

Short Communication:

Community structure and diversity of Odonata in Suranadi Natural Park, West Lombok Indonesia

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Abstract. Ilhamdi ML, Al Idrus A, Santoso D, Hadiprayitno G. 2020. Short Communication: Community structure and diversity of Odonata in Suranadi Natural Park, West Lombok Indonesia. *Biodiversitas* 21: 718-723. Odonata is an order of insects. The life cycle of this order is dependent on freshwater habitat. Sensitivity to environmental changes causes odonates to be important bioindicators of ecosystem change. The importance of the ecological role of odonates is not followed by adequate scientific information on Odonata communities, especially in the Suranadi Natural Park (SNP). The study aimed to monitor the existence and community structure of Odonata in the SNP area every six months in period. The data collection technique was using a survey method by following the transect line, namely the waterway transect line (WTL), plantation border transect (PT) and settlement border transect (ST). Data collection was done 4 times from April to May 2019, once every 2 weeks. The sampling was done twice in the morning from 08.00 to 11.00 AM and in the afternoon from 03.00 to 05.00 PM. Data were analyzed using the relative frequency equation and Diversity Index. The results showed that there were 16 species of odonates consisting of the family Libellulidae (11 species), Platynemididae (1 species), Chlorocyphidae (1 species), and Coegrinidae (3 species). *Orthetrum sabina*, *Neurothemis ramburii*, *Diplacodes trivialis*, *Gynacantha subinterrupta*, *Copera marginipes*, and *Pantala flavescens*, are species that are present in all of each observation sites. The waterway transect has the highest diversity index (2.027), followed by settlement transect (1.367), and the lowest is plantation transect (1.131).

Keywords: Community structure, diversity index, Odonata, Suranadi Natural Park

INTRODUCTION

Odonata is a group of insects that has a significant role in freshwater ecosystems. Odonata can potentially become a bioindicator in the freshwater environment to detect damage, change, and pollution that occurs in freshwater ecosystems or terrestrial forests (Jimenez et al. 2016; Abdul et al. 2017). Odonata is a good indicator for a variety of environments that differ from habitat quality to affect forest balance (Samways and Steytler 1996; Sahlén and Ekestubbe 2001; Clausnitzer 2003; Oertli 2008; Simaika and Samways 2009; Monteiro et al. 2013; Koch et al. 2013). The role of odonates as aquatic bioindicators is related to the character of their habitat, especially in larvae whose entire lives are in the waters. The larvae are very dependent on water, this is seen in the egg-laying phase where females lay their eggs in water or aquatic plants, which then metamorph into larvae which and develop in water bodies (Oppel 2005). The function as bioindicator is related to the varying ability of the distribution of Odonata. Corbet (1999) explains that through different dispersal abilities, many Anisoptera and Zygoptera species are reported to be indicators of environmental change. Ecologically, Odonata has a role as predators that generally prey on fish larvae and aquatic micro invertebrates. The second role, Odonata life phase, both adult and larval phases, make important contributions in maintaining the

balance of food webs in freshwater ecosystems (Sathe and Sinde 2008; Rathod et al. 2012).

Suranadi Natural Park (SNP) or *Taman Wisata Alam Suranadi* (TWA Suranadi) is a forest conservation area located in West Lombok District, West Nusa Tenggara, Indonesia. The SNP area has excellent forest vegetation conditions and is bordered by plantations and community settlements. SNP conservation management requires the integration of management between the protection of forest ecosystems and the exploitation of natural tourism potential without damaging and disturbing the balance of ecological processes in the forest. The exploitation of forest and water tourism activities in SNP can increase the economic potential of surrounding communities and increase independence in the SNP conservation management process, but also increase the potential for habitat destruction, especially aquatic microhabitats, and the Odonata community. Meanwhile, the low variety of freshwater ecosystem habitats in SNP, which only consists of a few springs and waterways, further increases the potential damage to the main Odonata habitat. Damage to the habitat of the Odonata community can significantly reduce species diversity, eliminate species that have a low range of habitat distribution and increase the appearance of Odonata species that have a wide range of habitats (Machado 2001; Monteiro et al. 2013). On the other hand, the lack of scientific information related to the existence and structure of the Odonata community on SNP can

increase the vulnerability of the Odonata community. Previous study by Ilhamdi (2018) conducted a study in 2017 with a limited research focus on the pattern of distribution of information in SNP. Scarce information related to the Odonata community structure on the SNP requires the need for further research, especially about the community structure. Therefore, research is needed on the existence and structure of the odonates community at SNP to determine the level of presence and condition of the structure of the odonates community at SNP.

