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DIVERSITY OF DRAGONFLIES (ODONATA) IN THE INSECT MUSEUM AND LAKE ARCHIPELAGO AREA AT TAMAN MINI INDONESIA INDAH

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Abstract

Dragonflies are insects that are highly reliant on freshwater habitats. Nevertheless, a multitude of problems pose a threat to the dragonfly population in urban freshwater ecosystems. This study aims to determine the diversity of odonata orders found in Taman Mini Indonesia Indah and the effect of environmental parameters on diversity for dragonfly ecosystem balance. This research was conducted in Taman Mini Indonesia Indah, Jakarta, Indonesia. Using purposive sampling to determine sampling stations based on the habitat inhabited by dragonflies. The observation location was divided into two large stations with each large station consisting of three sub stations. Data collection was carried out using direct capture or hunting techniques. Data was collected from March to May 2024. The results showed that there were 11 species from 3 families with a total of 137 individuals. The results of the Shannon-Wiener diversity index analysis showed that the highest dragonfly diversity value was found at station 1 with a value of H' = 1.68, and the location with the lowest value was station 2 with a value of H' = 0.82. At two different station locations and having different ecosystems, the dragonfly community structure formed is also different. The vegetation composition at each station is also one of the factors causing differences in dragonfly community structure.

Keywords

Dragonflies, environmental parameters, Insects, Indonesia.

1. Introduction

Insects are the group of organisms with the largest number of species within the Phylum Arthropoda. To date, approximately 950,000 species of insects have been identified worldwide. The high diversity of insects allows them to adapt to various habitat conditions, ranging from primary forests to human-made environments such as agricultural lands and plantations (Yumaida *et al*., 2022). Each insect species plays a key role in its ecosystem. One insect that holds a significant role in the ecosystem is the dragonfly. Dragonflies typically live in environments close to water sources and feed on smaller animals. Dragonflies are easily found in areas with water bodies such as rivers, ponds, and swamps. Adult dragonflies usually live and breed in open environments near water. Most dragonflies prefer to live among grasses, shrubs, and other plants that grow around water bodies. Dragonflies require an ideal living environment. Factors that support dragonflies' survival in their habitat include temperature, pH, and humidity. The development of dragonfly populations is closely tied to aquatic environments throughout their life cycle, as dragonfly nymphs always reside in water (Rahmawati & Budjiastuti, 2022). Dragonflies serve as bioindicators of water quality, wetlands, and the health of aquatic ecosystems. As predators, dragonflies are capable of preying on other small insects, including mosquitoes. Research on dragonflies is very important because data on dragonflies in Indonesia is still limited, particularly in terms of species diversity. Therefore, comprehensive data collection from various aspects is needed. This is supported by the fact that dragonflies are easily observed insects with limited distribution (Herlambang *et al*., 2016). A decline in dragonfly populations is often an early indicator of water pollution, which is then followed by an increase in water turbidity and green algae growth. Therefore, preserving dragonfly habitats is crucial, with a focus on maintaining the cleanliness of their living environments (Susanti, 1998). The Insect Museum and Butterfly Park are located within Taman Mini Indonesia Indah (TMII), which spans two districts, Kramat Jati and Pasar Rebo, in East Jakarta, covering an area of 120 hectares (Triwibowo, 2021). The TMII Insect Museum is situated in the Keong Emas Flower Garden area, East Jakarta. This museum is surrounded by various types of flora and fauna, creating a diverse and fascinating ecosystem. Syarifah *et al*. (2018) reported that there are five species of dragonflies found in Taman Mini Indonesia Indah. Recent studies on dragonfly diversity in TMII have not been conducted, highlighting the need for this research to understand the diversity of dragonfly species and to identify suitable habitat criteria for their breeding. Considering that dragonflies play a significant role in maintaining ecosystem balance, data on the number of dragonflies in Taman Mini Indonesia Indah, especially around the insect museum area, is essential.

