# Dragonfly Inventory and Active Time in Kasang Kulim Zoo Area, Riau, Indonesia

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***Abstract –*** *Dragonflies have an important role in ecosystem balance as biological control agents and environmental bioindicators because they are sensitive to changes in water quality. Community activities at the Kasang Kulim Zoo can cause changes to water quality. When habitat conditions change, Odonata (dragonfly) will also changes, both in distribution and diversity. This study aims to identify, invent and determine the activity time of dragonflies found in the Kasang Kulim Zoo area. Research was conducted at the end of March to mid-April 2023. Sampling used exploration method by using insect nets. The results obtained a total of 152 individuals belonging to 14 species, four families and two suborders (Anisoptera and Zygoptera). The family Libellulidae totaled eight species, Gomphidae one species, Coenagrionidae four species and Platycnemididae one species. The Libellulidae family are active from 08.00 am to 05.00 pm, while dragonfly species from the Gomphidae family and the Zygoptera suborder are active from 08.00 am to 03.00 pm. Dragonfly activity is influenced by air temperature, air humidity and sunlight intensity.*

***Keywords:*** *active time, inventory, Kasang Kulim Zoo, Odonata*

## INTRODUCTION

Indonesia is one of the countries that has the second largest biodiversity in the world (Buchori et al., 2019). One type of biodiversity is dragonflies. Indonesia has ±700 species of dragonflies, accounting for about 15% of the 5000 species in the world. Dragonflies have an important role in maintaining the balance of the food chain in the ecosystem, namely as predators of small insects (Rahadi et al., 2013). Besides being predators, dragonflies can also be used as bioindicators in an aquatic environment. Dragonfly nymphs are very sensitive to changes in water quality. Thus, if the aquatic environment as a breeding ground for dragonflies becomes polluted, it will result in a decrease in dragonfly diversity so that the existence of dragonflies in nature will be endangered (Kalkman et al., 2008).

Kasang Kulim Zoo is the only zoo in Riau Province. It is located in Kampar Regency, Siak Hulu District and is included in the sub-urban area (Pasaribu & Sari, 2019). The condition of Kasang Kulim Zoo with an area of approximately 10 hectares is suitable for dragonfly habitat, where the zoo has many shady trees so the air is relatively cool and has a large water area.

Based on data in early 2023, the zoo manager noted an increase in visitors of around 70% or as many as 15.000 people who visited the zoo and carried out various activities, such as sitting near the water area, fishing and sometimes littering. These activities can change the quality of the aquatic ecosystem or be an anthropogenic disturbance to the diversity of flora and fauna there, including dragonfly diversity.

Perez and Bautista (2020) stated that dragonfly diversity can decline due to anthropogenic impacts such as habitat destruction, agriculture, and urbanisation. Acquah et al. (2013) also stated that when habitat conditions change, Odonata will also show changes, both in distribution and diversity. Therefore, research on dragonfly inventory and activity in this area needs to be conducted to provide information on dragonfly species and activities in the Kasang Kulim Zoo area.

## MATERIALS AND METHODS

### 1. Time and Place

This research was conducted from end of March to mid-April 2023 (14 days) at Kasang Kulim Zoo. Sample identification was carried out at the Zoology Laboratory, Faculty of Mathematics and Natural Sciences (FMIPA), Riau University.

### 2. Data Collection Procedure

Firstly, the activity (active time) of dragonflies was observed using the exploration method by walking around the observation site. Observations and sampling were conducted throughout the day starting at 08.00 am to 05.00 pm. Dragonflies that were encountered were then captured using an insect net, and anaesthetised by placing them in a killing bottle containing cotton wool that had been treated with 70% ethanol. The anaesthetizsed dragon-flies were wrapped in papillot paper and placed in an insect box. Samples were then brought to the laboratory for preservation and identification. The sampling process was carried out until no new species were found.

During 14 days of observation, abiotic factors were measured, including air temperature and air humidity using a thermohygrometer (HTC-2) and light intensity using a lux meter (AS803) with 3 times repetition. Data were taken at the same time as dragonfly sampling.