MATERIALS AND METHODS

Study area

The research was carried out in the Suranadi Natural Park (SNP), Narmada Sub-district, West Lombok District, West Nusa Tenggara Province, Indonesia (Figure 1). SNP is at X 116.233728 and Y -8.565858. SNP topographic conditions are generally flat. According to the Schmidt-Ferguson classification, SNP has a type D climate with an average rainfall of between 1500 to 2000 mm per year. The temperature ranged from 22.2°C to 36.9°C. Overall, SNP has mixed vegetations which are characterized by the

growth of trees mixed with shrubs that both formed closed-canopy layer (Wahyuni and Mildranaya 2010).

Research method

The study was conducted from April to May 2019 on SNP. Data collection were done on three line transect by capturing the adult odonates around the line transect that has been determined based on the field survey. The first is the waterway transect line (WTL) which represents the freshwater ecosystem with total length about 229 m, the second is plantation border transect (PT) with total length about 998 m and the last is settlement border transect (ST) which has total length about 525 m.

The sampling was done on 8:00 to 11:00 am and 3:00 to 5:00 pm. The time was arranged during daylight because odonates are diurnal, given the limitations of Odonate thermoregulation at night (De Marco and Resende 2002). All samples then photographed for further off-field identification. Binoculars are also used to observe odonates species that were difficult to reach. The captured specimens then fixed with formalin then kept into papilot with the wings stretched out. The identification process is based on morphology using Orr (2003).