2. Materials and Methods

2.1 Time and Location Study

Data collection was carried out from the end of March 2024 until May 2024. Data collection then was carried once a week for a total of six weeks. Observation time around 08.00 am until 15.00 pm. Rest time around 12.00 pm to 13.00 pm. This research was conducted in Taman Mini Indonesia Indah, Jakarta, Indonesia. The area that is specifically being observed was an area around Insect Museum, Freshwater Aquarium, and Archipelago lake. This was based on a purposive technique to determine sampling stations based on

the habitat inhabited by dragonflies. The observation location was divided into two large stations with each large station consisting of three sub stations. The first large station is in the Insect and Freshwater World Museum area. The second major station is in the Archipelago Lake area. The observation location can be seen more on the map (figure 1.)

Figure 1. Observation location map

The area with a red pin is a sign for Station 1 consisting of three substations depicted by the number. The area with a blue pin is a sign for Station 2 consisting of three substations depicted by the number.

2.2 Data Collection

Data collection was carried out using direct capture or hunting techniques. The dragonflies are captured by using sweeping nets. The dragonflies found were identified, documented, and matched with identification guidebooks and literature according to their morphological form. During the observations, several dragonflies were taken to be used as specimens or preserves. Dragonfly collection is done by placing the captured dragonflies in a specimen box. Data collection on abiotic factors includes air temperature, air humidity and light intensity. These abiotic factors were measured at the same time as the dragonfly data collection. Measurements are carried out using a thermometer, luxmeter application, and hygrometer. Data were collected in stages at different times and then analyzed for their influence on the number and species of dragonflies encountered.

2.3 Materials

The tools used in this research are insect nets, insect needles, labels, specimen boxes, hygrometers, lux meter applications, thermometers, magnifying glasses, timepieces, digital cameras or smartphones. The materials used in the research were papilot paper and mothball.

2.4 Statistical Analysis

The data obtained is presented in the form of descriptive data. Dragonfly data that has been obtained from observations is identified to determine the taxonomy of the dragonfly specimens found. After the identification process is carried out, the dragonfly specimens are grouped to determine the number of each species found. The dragonfly species data that was obtained was then analyzed for relative abundance values, diversity

index using Shannon-Wiener (Odum, 1993), evenness index (Magurran, 2004) and Simpson dominance index (Odum, 1993). With the following formula:

$$H' = -\sum_{i=1}^{n} pi \ln pi$$

Information:

H': Shannon-Wiener diversity Index ni: Number of individuals of type

iN: Number of individuals of all types

$$E = \frac{H'}{H_{maks}}$$

Information:

E: Evenness index

H': Shannon-Wiener diversity index

Hmax: InS (number of species)

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

Information:

D: Dominance index

Ni: Number of individuals of type i N: Number of individuals of all types

Information:

RA: Relative abundance

ni: Number of individuals of type i

N: Number of individuals of all types

3. Results

Based on the observations made, eleven species of dragonflies were found which were divided into three families and two suborders, namely Anisoptera and Zygoptera. The Anisoptera suborder is a suborder that is found more frequently than the Zygoptera suborder. In the Anisoptera suborder there are two families consisting of Libellulidae and Macromiidae. The family with the most species found is the Libellulidae family. Dragonfly species found in the Libellulidae family consist of Orthetrum sabina, Pantala flavescens, Brachythemis contaminata, Rhyothemis phyllis, Orthetrum testaceum, Zyxomma obtusum, Brachydiplax chalybea, Tramea transmarina, and Camacinia gigantea. The Macromiidae family consists of Epophthalmia vittigera. In the suborder Zygoptera there is one family, namely Coenagrionidae, with the dragonfly species found being Pseudagrion rubriceps. More complete data can be seen in the picture and table.