The identification process was carried out by matching the morphological characteristics of the samples with those found in the books "Dragonflies of Peninsular and Singapore" by A.G.Orr (2005), "Capung Sumba" by Irawan and Rahadi (2016) and "Naga Terbang Wendit" by Rahadi et al. (2013). Dragonfly species identification is made by observing the body shape, colour, eyes, wing position, and flight behaviour (Rahadi et al., 2013).

### 3. Data Analysis

The data obtained will be processed manually and presented in tabular form and described.

## RESULTS AND DISCUSSION

### 1. Dragonfly Identification

Based on the observations at Kasang Kulim Zoo, a total of 152 dragonfly individuals were obtained, belonging to 14 species, four families and two suborders (Anisoptera and Zygoptera). The Anisoptera suborder consists of two families (Gomphidae and Libellulidae), Zygoptera suborder also consists of two families, (Coenagrionidae and Platycnemi-didae).

The highest number of species collected was from the Libellulidae family (eight species), followed by the Coenagrionidae family (four species). The Gomphidae and Platycnemididae families, on the other hand had only one species sampled (Table 1; Figure 1). According to Gillot (1980), the Libellulidae family is the largest and most diverse family of the Anisoptera suborder and its members are spread throughout the world.

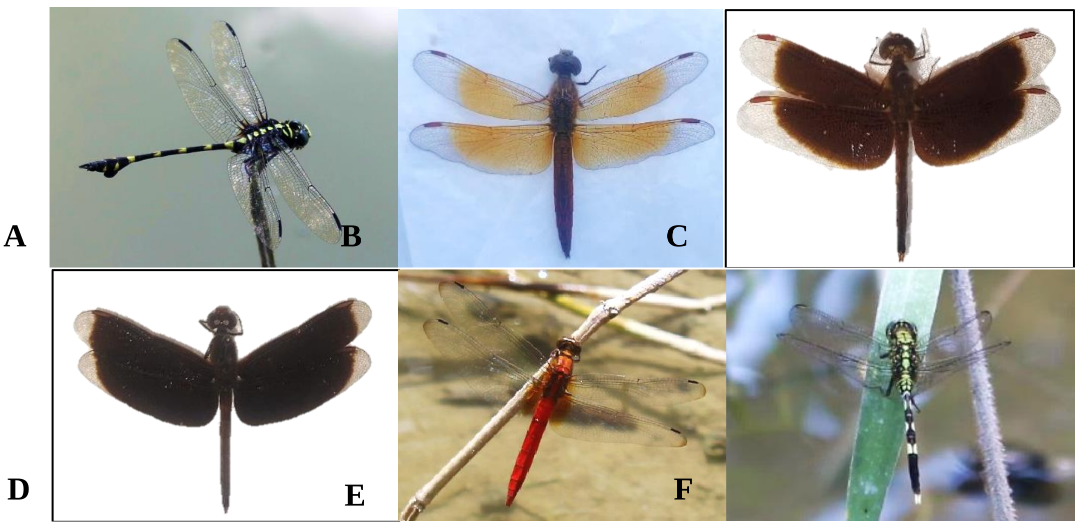
Susanti (1998) also stated that Libellulidae is a family whose geographical distribution is quite wide and the number of each species is abundant, so it is not difficult to find it in various habitats. The wide distribution of the Libellulidae family causes many species of this family to be found in the study area.

**Table 1. Dragonfly Diversity at Kasang Kulim Zoo**

| Order | Suborder | Family | Species |
|---|---|---|---|
| Odonata | Anisoptera | Gomphidae | 1. *Ictinogomphus decoratus* |
| | | Libellulidae | 2. *Brachythemis contaminata* |
| | | | 3. *Neurothemis fluctuans* |
| | | | 4. *Neurothemis terminata* |
| | | | 5. *Orthetrum testaceum* |
| | | | 6. *Orthetrum sabina* |
| | | | 7. *Potamarcha congener* |
| | | | 8. *Rhyothemis phyllis* |
| | | | 9. *Tholymis tillarga* |
| | Zygoptera | Coenagrionidae | 10. *Agriocnemis femina* |
| | | | 11. *Agriocnemis pygmaea* |
| | | | 12. *Ischnura senegalensis* |
| | | | 13. *Pseudagrion rubriceps* |
| | | Platycnemididae | 14. *Copera marginipes* |

The 14 species of dragonfly species found in the study site (Kasang Kulim Zoo) is comparable to those reported by researchers from various places. Syarifah et al. (2018) collected six species of dragonflies in DKI Jakarta. Putri et al. (2019), seven species in East Java. Other studies sampled 12 species in West Kalimantan (Wulandari et al., 2019), 14 species in Riau (Ghimbo Potai Traditional Forbidden Forest) (Agustina & Yulminarti, 2020), and eight species in North Sulawesi (Kaligis et al., 2023). The result obtained obtained here indicated that the Kasang Kulim Zoo environment (with open spaces, calm waters, and diverse vegetation) is an appropriate place to support dragonfly life.