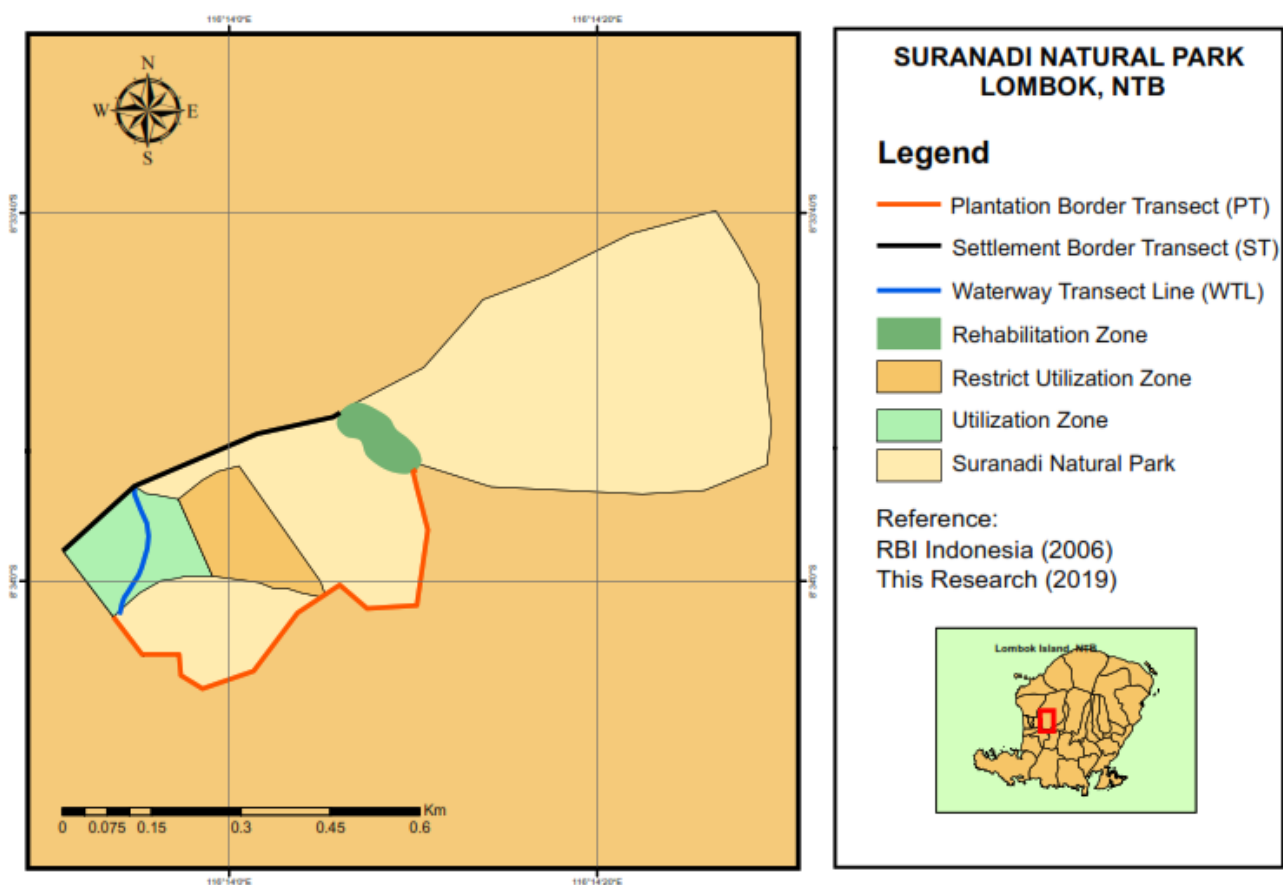


Figure 1. Map of Suranadi Natural Park (SNP), Narmada Sub-district, West Lombok District, West Nusa Tenggara Province, Indonesia

Data analysis

Data analysis was carried out through the application of several equations to find out the existence and structure of Odonata communities in SNP. Species frequencies are calculated through checklist presence and absence analysis while relative frequency values are analyzed through the following equation (Suin 2003):

$$Fr = \frac{f_i}{F} \times 100\%$$

Where:

Fr : Relative frequency

f_i : Total occurrence at the observation site

F : The number at the observation location

Meanwhile, the analysis of the odonates community structure was analyzed with Shannon-Wiener Diversity index using the following equation (Begon et al. 2006):

$$H' = - \sum_{i=1}^R p_i \ln p_i$$

Where:

H' : Biodiversity Index

p_i : Proportional abundance

RESULTS AND DISCUSSION

The odonates community structure on SNP

The frequency of the odonates occurrence on SNP reveals the different patterns of occurrence on each species, location of data collection, and habitat character (Table 1).

There are six species of Odonata that have a 100% presence rate, such as *Othetrum sabina*, *Neurothemis ramburii*, *Diplacodes trivialis*, *Gynacantha subinterrupta*, *Copera marginipes*, and *Pantala flavescens*. Meanwhile if grouped according to the present range of above 50%, there are 5 species namely *Orthetrum chrysis*, *Pseudagrion pilidorsum*, *Lathrecista asiatica*, *Neurothemis fluctuans*, *Trithemis festiva*, and. Furthermore, there are 50 species which have the presence of species below 50%, such as *Pseudagrion pruinsum*, *Agriocnemis femina*, *Libellago lineata*, *Zyxomma obtusum*, and *Zyxomma petiolatum*

Based on the sampling location, it is known that the water transect is the location where all of Odonata species are found. On the other hand, on the left and right transects, Odonata species were obtained for eight and nine species, respectively.

Composition of odonates

The result showed that there are 16 species of Odonata from four families and two orders occurred in SNP (Figure 2). Order Anisoptera which consists of some families such as Libellulidae (11 species) and the order Zygoptera consists of four families i.e., Platynemididae (1 species), Chlorocyphidae (1 species), Aeshnidae (1 species) and Coenagrionidae (3 species).

Biodiversity index

The community of odonates in SNP has different Shanon-Wiener diversity index values (Table 2. Waterway Transect has the highest Biodiversity Index (2.027), followed by Settlement Transect (1.367), and the lowest is Plantation Transect (1.131).

