BIOSFER: Jurnal Tadris Biologi Vol. 12 No. 2 (2021) 110-122

Contents lists available at BIOSFER

BIOSFER: JURNAL TADRIS BIOLOGI

p-ISSN: 2086-5945 (print), e-ISSN: 2580-4960 (online), DOI 10.24042/biosfer

http://ejournal.radenintan.ac.id/index.php/biosfer/index

Diversity and Abundance Of Dragonfly (Anisoptera) and Damselfly (Zygoptera) at Sabo Dam Complang, Kediri, East Java, Indonesia

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ARTICLE INFO

Article History

Received : 17-09-2021
Accepted: 28-12-2021
Published: 31-12-2021

Keywords:

Diversity;
Dragonfly;
Sabo Dam Complang.

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ABSTRACT

This research aimed to identify and analyze the diversity and abundance of dragonflies and damselflies species at Sabo Dam Complang. The samples were taken using the VES (Visual Encounter Survey) method and two transect methods: line transects, and belt transects. The data obtained were analyzed using the Shannon-Wienner species diversity index (H') and the relative abundance of species (RA). The results showed that at Sabo Dam Complang, the found 11 species with a total of 63 individuals dragonfly of Anisoptera suborder and nine species with a total of 160 individuals from 5 families in the Zygoptera suborder. The results of this research show a diversity index value of 2.59.

Keanekaragaman Dan Kelimpahan Jenis Capung (Anisoptera) Dan Capung Jarum (Zygoptera) Di Sabo Dam Complang, Kediri, East Java, Indonesia

Abstrak: *Penelitian ini bertujuan untuk mengidentifikasi dan menganalisis keanekaragaman dan kelimpahan spesies capung dan capung jarum di Sabo Dam Complang. Sampel diambil dengan metode metode VES (Visual Ecounter Survey) dan dua metode transek yaitu transek line dan transek belt. Data yang telah didapatkan dianalisis menggunakan indeks keanekaragaman (H') dan kelimpahan relatif jenis (RA). Hasil penelitian menunjukkan bahwa di Sabo Dam Complang ditemukan 11 spesies capung dengan jumlah 63 individu subordo Anisoptera dan sembilan spesies dengan total 160 individu dari 5 famili pada subordo Zygoptera. Hasil penelitian ini menunjukkan nilai indeks keanekaragaman sebesar 2,59.*

INTRODUCTION

Sabo Dam Complang is a water dam administratively located in Sumberurip, Manggis, Ngancar, Kediri, East Java. Sabo Dam Complang is an area with minimal pollution and disturbance. It has good habitat potential and conditions with various vegetation types suitable as a natural habitat for dragonflies.

Dragonflies (Odonata) are generally divided into two types of dragonflies (Vincent J. Kalkman et al. 2007), namely

dragonflies (Anisoptera) and damselflies (Zygoptera) (Maoka et al. 2020). Both have clear differences, ranging from body shape (Paulson 2009), wings, eyes, and flying behavior (Soendjoto 2016). Dragonflies (Anisoptera) have a large body shape. The hind wings are wider than the front wings (Hanum and Salmah 2013). They spread their wings when perched or rest horizontally (Sabin 1997) and have the ability to fly far and fast (M J Samways 1991). On the other hand, damselflies (Zygoptera) has a slender body shape (Bybee et al. 2016) the same wing shape (Fathudin 2013). they folded their wings when perched or resting and have the ability to fly slowly and cannot fly far (Hanum and Salmah 2013).

The diversity and abundance of dragonflies (including damselflies) (Lino, Koneri, and Butarbutar 2019) have an important role in the ecosystem in maintaining the balance of the food chain (Riyaz 2021). Dragonflies are flying insects that are predators of many small insects (Bell and Hitchomb 1961), including mosquitoes (Syarifah, Narti, and Fahma 2018) and flies (Safrudin and Maulana 2020). Dragonflies can be regarded as predators (Kumar and Hwang 2006) because of their role in the food chain, which eradicates pest populations (Kandibane, Raguraman, and Ganapathy 2005; Purba and Yulminarti 2018). Dragonflies can also be used as environmental bioindicators (Lino, Koneri, and Butarbutar 2019) because their presence in the waters can indirectly indicate clean water (Husnia 2019).