$$RA = \frac{ni}{N} \text{ x } 100\%$$

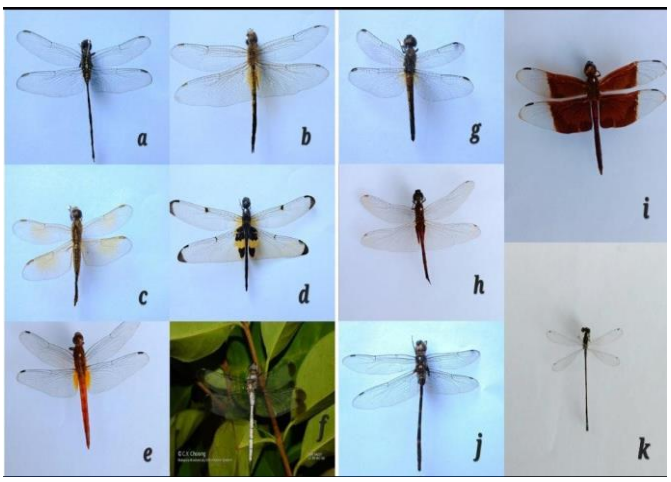
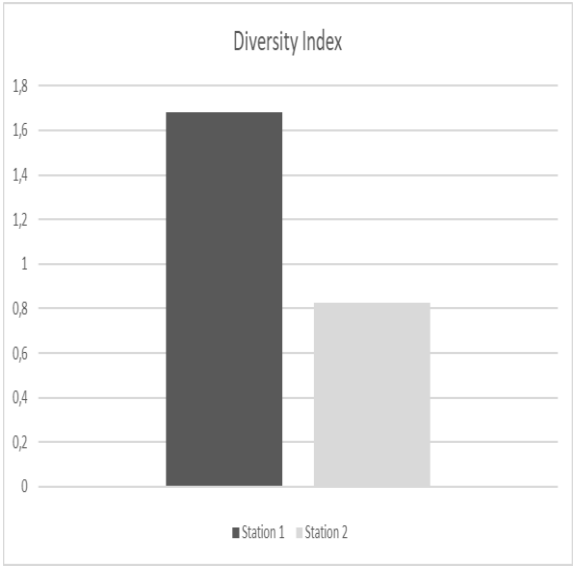
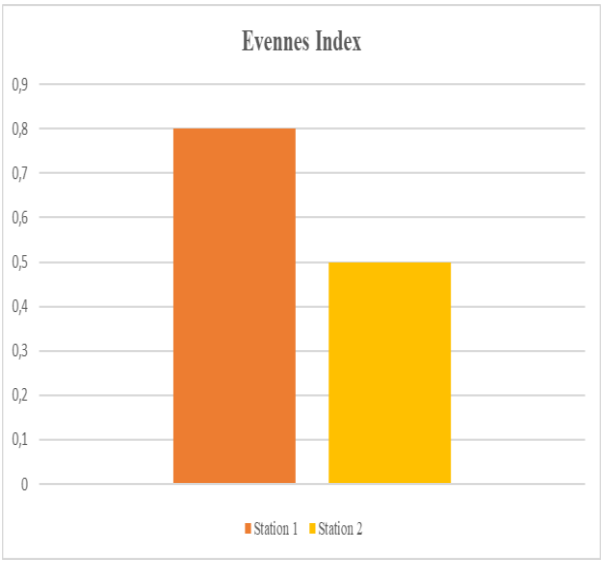


Figure 2. Documentation of suborder Anisoptera and Zygoptera (A) Orthetrum sabina, (B) Pantala flavescens, (C) Brachythemis contaminata (D) Rhyothemis phyllis, (E) Orthetrum testaceum, (F) Zyxomma obtusum, (G) Brachydiplax chalybea, (H) Tramea transmarina , (I) Camacinia gigantea, (J) Epophthalmia vittigera, (K) Pseudagrion rubriceps

Table 1. The observation result of Species Relative Abundance on both of the stations.