Table 1. Frequency of odonates community in Suranadi Natural Park, West Lombok District, Indonesia

Subordo	Familia	Species	Occurrence			Frequency (%)
			ST	PT	WTL	
Anisoptera	Libellulidae	<i>Diplacodes trivialis</i>	+	+	+	100
		<i>Lathrecista asiatica</i>	+	0	+	66
		<i>Neurothemis fluctuans</i>	+	0	+	66
		<i>Neurothemis ramburii</i>	+	+	+	100
		<i>Orthetrum chrysis</i>	0	+	+	66
		<i>Orthetrum sabina</i>	+	+	+	100
		<i>Pantala flavescens</i>	+	+	+	100
		<i>Trithemis festiva</i>	+	0	+	66
		<i>Zyxomma obtusum</i>	0	0	+	33
		<i>Zyxomma petiolatum</i>	0	0	+	33
		<i>Gynacantha subinterrupta</i>	+	+	+	100
	Aeshnidae					
Zygoptera	Coenagrionidae	<i>Agriocnemis femina</i>	0	0	+	33
		<i>Pseudagrion pilidorsum</i>	0	+	+	66
		<i>Pseudagrion pruinsum</i>	0	0	+	33
	Chlorocyphidae	<i>Libellago lineata</i>	0	0	+	33
	Platynemididae	<i>Copera marginipes</i>	+	+	+	100

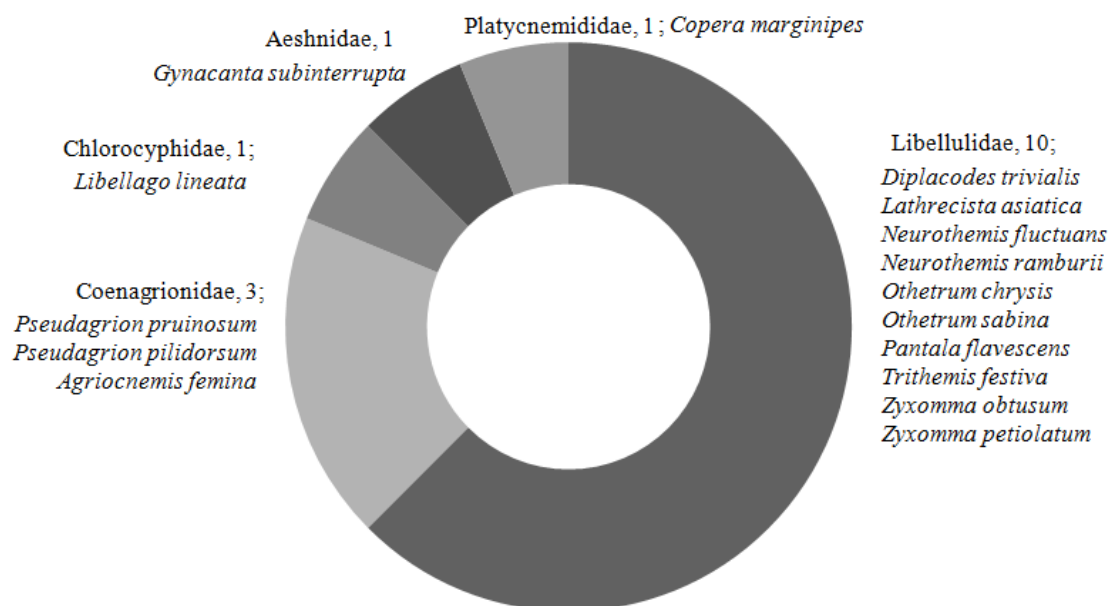


Figure 2. Composition of odonates in Suranadi Natural Park, West Lombok District, Indonesia