The diversity and abundance of dragonflies in a location are (Oliveira-Junior, Teodosio, and Juen 2021) limited by various factors that make up their natural habitat (Utari 2018). Factors that influence the presence of dragonflies include temperature (Suartini and Sudatri 2019), air humidity (Atourrohman et al. 2020), food (Susanto et al. 2020), and light intensity (Yudiawati and Pertiwi 2020). Dragonflies need these factors to support their lives (Rizal and Hadi 2015). Dragonflies can be found in various types of habitats, such as forests (Kulkarni and Subramanian 2013), rice fields, rivers, lakes (Renner et al. 2018), and urban areas (Ansori 2008).

Research on the diversity of dragonflies in Kediri Regency has previously been carried out, including the research by (Sulistiyowati, Rahmawati, and Prameswari 2018) regarding the diversity of dragonflies in the Brantas watershed (Rohim 2018), regarding the interaction of dragonflies with plants in the Irenggolo Waterfall area, (Abdillah et al. 2018) regarding the relationship between Libellulidae diversity and vegetation diversity in Sumber Clangap, (Abdillah, Prakarsa, and Tyastirin 2019) regarding the diversity of dragonflies in Sumber Clangap and Mangli, (Susanto et al. 2020) regarding the inventory of Anisoptera and Zygoptera dragonflies in Sumber Clangap and Mangli (Abdillah and Lupiyaningdyah 2020). Research on the diversity of dragonflies in the Kediri Regency needs to be updated with wider locations.

Research on the diversity and abundance of dragonflies is essential to be comprehensively researched in various regions in Indonesia. Therefore, it is necessary to research the diversity and abundance of dragonflies found in East Java, especially the Kediri Regency. Sabo Dam Complang has great potential as a natural habitat for dragonflies. There is no research data on the diversity and abundance of dragonflies. Therefore, this research reported the diversity and abundance of dragonflies at the Sabo Dam Complang, Kediri Regency.

METHOD

Time and Location

This research was carried out on February 18-21, 2021. The data collection in the field was carried out at 08.00-12.00 WIB. The selection of research time was based on the dragonfly active hours. This research

was conducted at Sabo Dam Complang, located in Sumberurip, Manggis, Ngancar, Kediri, East Java. The coordinates for Sabo Dam Complang are 7°58'16.2"S 112°11'07.6"E.

Tools and Materials

Tools and materials used in this research include stationery, digital cameras, watches, and identification books (Setiyono et al. 2017; Pamungkas 2016; W. S. Rahadi et al. 2013; Baskoro, Irawan, and Kamaludin 2018).

Methods

The researchers employed the direct observation method, namely the VES (Visual Counter Survey) method. The VES method observed dragonfly species and counted individuals directly on a predetermined path at Sabo Dam Complang. The transect method was performed to determine the research path. The transect method is a roaming method by following each predetermined path. Two transect methods were used in this research: line transects, and belt transects. Line transect is a transect method used for data collection by following a straight line, while belt transect is used for data collection using a circular path.

Data Analysis

The recorded dragonfly data were analyzed by calculating the diversity index (H') and relative abundance (RA). The parameters used in this research were species and the number of individuals obtained at Sabo Dam Complang. The data on the type and number of individuals obtained were analyzed using the following formula:

- Diversity index (Hedriansyah et al. 2017)

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

- Relative abundance (Suwarno, Fuadi, and Mahmud 2013)

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

Information :
H' = Diversity index
RA = Relative Abundance
Pi = ni/N
Ni = Number of Individuals of Each Species
N = Total Number of Individuals

Results and Discussion

The results showed that the researchers found 20 species with 193 individuals from 6 families (Table 1). In the dragonfly suborder of Anisoptera, the researchers found 11 species with 63 individuals in 1 family, namely Libellulidae. Meanwhile, in the Zygoptera suborder, the researchers found nine species with 160 individuals from 5 families, namely Calopterygidae, Clorocyphidae, Coenagrionidae, Platycnemididae, and Protoneuridae (Table 1).

