthetrum sabina* (Drury, 1770)	92	79	144	315
8	*Orthetrum chrysis* (Selys, 1891)	1	1	12	14
9	*Orthetrum testaceum* (Burmeister, 1839)	3	2	16	21
10	*Pantala flavescens* (Fabricius, 1798)	75	1	70	146
11	*Potamarcha congener* (Rambur, 1842)	-	32	6	38
12	*Rhyothemis phyllis* (Sulzer, 1776)	10	10	9	29
13	*Tholymis tillarga* (Fabricius, 1798)	45	2	21	68
14	*Zyxomma petiolatum* Rambur, 1842	8	4	-	12

No	Taxonomy	Station			Total
		1	2	3	
	Suborder Zygoptera				
	Platycnemididae				
15	*Pseudocopera ciliata* (Selys, 1863)	188	20	34	242
	Coenagrionidae				
16	*Agriocnemis femina* (Brauer, 1868)	54	7	15	76
17	*Ischnura senegalensis* (Rambur, 1842)	52	1	5	58
18	*Pseudagrion microcephalum* (Rambur, 1842)	4	-	1	5
19	*Pseudagrion rubriceps* Selys, 1876	36	-	1	37
	Number of individuals	772	190	444	1406
	Total species	17	14	18	

Note: -: absent

Table 3. Diversity Index and Evenness Index

Station	Diversity Index	Evennes Index
Pond area (Station 1)	2.25	0.79
Mini zoo area (Station 2)	1.86	0.71
Open area (Station 3)	2.25	0.78