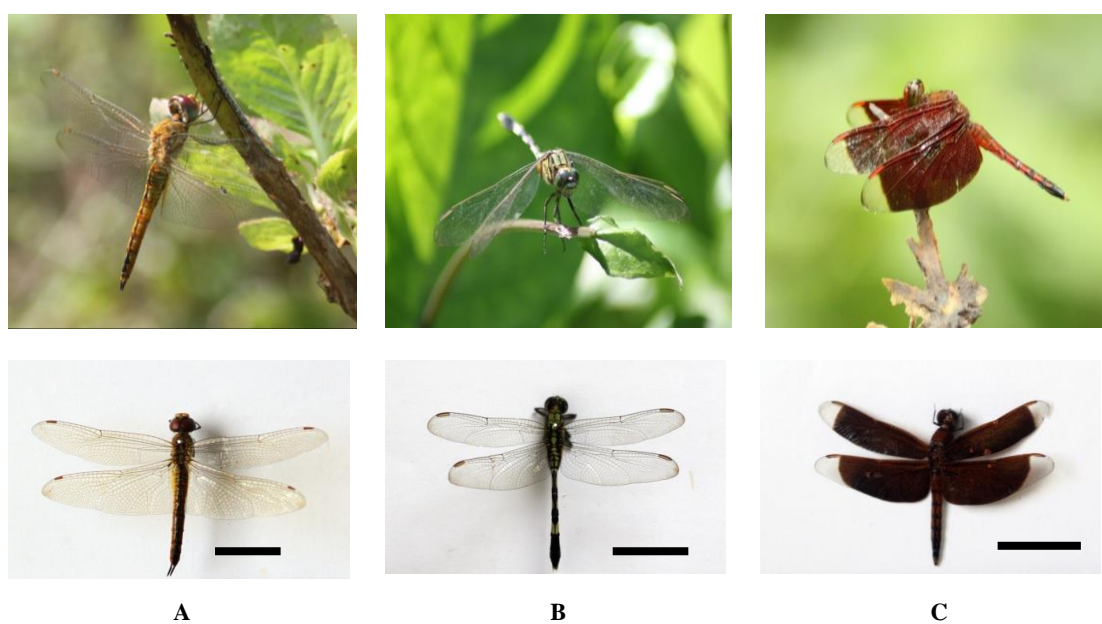


Figure 3. Some common Odonata species in Suranadi Natural Park, West Lombok District, Indonesia. A. *Pantala flavescens*, B. *Orthetrum sabina*, C. *Neurothemis ramburii*. Bar = 2 cm

Table 2. Biodiversity index of Odonates in Suranadi Natural Park, West Lombok District, Indonesia

Index	ST	PT	WTL	Suranadi Natural Park
Shannon Wiener Diversity	1.367	1.131	2.027	2.178
Species number	9	8	16	16
Abundance species	268	295	737	1300

Discussion

Research on Odonata has been carried out by Ilhamdi (2018) but further research is required, especially to reveal the composition and distribution of Odonata all around SNP, as the information is not widely available. Comparison of Odonata species composition in 2017 and 2019 shows different results, in 2019 found 16 species were obtained while in 2017 19 species were obtained (Ilhamdi 2018). Based on this study, *Pantala flavescens*, *Othetrum sabina* and *N. ramburi* occurred in all of the studied habitat types (Figure 3). Similar results were obtained by Mapi-ot et al. (2013), Neog and Rajkhowa (2016), Siregar and Bakti (2016), and Saha (2017) who reported that *O. sabina* and *N. ramburi* are the most abundant species. IUCN (n.d) and Tuhin and Khan (2018) report that *O. sabina* has a wide range of habitats from ponds, lakes, rice fields, ditches, and swamps, and even these species very tolerant of the high salinity and disturbed habitat.

Odonate is an insect with a semi-aquatic character that highly depends on water bodies and shows very high diversity (Hornung and Rice 2003; Oppel 2005; Silva et al. 2010). Odonates require water for the egg-laying phase, where females laid their eggs in water or submerged plants and in the larval phase grow in water bodies (Oppel 2005). Based on the number of species found, in the Anisoptera order, only species from the family Libellulidae were found, whereas in the suborder Zygoptera species from the Coenagrionidae family were more common than other families. Similar to the results of other Odonata community researches, the Odonata community was dominated by species from the family Libellulidae from the suborder Anisoptera and species from the family Coenagrionidae from the suborder Zygoptera (Mapi-ot et al. 2013; Dayakrishna and Arya 2015; Siregar and Bakti 2016; Seidu et al. 2017; Ilhamdi 2018).