Taxa	Station 1	Station 2	Total	Relative Abundance (%)
Libellulidae *Orthetrum sabina*	24	4	28	0.20437
Pantala flavescens	3	64	67	0.48905
Brachythemis contaminata	7	-	7	0,05109
Rhyothemis phyllis	1	-	1	0,00730
Orthetrum testaceum	10	10	20	0,14599
Zyxomma obtusum	-	1	1	0,00730
Brachydiplax chalybea	-	1	1	0,00730
Tramea transmarina	2	-	2	0,01460
Camacinia gigantea	1	-	1	0,00730
Macromiidae *Epophthalmia vittigera*	2	3	5	0,03650
Coenagrionidae *Pseudagrion rubriceps*	4	-	4	0,02920





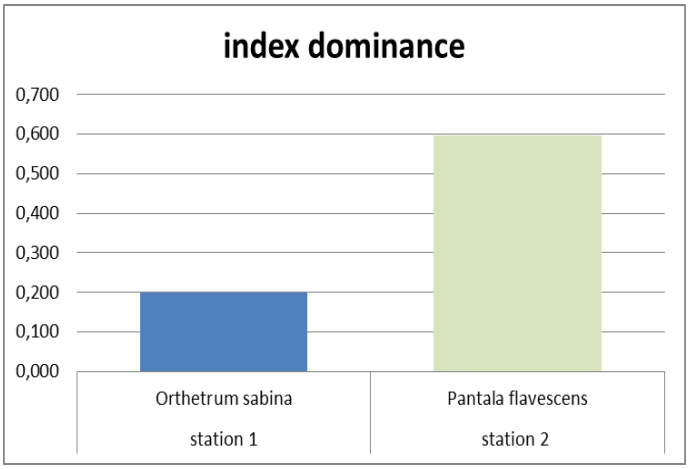


Figure 3. Result of diversity, evenness and dominance index

4. Discussion

4.1 Diversity

Based on the results of the calculation of dragonfly diversity index taken 2 stations fall into the category of low to medium. From the calculation of the diversity index of station 1, the number 1.68279 is obtained which is included in the range 1 < H' <3, meaning that the diversity index is classified as moderate. Meanwhile, the results of the calculation of the diversity index of station 2 obtained the number 0.82805 which is included in the range of H'<1 which means the diversity is classified as low. From the calculation of the diversity index of the two sampling locations obtained different diversity index values. Station 1 has a diversity index of 1.68279 while station 2 has a lower diversity index value of 0.82805. The diversity index value at station 1 which is higher than station 2 can occur because this station has a more suitable habitat for dragonfly life. Station1 is a habitat that is more supportive of dragonfly life as indicated by the many small insects that become dragonfly food that live in this area with diverse vegetation when compared to station 2. The diversity index value of dragonfly species found at station 1 is higher than the diversity index value of station 2 because the vegetation around station 1 is more diverse than station 2 (Lino *et al*., 2019). In addition, factors that affect dragonfly habitat conditions include pollution due to human activities, existing vegetation, and abiotic conditions of the environment that are less favorable for dragonfly life (Virgiawan, 2016). The low diversity index of station 2 indicates that the diversity is small and the stability of the community is low. The low diversity of dragonflies can also be caused by low biotic diversity. Environments with high biotic diversity generally have longer and more complex food chains that allow for interactions such as predation, parasitism, competition, commensalism, mutualism, and so on. The existence of feedback from these interactions can control shocks that occur so that the ecosystem becomes more stable (Odum, 1971).

4.2 Evenness

Based on the calculation results obtained, the evenness index value from the first station in the Insect and Freshwater World Museum area was 0.8 and was included in the high-distance population uniformity. At the second large station in the Lake Islands area, the result was 0.5 and was included in

the population evennes over medium distances. The more evenly distributed a type is throughout the research location, the higher the uniformity or evenness value. On the other hand, if certain types are dominant while other types are not dominant or have a lower density, the uniformity value of the community in question will be lower. In line with this, Odum (1996) stated that the evenness index value will be high if there is no concentration of individuals in a species, whereas the evenness index will be low if there is a concentration of individuals in a particular species (Setiarno *et al*., 2020). A high evenness or uniformity index indicates that no species is known to have too high a dominance at the observed location (Rahman and Mujiyanto, 2013). Station one and station two do not have species that have a significantly high dominance compared to other populations. This could be caused by the comparison of the number of individuals of each type caught not varying too much, thus indicating that the types of dragonflies between the stations were distributed quite evenly. According to Magurran (1988) in Hafizah (2016) and Setiarno *et al*., (2020), an evenness value that is close to one indicates that a community is more evenly distributed, whereas if the value is close to zero it is more uneven. Restu (2002), stated that the evenness index at a stable level shows that the distribution of individuals of each type in this area is quite balanced and indicates that the ecosystem is still not experiencing significant ecological pressure.