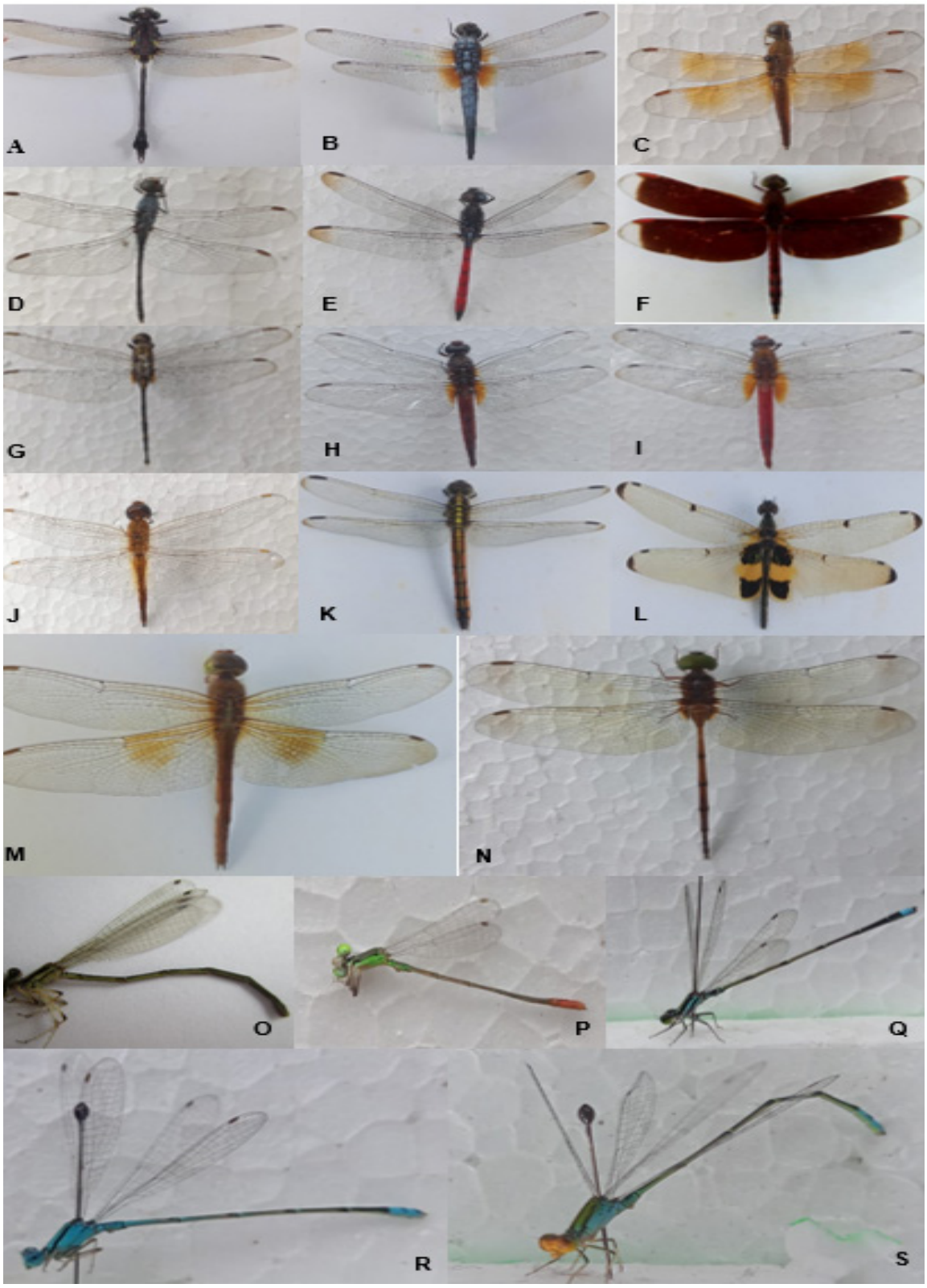

Figure 2. Odonata species in LUF: A: *Ictinogomphus decoratus* Male; B: *Brachydiplax chalybea* Male*;* C. *Brachythemis contaminata* Male; D*: Diplacodes trivialis* Male; E*: Lathrecista asiatica* Male; F: *Neurothemis terminata* Male; G: *Orthetrum sabina*; H: *Orthetrum chrysis* Female; I: *Orthetrum testaceum* Male; J: *Pantala flavescens* Male; K: *Potamarcha congener* Female; L: *Rhyothemis phyllis*; M: *Tholymis tillarga* Female; N: *Zyxomma petiolatum* Male; O: *Pseudocopera ciliata* Female; P: *Agriocnemis femina* Male (immature); Q*: Ischnura senegalensis* Male; R: *Pseudagrion microcephalum* Male; S: *Pseudagrion rubriceps* Male (photograph by Asrori, 2022).

DISCUSSION

The species number of Odonata species from LUF is higher than Ketambe Forest, Aceh (with only nine species reported) (Wirdjoatmodjo & Atmowidjojo, 1985). Also, this result is higher than the number of species found from other area in Indonesia, such as six species from Watu Gajah Tuban (Sonia, 2022); 8 species from Rawa Lebak Palembang (Teristiandi & Riyanto, 2021); 11 species from Batubolong West Lombok (Zulhariadi, 2022); 12 species from Urban Forest Pontianak (Hartika et al., 2017); 14 species from Tanjung Persada Urban Forest Kalimantan (Soendjoto et al., 2016); and 16 species from the lakes of Universitas Indonesia West Java (Akbar & Basukriadi, 2018). This result was influenced by various factors, including the time of observation, length of observation period, site area, and conditions of the study site. For example, from Ketambe Forest, Aceh only nine species was found, because the sampling was only carried out in water bodies, so only the nymphs were recorded, and presumably it was only a by-catch result of effort to document other aquatic faunas. Another example, from Batubolong West Lombok, only 11 species were found even though the ecosystem is supported by rivers that have good physical parameters and surrounding vegetation. This is because Odonata sampling was only carried out two times, in April and July. Meanwhile, the low number of Odonata species in Rawa Lebak Palembang was influenced by environmental conditions that had deforestation and were residential areas.