The Libellulidae and Coenagrionidae are the two largest families of Odonata in the world and dominate fauna in freshwater ecosystems on each continent (Mapi-ot et al. 2013). Species of the family Libellulidae have a wide distribution range therefore this family has a diversity of species (Kaize and Kalkman 2009; Bechly and Sach 2002). Folsom and Collins (1984) reported that species of Libellulidae and Coenagrionidae are usually aggressive and consume almost all insects. Libellulidae are often cannibal and consume all species of aquatic organisms, pests on plantations and agriculture and all insects that are suitable for their sizes such as Anopheles mosquito larvae, small Sogatella, and other insects.

The Shannon Wiener Index value of the community odonates in SNP is 2.127. This index value is lower than in some other areas in Indonesia such as in Water Sources in Magetan which has a value of 2.28 (Pamungkas and Ridwan 2015), Kali Village with a range of values of 2.39 to 2.56 (Lino et al. 2019) and in Situ Pamulang with a value of 2.41 (Fitriana 2016). On the other hand, the Diversity Index value in SNP is better than some other areas such as in Taman Mini Indonesia Indah and Ragunan Wildlife Park with values 1.397 and 1.112, respectively

(Syarifah et al. 2018)

The biodiversity index value in the WTL is higher than two other studied ecosystems. It shows that WTL has a better value of species diversity, presence, and abundance species compared to others. Habitat characteristics in a waterway location dominated by freshwater aquatic habitats are suitable habitats for Odonata. Corbet (1999) explained that Odonata is inhabitants of various aquatic ecosystems such as rivers, lakes, and share the kinds of freshwater ecosystems that form in forests. Habitat conditions can be caused by presence and abundance of Odonata species. Settlement border and plantation border transect have a similar condition because this transect has dense vegetation, has no water source, and there are human traffic activities. Unlike the two transects, the presence of water sources in the waterway transect plays as the distinguishing factor (Table 2). These conditions appear in the presence and number of individuals of each species in the water transect. Much different from the transect boundaries of settlements and plantations, which tend to have the same habitat and community similarity Opel (2005) explains that Odonata species need aquatic ecosystems for maintaining their life cycle. The presence of clear waters is one of the conditions for Odonata habitat selection. Therefore, water transect is the best choice for the Odonata community.

The aquatic habitats in the Waterway line of the SNP are in good condition and play very important role in the odonates. Simaika and Samways (2009) explained- that the gathering of the community of odonates in an aquatic habitat could be the reason the waters were prioritized for conservation. There are few changes in SNP from the previous research, especially in the aquatic environment which now has turned into water reservoir and other tourism facilities. Grant and Samways (2011) and Hart et al. (2014) argued that the existence of Odonata information in wetland waters is very important as a baseline data because they are often successfully used as indicator for environmental health and conservation management. Furthermore, biodiversity information can be an important point in effective management and budgeting in conservation efforts. The water habitat in the SNP should be a local "hotspot" area in this area because besides being an important habitat the community of odonates is also an important habitat for other fauna communities such as herpetofauna and butterflies (Syazali et al. 2017; Ilhamdi et al. 2018). SNP managers must always pay attention to the quality of aquatic habitats to conserve the diversity of Odonata communities and other fauna. At this time, SNP is one of the most preferred destinations which is can significantly become the potential for habitat destruction and reduce the quality of waters in the SNP.