The Shannon Wiener Diversity Index at the Sabo Dam Complang location has a value of H'= 2.59. it indicated that the diversity of dragonflies at this location was moderate. If the Shannon-Wienner diversity index value is more than H'= 1.5 to 3.5, it is classified as moderate (Hartika, Diba, and Wahdina 2017). The moderate value of diversity indicates that the Sabo Dam Complang location has a suitable environmental condition for the natural habitat of various types of dragonflies. The value of Shannon Wiener Diversity at the Sabo Dam Complang location has the highest value than the Diversity of Dragonflies in the Lake Sicikeh–Cikeh Nature Tourism Park, Lae Hole Village, Parbuluan District, Dairi Regency, North Sumatra with a value of H'= 1.91 (Gultom, Manalu, and Tambunan 2021). However, the Shannon Wiener Diversity value at the Sabo Dam Complang is smaller than the diversity value of the Lempake Dam, Samarinda, with H'= 2.85 (Nisita, Hariani, and Trimurti 2020). Differences in dragonfly diversity at each location are influenced by various factors, including habitat type (McCauley 2006), vegetation conditions (Remsburg,

Olson, and Samways 2008), water quality (Aziz and Mohamed 2018; Buczyński et al. 2020), and availability of food (Herlambang, Hadi, and Tarwotjo 2016).

Habitat type is one of the main factors that affect the diversity and abundance of dragonflies and damselflies (Rahmawati and Budjiastuti 2022). Dragonflies are insects that most of their lives are aquatic, so the main habitat of dragonflies is in the aquatic ecosystem, such as reservoirs, lakes, rivers, swamps, and ponds (Choong et al. 2020). In all habitat types, aquatic ecosystems can be a natural habitat for dragonflies (Luke et al. 2017). However, most dragonfly species have different habitat characteristics (Wahyu Sigit Rahadi 2019). Aquatic habitat types with a lot of plant vegetation in water bodies (Renner, Périco, and Sahlén 2016) are likely to be natural habitats for many species of dragonflies (Clausnitzer 2003). There are many species (Ott 2010) of dragonflies that have specific natural habitats (Magoba and Samways 2010), which are determined by canopy cover, rapid water currents (Michael J. Samways, Sharratt, and Simaika 2011), or vegetation conditions (Paulson 2009).

Table 1. List of Species, Individuals, and Conservation Status

Suborder & Family	Species	Amount	Relative Abundance	Conservation Status
Anisoptera				
Libellulidae	*Brachydiplax chalybea*	5	2.59	LC
	Brachythemis contaminata	7	3.63	LC
	Crocothemis servilia	21	10.88	LC
	Neurothemis ramburii	3	1.55	LC
	Neurothemis terminata	6	3.11	LC
	Macrodiplax cora	5	2.59	LC
	Orthetrum sabina	34	17.62	LC
	Pantala flavescens	41	21.24	LC
	Rhyothemis phyllis	3	1.55	LC
	Trithemis aurora	3	1.55	LC
	Trithemis festiva	2	1.04	LC
Zygoptera				
Calopterygidae	*Vestalis luctuosa*	4	2.07	LC
Clorocyphidae	*Heliocypha fenestrata*	5	2.59	LC
Coenagrionidae	*Agriocnemis pygmaea*	5	2.59	LC
	Agriocnemis femina	17	8.81	LC
	Ischnura senegalensis	9	4.66	LC
	Pseudagrion pruinosum	9	4.66	LC
	Pseudagrion rubriceps	7	3.63	LC
Platycnemididae	*Copera marginipes*	4	2.07	LC
Protoneuridae	*Prodasineura aumtunalis*	3	1.55	NE
	Total	193		

Note: NE (Not Evaluated), LC (Least Concern) Source: (IUCN 2021).