4.3 Dominance

A high dominance index in a community indicates low biodiversity. The dominance observed at both study locations suggests that the distribution of dragonfly species is uneven, due to the unstable environments at these sites. This instability occurs because of the high level of adaptation to the environment. *Orthetrum sabina* is a type of dragonfly that lives solitarily, can be found year-round, has a wide distribution, and is highly tolerant of changing environmental conditions, including polluted waters (Utari, 2018). *P. flavescens* is usually found in large numbers and lives in groups in open grasslands near drainage areas. This dragonfly is rarely seen perching or staying still. *P. flavescens* has a long flight range and often flies in circles. Additionally, this species is known to migrate. The abundance of *P. flavescens* in an area is likely due to their search for better and more supportive habitats (Maharani *et al.*, 2023). The purpose of using the dominance index is to illustrate the presence of various other dragonfly species in an area, with index values ranging from 0.000 to 1. At the Insect Museum area and Archipelago Lake in Taman Mini Indonesia Indah, the dragonfly dominance index ranges from 0.000 to 0.595, indicating that certain dragonfly species dominate over others. At Archipelago Lake, or station 2, the dragonfly species *Pantala flavescens* is the most dominant.

4.4 Ecology Trait

Dragonfly activity is influenced by air temperature and humidity (Hermawan, 2015). According to Jumar (2000), the minimum air humidity for dragonfly activity is ±70%, while the optimal air humidity that supports dragonfly survival ranges from 85-90% (Moore, 1994). So the air humidity measured in the research that has been carried out is still within the tolerance range for dragonflies to be able to carry out their activities. The temperature data obtained has results that are in accordance with previous research (Corbet, 1999) in Mubarak *et al*., (2022) which states that dragonflies are often found in the temperature

range of 25 - 33 ºC in open areas and close to water and have high sunlight intensity. Enough. Optimally, dragonflies can survive at temperatures of 27 ºC and adults can survive at temperatures reaching 45 ºC (Gustia *et al*, 2013). As stated in Mubarak *et al.*, (2022), according to Klym & Quinn (2003), in the morning dragonflies need more sunlight to warm their bodies and pump wing venation in preparation for flight. However, in the afternoon dragonflies have enough heat energy so they will hide in the shade to lower their body temperature (Delithalia & Mahathma, 2023). Therefore, according to the data obtained, most dragonflies can be found more frequently in the morning to afternoon time range. The level of insect activity is highly dependent on body temperature and is strongly influenced by abiotic environmental factors. Dragonflies are known to like the sun and are able to withstand the high temperature of the sun during the day. Weather has an important role, both directly and indirectly, in the distribution, distribution, abundance and behavior of insects (Koesmaryono, 1987). Light intensity also controls locomotor activity in many small animals (Wirakusumah, 2003). Some dragonflies, such as those in the Libellulidae family, prefer high light intensity and perch in the hot sun. This can be seen in the data on the dragonfly species encountered. Of the 11 species of dragonflies, 9 species belong to the Libellulidae family. In the research that has been carried out, the values obtained from measuring abiotic factors (air temperature, light intensity, and relative air humidity) are still quite effective for the life of dragonflies.