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REFERENCES

- Abdul NH, Rawi CSMD, Ahmad AH, Al-Shami S. 2017. Effect of environmental disturbances on Odonata assemblages along a tropical polluted river. *Ekológia (Bratislava)* 36: 388-402.
- Bechly G, Sach VJ. 2002. An interesting new fossil dragonfly (Anisoptera: Libellulidae. "Brachydiplacini") from the Miocene of Germany, with discussion on the phylogeny of Tretanemistinae and a fossil list for the locality. *Heggbach* 325: 1-11.
- Begon M, Townsend CR, Harper JL. 2006. *Ecology From Individuals to Ecosystems* 4th Edition. Blackwell Publishing, USA.
- Clausnitzer V. 2003. Dragonfly communities in coastal habitats of Kenya: indication of biotope quality and the need of conservation measures. *Biodivers Conserv* 12: 333-356.
- Corbet PS. 1999. *Dragonfly: Behaviour and Ecology of Odonata*. Cornell University Press, New York.
- Dayakrishna, Arya MK. 2015. Study on the abundance and diversity of dragonflies and damselflies (Insecta: Odonata) of Corbett Tiger Reserve, Uttarakhand, India. *J Entomol Zool Stud* 3: 467-472.
- De Marco JP, Resende DC. 2002. Activity patterns and thermoregulation in a tropical dragonfly assemblage. *Odonatologica* 31: 129-138.
- Fitriana N. 2016. Diversitas capung (Odonata) di Situ Pamulang Kota Tangerang Selatan, Banten. *Jurnal Pro-Life* 3 (3): 228-240. [Indonesian]
- Folsom TC, Collins C. 1984. The diet and foraging behaviour of the larval dragonfly *Anaxjunius* (Aeshenidae) with assessment of the role of refuges and prey activity. *Oikos* 42: 105-113.
- Grant PBC, Samways MJ. 2011. Micro-hotspot determination and buffer zone value for Odonata in a globally significant biosphere reserve. *Biol Conserv* 144: 772-781.
- Hart LA, Bowker MB, Tarboton W, Downs CT. 2014. Species composition, distribution and habitat types of Odonata in the Isimangaliso Wetland Park, KwaZulu-Natal, South Africa and the associated conservation implications. *PLoS ONE* 9 (3): e92588. DOI: 10.1371/journal.pone.0092588.
- Hornung JP, Rice CL. 2003. Odonata and wetland quality in southern Alberta, Canada: A preliminary study. *Odonatologica* 32: 119-129.
- Ilhamdi ML, Idrus AA, Santoso D. 2018. Diversity of species and conservation priority of butterfly at Suranadi Natural Reservation, West Lombok. *Biosaintifika* 10: 48-55. [Indonesian]
- Ilhamdi ML. 2018. Pola penyebaran capung (Odonata) di Kawasan Taman Wisata Alam Suranadi Lombok Barat. *Jurnal Biologi Tropis* 18(1): 27-33. [Indonesian]
- IUCN. n.d. *Orthetrum sabina* (Slender Skimmer). <https://www.iucnredlist.org/species/165470/17533255>.
- Jimenez VG, Dunn A, Hassall C. 2016. Dragonflies and damselflies (Odonata) in urban ecosystems: A review. *Eur J Entomol* 11: 217-232.
- Kaize J, Kalkman VJ. 2009. Records of dragonflies from Kabupaten Merauke, Papua, Indonesia collected in 2007 and 2008 (Odonata). *Suara Serangga Papua* 4: 40-45. [Indonesian]
- Koch K, Wagner C, Sahlén G. 2014. Farmland versus forest: comparing changes in Odonata species composition in western and eastern Sweden. *Insect Conserv Diver* 7: 22-31.
- Lino J, Koneri R, Butarbutar RR. 2019. Keanekaragaman capung (Odonata) di tepi Sungai Kali, Desa Kali, Kabupaten Minahasa Sulawesi Utara. *Jurnal MIPA UNSRAT* 8 (2) 59-62. [Indonesian]
- Machado ABM. 2001. Studies on neotropical Protoneuridae (Odonata, Zygoptera). *Revista Brasileira Zool* 21: 333-336.