Kalkman and Orr (2013) point out that the dragonflies are often found in open habitats in which they seek food and fly towards areas with greater light intensity. The most important habitat components for dragonflies are vegetation for sheltering and basking, the food sources availability, the favourable environmental conditions (such as water and air free of pollutants), the presence of water sources, and sufficient sunlight intensity.



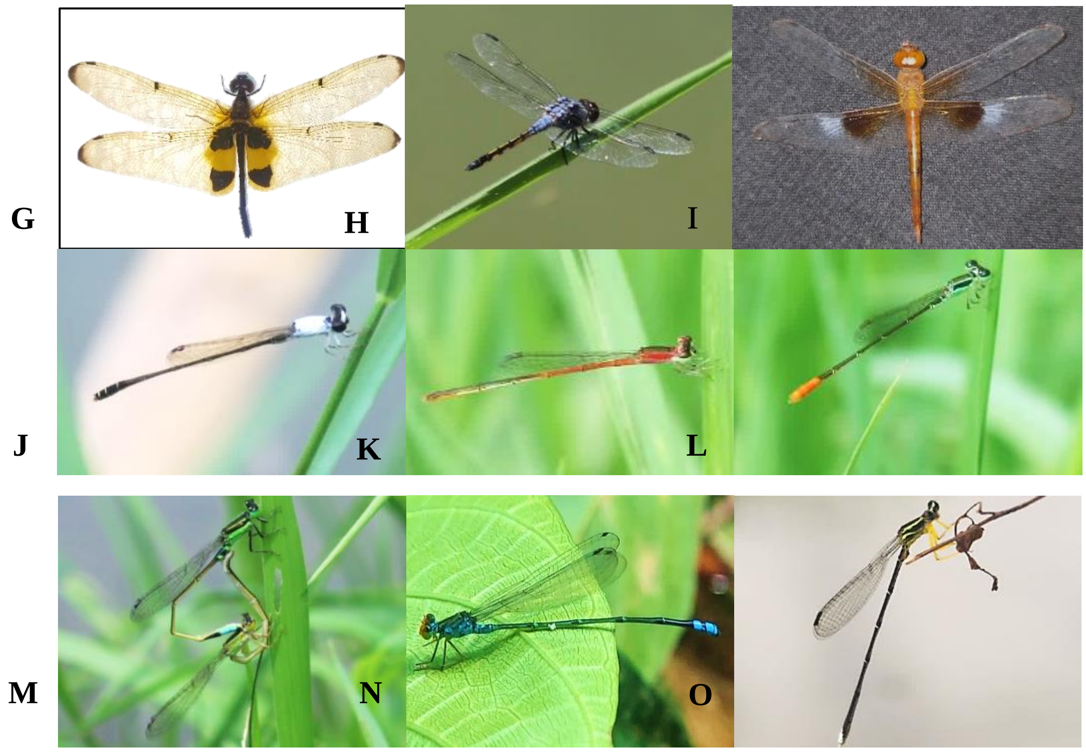



**Figure 1. Documentation of dragonflies found at Kasang Kulim Zoo; (A) Ictinogomphus decoratus, (B) Brachythemis contaminata, (C) Neurothemis fluctuans, (D) Neurothemis terminata, (E) Orthetrum testaceum, (F) Orthetrum sabina, (G) Rhyothemis phyllis, (H) Potamarcha congener, (I) Tholymis tillarga, (J) Agriocnemis pygmaea male, (K) Agriocnemis pygmaea female, (L) Agriocnemis femina, (M) Ischnura senegalensis, (N) Pseudagrion rubriceps, (O) Copera marginipes.**

## 2. Dragonfly Active Time

The environmental factors strongly influenced living beings activities. This can be observed from dragonfly activity in the study area. The species from Libellulidae family are active from 08.00 am to 05.00 pm, while whose from the Gomphidae family and the Zygoptera suborder are active from 08.00 am to 03.00 pm (Table 2).