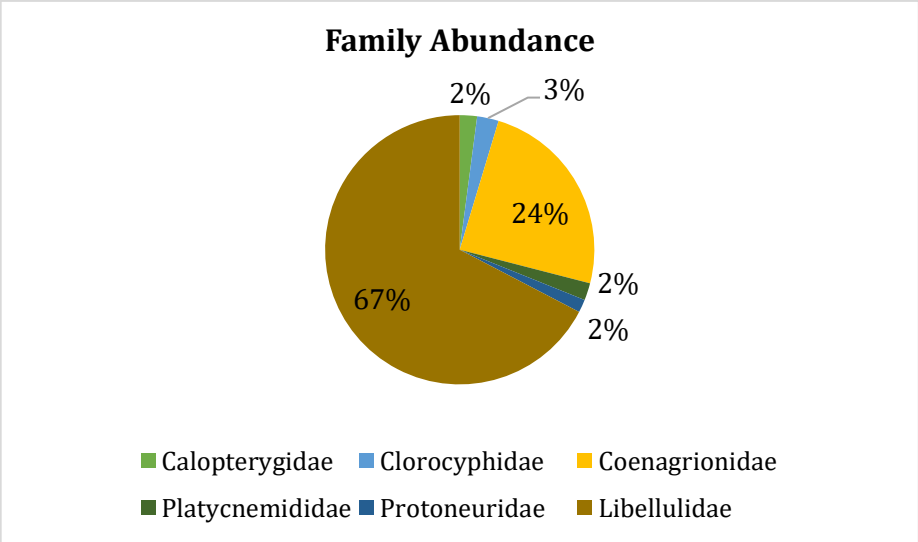

Figure 1. Family Abundance

Figure 2. Documentation of species A). *Pantala flavescens*, B). *Trithemis festiva*, C). *Agriocnemis femina*, D). *Prodasineura aumtunalis*.

Vegetation conditions at a location are also factors that affect the diversity and abundance of dragonflies and damselflies. Vegetation is the main factor providing a natural habitat for small insects that have the potential as the main food for dragonflies (Normasari 2012). For adult dragonflies, vegetation, such as understorey, is needed to lay eggs (Nugrahani et al. 2014). In the nymph phase, vegetation in water bodies is needed to protect themselves from predators. Furthermore, the vegetation on

the river banks is used for resting and sunbathing (Silva, De Marco, and Resende 2010). Trees are also required for several types of dragonflies to protect them from the high intensity of sunlight (Nugrahani et al. 2014).

Water quality is an important factor influencing dragonflies' life cycle (Harabiš and Dolnỳ 2010). Dragonflies spend most of their lives in aquatic habitats. The dragonfly nymph phase is completed in the water (McPeek 2008); therefore, any water changes will affect their survival (Aziz and Mohamed 2018). Most dragonfly species require good water quality to thrive and survive (Thongprem et al., 2021). Dragonflies are considered to be used as an indicator of the quality of freshwater ecosystem habitats (Martín and Maynou 2016). Adult dragonflies have sensitivity to conditions in aquatic locations, so they can react quickly to changes in the quality of freshwater ecosystems (Perez and Bautista 2020). However, many Odonata species have a high tolerance for pollution and can colonize in various extreme environments (Potapov et al. 2020).

The availability of food at a location is one factor that provides a natural habitat for insects in the ecosystem, especially in the larval phase of Odonata and the adult phase of the damselflies. Odonata is an insect that all members of its family are predators (Kandibane, Raguraman, and Ganapathy 2005). The larval phase of dragonflies inhabits the aquatic system for months or even years with relatively limited dispersal capabilities (Kietzka et al. 2021). The adult phase of Zygoptera dragonflies has low flight abilities. Therefore, the larval stage of Odonata and Zygopotera is very dependent on the availability of food. Adult dragonflies eat aphids, grasshoppers, flies, and mosquitoes (Rafi et al. 2009). For adult Anisoptera dragonflies, the availability of food at a location does not seem to be the main factor in the composition of their natural habitat because Anisoptera dragonflies have high flight and migration abilities so that they can move far to find food (Remsburg, Olson, and Samways 2008). Anisoptera dragonflies are often found in open areas such as forests, roadsides, and grass fields to catch insects for food (V. J. Kalkman and Orr 2013).

The highest family abundance value was the Libellulidae at 67% (Figure 1), with 130 individuals. Conversely, the lowest family abundance value was Protoneuridae at 2% (Figure 1), with a total of 3 individuals (Figure 3). In the Anisoptera suborder, the dragonflies with the highest and lowest abundance were *Pantala flavescens* and *Trithemis festiva* (Table 1). At the same time, the Zygoptera suborder's highest and lowest abundances were *Agriocnemis femina* and *Prodasineura aumtunalis* (Table 1).

The *Pantala flavescens* (Figure 2A) is a species of the Anisoptera family with the highest abundance at this location with a value of 21.24 and 41 individuals. The *Pantala flavescens* species is predominantly orange in color on the thorax, and there is a slight brown coloration on the abdomen. The male *Pantala flavescens* species has a reddish-brown color on the upper eye and light gray color on the underside (Irawan and Rahadi 2016). The female is dominated by pale yellow coloration on the thorax and abdomen (W. S. Rahadi et al. 2013).