However, the result obtained from LUF is fewer than the species found in Sabo Dam Complang Kediri (Susanto & Arianti, 2021), Duriangkang Tanjung Piayu Urban Forest Batam (Simatupang et al., 2019), Universitas Andalas West Sumatra (Janra, 2018), and Ujung Kulon National Park (Sugiman et al., 2020), by 20 species, 24 species, 27 species, and 31 species, respectively. This result was also influenced by some other factors. For example, good environmental conditions at Sabo Dam Complang, which has minimal pollution and disturbance, and has conditions of various types of vegetation. The length of observation time also affects the results of the species found, like the results from Andalas West Sumatra University, where data collection was carried out for up to 14 days, besides that the ecosystems at the observation site also consisted of various types such as river, garden, pond, and forest edge.

Station 1 at Pond Area and Station 3 at the open area in LUF had the highest Odonata diversity (both with H’ = 2.25). There were many supporting factors for the life of Odonata at these two stations, such as clean waterbodies, vegetation cover and open space. These factors are not only favorable for adult Odonata to find preys, but also advantageous for the development of Odonata nymphs. According to Samways (2008), a good habitat for Odonata nymphs is calm, clean, sunlit waters and with abundant preys.

Station 2 at Mini Zoo Area, despite having similarly moderate Odonata diversity, yet had lower index value (H’ = 1.86). Station 2 had the least water resource and was often drought during dry season. Dry area is not supportive for the development of Odonata nymphs (Rahadi et al., 2013). Zygoptera or damselflies never fly far away from the water where their nymphs developed and most species are considered as habitat specialists especially in streams and rivers (Orr, 2003; Dolný et al., 2012). Station 2 only had two damselfly species, which may result from the poor water resource as well as disturbance recorded such as human activity from LUF

visitors in the area of Station 2. The intensity of disturbance and anthropogenic activity will potentially decrease Odonata species in certain areas and especially negate the proportion of Zygoptera within the Odonata community (Dolný et al., 2012; Janra, 2018).

On species level, *Orthetrum sabina* (Libellulidae) was the most prominent with 315 individuals (22.40%) recorded during the study. This species was found at every station, especially at Station 3 which was more open than the other two stations. *Orthetrum sabina* is known as a ferocious predator and is very adaptive to various environment conditions. It is solitary species that prefers open and warm places, in addition to its cosmopolitan distribution (Rahadi et al., 2013; Irawan & Rahadi, 2018; Reels, 2021; Zulhariadi, 2022). *Pseudocopera ciliata* with 242 individuals (17.21%) became the most prominent damselfly recorded in this study, especially at Station 1, where plenty resources were available i.e artificial pond and canopy from trees around. This species distributes across Indomalaya region, also widespread in tropical Asia (Lieftinck, 1940; Orr, 2005; Reels, 2021), prefers pool, lakes, and calm water flows (Reels, 2021).

Libellulidae became the most common Odonata family recorded in LUF with 13 species (68.42%) identified. This family has been reported as the most observed in various studies from Indonesia (Janra, 2018; Laily et al., 2018; Sugiman et al., 2020; Akbar & Basukriadi, 2021; Susanto & Arianti, 2021) or globally (Dolný et al., 2012; Seidu et al., 2018). With its most numerous members, Libellulidae significantly contributes the higher proportion in Odonata community even in affected and frequently disturbed environments (Dolný et al., 2012), such as LUF area. Coenagrionidae, on the other hand, became the most prominent Zygoptera as five species of its were recorded in this study (26.31%). Members of Coenagrionidae adapt well to various environments and broadly distributed even in human settlement, mining sites, and agricultural fields (Seidu et al., 2018).

Moderate Odonata diversity that was observed at LUF area might indicate fairly dragonfly community existing therein. Although we may need longer observation periods at different seasons as well to obtain more complete data on Odonata community in this area, the result provided by this study can still serve as a reference for conservation and future environmental management.

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