The active time of dragonflies observed at the study site was mostly in the morning until noon (08.00 am - 03.00 pm). The results of this study show similar results to research conducted by Hidayah (2008), Khairiyah et al. (2012) and Wulandari et al. (2019), where the activities and species of dragonflies obtained in the morning and early to mid-afternoon were more abundant compared to the late afternoon.

This result is supported by Dunkle (2000) study, which stated that adult Odonata tend to be more active in the morning until late afternoon. Klym and Quinn (2003) also remarked that Odonata are ectotherms and depend on environmental factors to regulate their body temperature. In this way, dragonflies need more sunlight to warm their bodies in the morning until noon. Meanwhile, in the late afternoon, dragonflies that have enough heat energy will hide in the shade to lower their body temperature.

Table 2. Active time of dragonflies at Kasang Kulim Zoo

| Family/Species | Observation Time | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | AM | | | | | PM | | | | |
| | 8 | 9 | 10 | 11 | 12 | 1 | 2 | 3 | 4 | 5 |
| <u>Subordo Anisoptera</u> | | | | | | | | | | |
| **Family Gomphidae** | | | | | | | | | | |
| 1. *Ictinogomphus decoratus* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| **Family Libellulidae** | | | | | | | | | | |
| 2. *Brachythemis contaminata* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 3. *Neurothemis fluctuans* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 4. *Neurothemis terminata* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 5. *Orthetrum testaceum* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 6. *Orthetrum sabina* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 7. *Potamarcha congener* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 8. *Rhyothemis phyllis* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| 9. *Tholymis tillarga* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| <u>Subordo Zygoptera</u> | | | | | | | | | | |
| **Family Coenagrionidae** | | | | | | | | | | |
| 10. *Agriocnemis femina* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| 11. *Agriocnemis pygmaea* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| 12. *Ischnura senegalensis* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| 13. *Pseudagrion rubriceps* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| **Family Platycnemididae** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |
| 14. *Copera marginipes* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | - | - |

Description:
✓: dragonfly species found at that time

According to Rohr et al. (2018), the tolerance limit for solar heat is related to body size and mass in insects, because body mass is positively associated with increased tolerance to high temperatures and thus better thermoregulation. Zygoptera species have smaller body size and mass, so species from this suborder have poorer thermo-regulatory abilities (Carvalho et al., 2013). Therefore, most of them cannot survive in direct sunlight, where there is no shade for a long time, because when the intensity of sunlight increases and the temperature oscillates more, it will cause overheating in Zygoptera (Oliveira-Junior et al., 2017). This could explain the activity decrease of Zygoptera species in the afternoon.

Whereas Anisoptera species have a larger body size and mass, species from this suborder have better thermoregulatory abilities (Castillo-Pérez et al., 2021). Dragonflies larger than members of the family Libellulidae, such as the family Gomphidae, can retain large amounts of heat efficiently in their muscle mass. However, this ability can be detrimental at high ambient temperatures as dragonflies can overheat. As a result, in the late afternoon, species from this family can be found hiding under the shade or canopies. This strategy is effective to reduce the amount of light intensity absorbed from the sun and also allows the dragonfly to dissipate heat, thus helping to lower its body temperature (May 1976).

Differences in tolerance of each species to environmental parameters are thought to cause differences in active behaviour. Some dragonfly species such as those from the family Libellulidae have a preference for high light intensity (Borkenstein & Jödicke, 2022), so they can survive longer under sunlight with high light intensity (up to 5 pm). However, some dragonfly species, such as those from the family Gomphidae and the suborder Zygoptera, do not survive long in strong sunlight, so in the afternoon they will seek shelter in the shade to lower their body temperature (Henry et al., 2018). However, it is not yet known whether this behaviour is also exhibited by other dragonfly species.

### 3. Environmental Factors

The average air temperature at Kasang Kulim Zoo is at 30°C (Table 3). According to Jumar (2000), the effective temperature range for dragonflies is between 15°C to 45°C with 25°C as the optimum temperature.