- Mapi-ot EF, Taotao AU, Nuñez OM, Villanueva RJT. 2013. Species diversity of adult Odonata in selected areas from Misamis Occidental Province, Philippines. *AACL Bioflux* 6: 1-12.
- Monteiro JCS, Couceiro SRM, Hamada N, Juen L. 2013. Effect of vegetation removal for road building on richness and composition of Odonata communities in Amazonia, Brazil. *Intl J Odonatol* 16: 135-144.
- Neog N, Rajkhowa SM. 2016. Dragonfly diversity in two different ecosystems in and around Assam University, Silchar (Ecoforest and Irongmara). *J Entomol Zool Stud* 4: 184-190.
- Oertli S. 2008. The use of dragonflies in the assessing and monitoring of aquatic habitats. In: Córdoba-Aguilar A (eds) *Dragonflies and Damselflies: Model Organisms for Ecological and Evolutionary Research*. Oxford University Press, Oxford.
- Oppel S. 2005. Habitat associations of an Odonata community in a lower montane rainforest in Papua New Guinea. *Intl J Odonatol* 8: 243-257.
- Orr AG. 2003. A guide to the dragonflies of Borneo - Their identification and biology. Natural History Publication, Sabah, Malaysia.
- Pamungkas DW, Ridwan M. 2015. Keragaman jenis capung dan capung jarum (Odonata) di beberapa sumber air di Magetan, Jawa Timur. *Pros Sem Nas Masy Biodiv Indon* 1 (6): 1295-1301. [Indonesian]
- Rathod PP, Manwar NA, Pawar SS, Raja, A. 2012. Diversity and abundance of dragonflies and damselflies (order - Odonata) in agroecosystems around the Amravati city (M.S.), India in monsoon season. *Intl J Agric Innov Res* 3 (1): 174-182.
- Saha SK. 2017. Odonate (Insecta: Odonata) diversity of West Bengal State University Campus; A checklist and pictorial catalogue. *Intl J Zool Stud* 2: 132-138.
- Sahlén G, Ekestubbe K. 2001. Identification of dragonflies (Odonata) as indicators of general species richness in boreal forest lakes. *Biodiv Conserv* 10: 673-690.
- Samways MJ, Steytler NS. 1996. Dragonfly (Odonata) distribution patterns in urban and forest landscapes, and recommendations for riparian management. *Biol Conserv* 78: 279-288.
- Sathe TV, Shinde KP. 2008. *Dragonflies and Pest Management*. Daya Publications House, New Delhi.
- Seidu I, Danquah E, Nsor CA, Kwarteng AD, Lancaster LT. 2017. Odonata community structure and patterns of land use in the Atewa Range Forest Reserve, Eastern Region (Ghana) *Intl J Odonatol* 20: 173-189.
- Silva DD, De Marco P, Resende DC. 2010. Adult odonate abundance and community assemblage measures as indicators of stream ecological integrity: A case study. *Ecol Indic* 10: 744-752.
- Simaika JP, Samways MJ. 2009. Reserve selection using red-listed taxa in three global biodiversity hotspots: dragonflies in South Africa. *Biol Conserv* 142: 638-661.
- Siregar AZ, Bakti D. 2016. Diversity and distribution of Odonata in University Sumatera Utara, Medan, Indonesian. *Intl J Sci Technol Res* 5: 229-2434.
- Suin NM. 2003. *Ekologi Hewan Tanah*. PT. Bumi Aksara. Jakarta. [Indonesian]
- Syarifah EB, Fitriana N, Wijayanti F. 2018. Keanekaragaman capung (Odonata) di Taman Mini Indonesia Indah dan Taman Margasatwa Ragunan, DKI Jakarta, Indonesia. *Bioprospek* 13 (1): 50-58. [Indonesian]
- Syazali M, Idrus AA, Hadiprayitno G. 2017. Densitas amfibi di Pulau Lombok, Nusa Tenggara Barat. *Jurnal Biologi Tropis* 17: 53-58. [Indonesian]
- Tuhin SH, Khan K. 2018. Species richness, habitat association and Odonata diversity of the south-western region of Bangladesh. *bioRxiv*. DOI: 10.1101/252890.
- Wahyuni TE, Mildranaya E. 2010. Panduan Wisata Alam di Kawasan Konservasi Nusa Tenggara Barat. BKSDA NTB, Mataram. [Indonesian]