5. Conclusion

The diversity of dragonflies at station 1 is 1.68279 which is included in the medium category. Meanwhile, the dragonfly diversity index value at station 2 is 0.82805, which is included in the low category. Environmental parameters such as temperature, humidity, and sunlight intensity affect dragonfly diversity. The low diversity of dragonfly species could be caused by the lack of aquatic vegetation, temperature fluctuations and light. The lower the diversity value index, the more vulnerable the ecosystem is to disturbance due to the lack of species that can take over the role of lost or reduced species. Therefore the quality of the environment needs to be maintained for an effective life of a dragonfly.

References

Anggraini, T. K., Budiarti, L., Rizkie, L., & Octavia, D. M. (2021). Pengantar Ekologi Serangga. Palembang: Universitas Sriwijaya.

Attaullah, M., Ullah, I., Ali, M., Maula, F., Ilahi, I., Ahmad, B., & Raheel, S. M. M. (2021). Diversity of the Anisoptera & Zygoptera (Odonata: Insecta) of Swat, Pakistan. *Brazilian Journal of Biology*, 83.

Aswari, M., & Kahono, S. (2003). *Pedoman Pengumpulan Data Keanekaragaman Fauna.* Bogor: Puslitbang LIPI Bogor.

Borror, D. J., & Johnson, N. F. (1992). *Pengenalan Pelajaran Serangga*. Yogyakarta: UGM Press.

Borror, D. J., & White, R. E. (1998). *A field guide to insects: America north of Mexico*. Boston: Houghton Mifflin Harcourt.

Brown, J. H., Gillooly, J. F., Allen, A. P., Savage, V. M. & West, G. B. (2004). Toward a metabolic theory of ecology. *Ecology*, 85, 1771–1789.

Cranshaw, W. (1998). *Pests of the West*. Colorado: Fulcrum Publishing.

Cranshaw, W. (2004). *Garden Insects of North America*. New Jersey: Princeton University Press. Cranshaw, W. (2004). *Insects and Diseases of Woody Plants of the Central Rockies*. Colorado: Colorado University Press.

Delithalia, M., & Mahatma, R. Dragonfly Inventory and Active Time in Kasang Kulim Zoo Area, Riau, Indonesia. *Bioeksperimen: Jurnal Penelitian Biologi*, 9(2), 134-141.

Everling, S., & Johansson, F. (2022). The effect of temperature and behaviour on the interaction between two dragonfly larvae species within the native and expanded range. *Ecological Entomology*, 47(3), 460-474.

Gultom, S. (2020). Keanekaragaman Jenis Capung (Ordo Odonata) Di Taman Wisata Alam Danau Sicikeh-Cikeh Desa Lae Hole Kecamatan Parbuluan Kabupaten Dairi Sumatera Utara (Doctoral dissertation, Universitas Islam Negeri Sumatera Utara).

Herlambang, A. E. N., Hadi, M., & Tarwotjo, U. (2016). Struktur Komunitas Capung di Kawasan Wisata Curug Lawe Benowo Ungaran Barat. Bioma: Berkala Ilmiah Biologi, 18(2), 70-78.

Hermawan, A. S., & Fitriana, N. (2015). Jenis dan fluktuasi capung pada taman kota bumi serpong damai, TangerangSelatan, Banten. *Jurnal PROSSEM NAS MASY BIODIINDO*, 1(8),1795-1801.

Kustiati, A. S. N. W. T. R. S. (2019). Komposisi Spesies Capung (Odonata) di Kawasan Cagar Alam Mandor Kecamatan Mandor Kabupaten Landak Kalimantan Barat. *Jurnal Protobiont*, *8*(1), 20-26.

Lino, J., Koneri, R., & Butarbutar, R. R. (2019). Keanekaragaman capung (odonata) di tepi sungai kali desa kali kabupaten minahasa sulawesi utara. *Jurnal MIPA*, 8(2), 59.

Maharani, R., Triana, E., & Dharma, A. P. (2023). Studi Keanekaragaman Jenis Capung (Ordo Odonata) di Blok Legok Majalaya Resort Sarongge Taman Nasional Gunung Gede Pangrango. *BIOPENDIX: Jurnal Biologi, Pendidikan dan Terapan*, *9*(2), 195-202.