**Table 3. Measurement results of environmental factors at Kasang Kulim Zoo**

| Abiotic Factors | Average (N) |
|---|---|
| Air Temperature (°C) | 30°C |
| Air Humidity (%) | 79% |
| Light Intensity (lux) | 21203 lux |

Furthermore, the air humidity obtained an average result of 79% which is still in the normal category for dragonfly life. The minimum air humidity range according to Jumar (2000) is ±70%. While the optimal humidity for insects is in the range of 73-100%.

Then, the light intensity obtained an average of 21203 lux. Zahner (1960) in Mill and Ward (2005), the appropriate light intensity for dragonfly survival is >7000 lux. Thus, the air temperature, humidity and light intensity in the Kasang Kulim Zoo area include the ideal temperature for dragonfly life to carry out its activities.

## CONCLUSION

Based on the results of the study, a total of 152 dragonfly individuals were obtained which belonged to 14 species, four families and two suborders (Anisoptera and Zygoptera) found at Kasang Kulim Zoo. In the suborder Anisoptera there are nine species of which are *Ictinogomphus decoratus*, *Brachythemis contaminata*, *Neurothemis fluctuans*, *Neurothemis terminata, Orthetrum testaceum*, *Orthetrum sabina*, *Potamarcha congener*, *Rhyothemis phyllis*, and *Tholymis tillarga*. While in the Zygoptera suborder there are five species of which are *Agriocnemis femina*, *Agriocnemis pygmaea*, *Ischnura senegalensis*, *Pseudagrion rubriceps* and *Copera marginipes*. Dragonfly species from the Libellulidae family are active from 08.00 am to 05.00 pm. While dragonfly species from the Gomphidae family and the Zygoptera suborder are active from 08.00 am to 03.00 pm. Dragonfly activity is influenced by air temperature, air humidity and sunlight intensity.

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## REFERENCES


Acquah D, Kyerematen R, Owus EO. (2013). Using Odonates as Markers of The Environmental Health of Water and It's Land Related Ecotone. *International Journal of Biodiversity and Conservation* 5(11): 761-769.

Agustina Y & Yulminarti. (2020). Keanekaragaman dan Kelimpahan Capung (Odonata: Anisoptera) di Hutan Larangan Adat Ghimbo Potai Kabupaten Kampar Provinsi Riau. Repository FMIPA Universitas Riau. 1-13.

Borkenstein A & Jödicke R. (2022). Thermoregulatory Behaviour of *Sympetrum striolatum* at Low Temperatures with Special Reference to the Role of Direct Sunlight (Odonata: Libellulidae). *Odonatologica* 51(1): 83-109.

Buchori D, Ardhian D, Salaki LD, Pirnanda D, Agustina M, Pradana EW, Rahadi WS, Nazar L. (2019). *Capung KELOLA Sendang: Mengumpulkan Yang Terserak, Merawat Yang Tersisa*. Zoological Society of London.

Carvalho F, Pinto NS, Jose OJ, Juen L. (2013). Effects of Marginal Vegetation Removal on Odonata Communities. *Acta Limnologica Brasiliensia* 25(10).

Castillo-Pérez EU, Suárez-Tovar CM, González-Tokman D, Schondube JE, Córdoba-Aguilar A. (2022). Insect Thermal Limits in Warm and Perturbed Habitats: Dragonflies and Damselflies as Study Cases. *Journal of Thermal Biology* 103(368).

Dunkle SW. (2000). *Dragonflies Through Binoculars*: *A Field Guide to Dragonflies of North America*. New York: Oxford University Press.

Gillot C. (1980). *Entomology*. New York and London: Plenum Press.

Henry ER, Rivera JA, Linkem CN, Scales JA, Butler MA. (2018). Damselflies that Prefer Dark Habitats Illustrate the Importance of Light as an Ecological Resource. *Biological Journal of the Linnean Society* 123: 144-154.

Hidayah SNI. (2008). Keanekaragaman dan Aktivitas Capung (Ordo: Odonata) di Kebun Raya Bogor [skripsi]. Fakultas Pertanian, Institut Pertanian Bogor, Bogor.

Irawan A & Rahadi WS. (2016). *Capung Sumba*. Nusa Tenggara Timur: Balai Taman Nasional Manupeu Tanah Daru dan Laiwangi Wanggameti.