At the Sabo Dam Complang, *Pantala flavescens* were flying by forming colonies in open areas. The location has an open water habitat, and there are few trees. This location is a natural habitat suitable for the *Pantala flavescens* species. This finding is in line with (W. S. Rahadi et al. 2013) and (Irawan and Rahadi 2016), who state that the *Pantala flavescens* species is often found in grasslands, fields, rice fields, and bushes since this species like open habitats.

The *Trithemis festiva* species (Figure 2B) is a species from the Anisoptera family with the lowest abundance at this location with a value of 1.04 and a total of 2 individuals. Species *Trithemis festiva* is dominated by dark blue-gray color all over its body. The thorax is dark blue with white

powder (W. S. Rahadi et al. 2013). In *the Trithemis festiva* species (Vincent J. Kalkman 2006), the female has a yellow-brown color on the thorax and a black line on each abdomen segment (Irawan and Rahadi 2016).

At the Sabo Dam Complang, *Trithemis festiva* species perched on dry wood branches in open areas. The location does not have many trees and is dominated by open areas with grass vegetation and rocks in the waters. This is also one of the reasons why the *Trithemis festiva* species was found in very low abundance. This finding is in line with (W. S. Rahadi et al. 2013) and (Irawan and Rahadi 2016), who reported that *Trithemis festiva* species are often found in rocky rivers and waters on the edge of forests or plantations.

Agriocnemis femina species (Figure 2C) is a species from the Zygoptera family with the highest abundance at this location with a value of 8.81 and a total of 17 individuals. *It has a yellowish-green color and black on the top (W. S. Rahadi et al. 2013). Agriocnemis femina* is dominated by green and black on the whole body. There is an orange color on the last two segments of the abdomen. The older species have white powder almost all over the thorax, and the orange color located on the abdomen disappears (Irawan and Rahadi 2016). In the *Agriocnemis femina* species (Nair and Subramanian 2014), the female has a green color with a thick black line on the thorax and abdomen (Phan and Dinh 2016).

At the Sabo Dam Complang, the *Agriocnemis femina* species was found perched on the grass in an open area and has fairly dense vegetation. The location is dominated by grass vegetation with open areas. This location is a suitable natural habitat for the *Agriocnemis femina* species so that this species can be found in very high abundance. This finding is in line with (Irawan and Rahadi 2016), who reported that the *Agriocnemis femina*'s habitat has grass vegetation on the edges of rice fields, swamps, or ponds.

The *Prodasineura aumtunalis* (Figure 2D) is a species from the Zygoptera family with the lowest abundance at this location. The value was 1.55, with a total of 3 individuals. The *Prodasineura aumtunalis* species is dominated by black in almost all of its body, with gray and brown reflections on the side of the synthora. The female *Prodasineura aumtunalis* is black and white on the thorax and black on the abdomen (W. S. Rahadi et al., 2013).

At the Sabo Dam Complang, the species *Prodasineura aumtunalis* perched on a small stream with a slow current in a slightly closed area. The location does not have many trees and is dominated by open areas with grass vegetation in the waters. It is also one of the causes for the *Prodasineura aumtunalis* in very low abundance. This finding is in line with (W. S. Rahadi et al. 2013), who reported that *Prodasineura aumtunalis* is often found in waters that have dense to slightly open vegetation in flowing waters.

CONCLUSIONS

Based on research, the diversity index value obtained was H' = 2.59. It indicates that the diversity of dragonflies at this location is classified as moderate. The number of dragonfly species is 20 species from six families, with 193 individuals. There are 11 species of Anisoptera suborder with 63 individuals from one family, namely Libellulidae. On the other hand, there are nine species of Zygoptera suborder with a total of 160 individuals from 5 families, namely Calopterygidae, Clorocyphidae, Coenagrionidae, Platycnemididae, and Protoneuridae.

The researchers suggest that the results of this research can be developed so that it can compare the diversity of dragonflies in the dry and rainy seasons.

ACKNOWLEDGMENT

The author would like to thank Muhammad Muhibbuddin Abdillah, who

assisted in the data collection process in the field and the species identification process.

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