Mandolang, M., Kusen, J. D., Warouw, V., Paulus, J. H., & Rember, U. N. (2021). Struktur Komunitas Ikan Target Di Ekosistem Terumbu Karang Pada Zona Tradisional Pulau Bunaken, Taman Nasional BNAKEN. *Jurnal Pesisir dan Laut Tropis*, *9*(3), 104-110.

Meliawati, M., Suyamto, S., Abdillah, N. A., Mujijah, M., & Setiawan, U. (2024). Inventarisasi Serangga air di Desa Bungurcopong Kecamatan Picung Pandeglang Banten. *Bioscientiae*, 21(1), 1-11.4.

Mubarak, Z., Firdhausi, N. F., & Bahri, S. (2022). Keanekaragaman Capung (Odonata) di Aliran Sungai Desa Karangrejo, Kecamatan Garum, Blitar. *Biotropic: The Journal of Tropical Biology*, *6*(1), 47-52.

Odum, E. P. (1971). *Fundamental of ecology*.Philadelphia: W. B. Saunders Company.

Odum, E. P. (1993). *Dasar-Dasar Ekologi*. Yogyakarta: Gadjah Mada University Press.

Oktidila, N. F. (2018). *Keanekaragaman Capung (Odonata) di Bumi Perkemahan dan Graha Wisata (BUPERTA) Pramuka Cibubur, Jakarta* (Bachelor's thesis, Fakultas Sains dan Teknologi UIN Syarif Hidayatullah Jakarta).

Orr, A.G. (2005). A Pocket Guide: Dragonflies of Peninsular Malaysia and Singapore. Natural History Publication (Borneo) Sdn. Bhd., Kota Kinabalu, Malaysia.pp. 127.

Pamungkas, D. W., & Ridwan, M. (2015, September). Keragaman jenis capung dan capung jarum (Odonata) di beberapa sumber air di Magetan, Jawa Timur. In Prosiding Seminar Nasional Masyarakat Biodiversitas Indonesia (Vol. 1, No. 6, pp. 1295-1301).

Pitcher, T. J., Magurran, A. E., & Winfield, I.J. (1982). Fish in larger shoals find food faster. *Behavioral Ecology and Sociobiology*, *10*, 149-151.

Putri, D. K., Murnisari, Y., Madalena, D. K., Setiarini, N., Diputri, R. L. D., Suryanda, A., & Azrai, E. P. (2024). Keanekaragaman Tumbuhan Bawah di Kawasan Universitas Negeri Jakarta. *Panthera: Jurnal Ilmiah Pendidikan Sains dan Terapan*, 4(1), 10-17.

Rachmatiyah, R., & Lupiyaningdyah, P. Spesimen Capung (Odonata) Koleksi Kebun Raya Bogor: Proses Pembuatan dan Identifikasi.

Rahadi, W. S., Feriwibisono, B., Nugrahani, M. P., Dalia, B. P. I., & Makitan, T. (2013). *Naga Terbang Wendit: Keanekaragaman Capung Perairan Wendit, Malang, Jawa Timur*. Jawa Timur : Indonesia Dragonfly Society.

Rahmawati, W. A., & Budjiastuti, W. (2022). Pengaruh Faktor Lingkungan Terhadap Indeks Keanekaragaman dan Morfologi Capung (Ordo: Odonata) di Kawasan Hutan Kota Surabaya. *LenteraBio: Berkala Ilmiah Biologi*, 11(1), 192–201.

Rismayani, Y. (2018). Keanekaragaman Capung (Odonata) di Kubu Perahu Taman Nasional Bukit Barisan Selatan.

Rizal, S., & Hadi, M. (2015). Inventarisasi Jenis Capung (Odonata) Pada Areal Persawahan Di Desa Pundenarum Kecamatan Karangawen Kabupaten Demak. Bioma: Berkala Ilmiah Biologi, 17(1), 16-20.