Jumar. (2000). *Entomologi Pertanian*. Jakarta: Rineka Cipta.

Kaligis KH, Pollo HN, Tulung M. (2023). Penilaian Sumber-daya Alam di Sekitar Danau Pulisan, Linow dan Tampusu, Kota Tomohon, Sulawesi Utara: Capung (Odonata) Sebagai Bio-indikator. *Silvarum* 2(1): 13-19.

Kalkman VJ & Orr AG. (2013). Field Guide to The Damselflies of New Guinea. *Brachytron* 16(2): 3-118.

Kalkman VJ, Clausnitzer V, Dijkstra KDB, Orr AG, Paulson DR, Tol JV. (2008). Global Diversity of Dragonflies (Odonata) in Freshwater. *Hydrobilogia* 595: 351-363.

Khairiyah SMH, Izzati NMR, Faezah P. (2012). Species Richness and Temporal Variation in the Dragonfly and Damselfly Fauna at National Botanical Garden Shah Alam. *IEEE Colloquium on Humanities, Science and Engineering (CHUSER)* 442-447.

Klym M & Quinn M. (2003). *Introduction to Dragonfly and Damselfly Watching*. Texas: Texas Parks and Wildlife Department.

May ML. (1976). Thermo-regulation and Adaptation to Temperature in Dragonflies (Odonata: Anisoptera). *Ecological Monographs* 46(1): 1-32.

Mill PJ & Ward L. (2005). Habitat Factors Influencing the Presence of Adult *Calopteryx Splendens* (Odonata: Zygoptera). *Eur. J. Entomol* 102: 47-51.

Oliveira-Junior JMB, De Marco P, Dias-Silva K, Leitao RP, Leal CG, Pompeu PS, Gardner TA, Hughes RM, Juen L. (2017). Effects of Human Disturbance and Riparian Conditions on Odonata (Insecta) Assemblages in Easterns Amazon Basin Streams. *Limnologica* 66: 31-39.

Orr AG. (2005). *Dragonflies of Peninsular Malaysia and Singapore*. Malaysia: Natural History Publications (Borneo) Sdn. Bhd.

Pasaribu R & Sari LO. (2019). Perancangan Aplikasi Link Budget Untuk Menghitung Jumlah Enode B di Kabupaten Kampar. *JOM FTEKNIK* 6(1): 1-6.

Perez ESN & Bautista MG. (2020). Dragonflies in The City: Diversity of Odonates in Urban Davao, Philippines. *Journal of Agricultural Science and Technology* 10(1): 12-19.

Putri TAM, Wimbaningrum R, Setiawan R. (2019). Keanekaragaman Jenis Capung Anggota Ordo Odonata di Area Persawahan Kecamatan Sumbersari Kabupaten Jember. *Bioma* 8(1): 324-336.

Rahadi WS, Feriwibisono B, Nugrahani MP, Putri IDB, Makitan T. (2013). *Naga Terbang Wendit: Keanekaragaman Capung Perairan Wendit di Malang, Jawa Timur*. Malang: Indonesia Dragonfly Society.

Rohr J, Civitello D, Cohen J, Roznik E, Sinervo B, Dell A. (2018). The Complex Drivers of Thermal Acclimation and Breadth in Ectotherms. *Ecology letters* 21: 1425-1439.

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

Syarifah EB, Fitriana N, Wijayanti F. (2018). Keanekaragaman Capung (Odonata) Taman Mini Indonesia Indah dan Taman Margasatwa Ragunan, DKI Jakarta, Indonesia. *Bioprospek* 13(1): 50-58.

Wulandari ASN, Setyawati TR, Kustiati. (2019). Komposisi Spesies Capung (Odonata) di Kawasan Cagar Alam Mandor Kecamatan Mandor Kabupaten Landak Kalimantan Barat. *Protobiont* 8(1): 20-26.

Zahner R. (1960). Über die Bindung der mitteleuropäischen Calopteryx-arten (Odonata, Zygoptera) an den Lebensraum des strömenden Wassers. II. Der Anteil der Imagines an der Biotopbindung. *Int. Rev. Gesam. Hydrobiol. Hydrogr*. 45: 101–123.