Ruslan, H. (2020). Keanekaragaman capung (Odonata) di sekitar kawasan cagar biosfer Giam Siak Kecil-Bukit Batu Riau. *Bioma*, 16(1), 31 - 42.

Setiarno, S., Hidayat, N., & Bambang, T. A. Komposisi Jenis Dan Struktur Komunitas Serta Keanekaragaman Jenis Vegetasi Di Areal Cagar Alam Bukit Tangkiling: Composition, Structure and Plants Diversity in Nature Reserves of Bukit Tangkiling. *Jurnal Hutan Tropika*, *15*(2), 150-162.

Sigit, W. R., Feriwibisono, B., Nugrahani, M. P., ID, B. P., & Makitan, T. (2013). Keanekaragaman Capung Perairan Wendit, Malang, Jawa Timur. Malang: Indonesia Dragonfly Society.

Sirait, M., Rahmatia, F., & Pattulloh, P. (2018). Komparasi indeks keanekaragaman dan indeks dominansi fitoplankton di sungai ciliwung Jakarta (comparison of diversity index and dominant index of phytoplankton at ciliwung river jakarta). *Jurnal Kelautan: Indonesian*

Journal of Marine Science and Technology, *11*(1), 75-79.

Siregar, A. Z. (2013). Capung (Odonata) Sahabat dalam Ekosistem Kita. Warta Konservasi.

Sonia, S., Azzahra, A. N. A., Anissa, R. K., Jamilah, Y. M., & Rahayu, D. A. (2022). Keanekaragaman dan Kelimpahan Capung (Odonata: Anisoptera) di Lapangan Watu Gajah Tuban. *BIO-SAINS: Jurnal Ilmiah Biologi*, *1*(2), 1-11.Lahan Basah. Wetlands International, 21(2), 15-18.

Suhonen, J., Korkeamaki, E.S.A., Salmela, J. and Kuitunen, M. (2014). Risk of local extinction of Odonata freshwater habitat generalists and specialists. *Conservation Biology*, 28(3), 783-789.

Susanti, S. (1998). Seri Panduan Lapangan Mengenal Capung. Bogor: Puslitbang Biologi LIPI.

Susanto, M. A. D. (2021). Inventory and identification dragonfly Family Libellulidae at Slamet Reservoir, Surabaya, East Java. *Journal on Biology and Instruction*, *1*(2), 40-50.

Syarifah, E. B., Fitriana, N., & Wijayanti, F. (2018). Keanekaragaman capung (odonata) di taman mini indonesia indah dan taman margasatwa ragunan, dki jakarta, Indonesia. *Bioprospek: Jurnal Ilmiah Biologi*, *13*(1), 50-58.

Tang, H.B., Wang, L.K. & Hämäläinen, M. (2010). A photographic guide to the dragonflies of Singapore. Singapore: Raffles Museum of Biodiversity Research.

Tarumingkeng, R. C. (1992). *Dinamika Pertumbuhan populasi Serangga*. Bogor: Pusat Ilmu Hayati Institute Pertanian Bogor.

Triwibowo, A. (2021). Perancangan Media Informasi Museum Serangga Dan Taman Kupu Taman Mini Indonesia Indah Tmii Melalui Media Permainan Kartu (Doctoral dissertation, Universitas Komputer Indonesia).

Triyanti, M., & Arisandy, D. A. (2021). Keanekaragaman Jenis Capung Famili Libellulidae di Bukit Cogong Kabupaten Musi Rawas. Biota : Jurnal Ilmiah Ilmu-Ilmu Hayati, 6(1), 44–51. https://doi.org/10.24002/biota.v6i1.3216 TMII. (2024).

Taman Mini Dulu dan Kini. Diakses pada 22 Februari 2024, dari https://tamanmini.com/taman_jelajah_indonesia/tentang-tmii/ TMII. (2024). *Museum Serangga dan Taman Kupu*. Diakses pada 22 Februari 2024, dari https://tamanmini.com/taman_jelajah_indonesia/museum/museum-serangga-dan-taman-kupu/.