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Diversity of Dragonfly Species (Odonata) in the Tun Telanai Lake Ecosystem at Jambi University, Indonesia

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ABSTRACT

Lakes are among the most complex aquatic ecosystems, as they support a wide variety of organisms. One of the organisms commonly found in lake ecosystems is the dragonfly (Order Odonata). Ecologically, dragonflies play important roles, including acting as predators in the food chain that help regulate insect populations and serving as bioindicators of water quality. The presence and diversity of dragonflies are closely related to environmental conditions, particularly water quality and surrounding vegetation. This study aims to examine the species diversity of dragonflies in the Tun Telanai Lake area at Jambi University. A descriptive quantitative method was employed, involving direct observation and identification of dragonfly species found in the study area. The results of the identification revealed the presence of three dragonfly families comprising a total of ten species. The family Libellulidae was the most dominant, represented by seven species, followed by the family Gomphidae with two species, and the family Coenagrionidae with one species. The calculation of the Shannon–Wiener diversity index (H') yielded a value of 1.29, which falls within the moderate diversity category. This result indicates that the habitat conditions and aquatic ecosystem of Tun Telanai Lake are relatively stable and capable of supporting dragonfly populations.

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INTRODUCTION

Environmental factors such as water quality, vegetation structure, temperature, and human disturbance strongly influence the distribution and abundance of dragonfly species. Several studies have shown that dragonflies are particularly sensitive to changes in physicochemical parameters of water, including pH, dissolved oxygen, and nutrient levels (Kalkman et al., 2020). Aquatic vegetation also plays a crucial role by providing oviposition sites, shelter for naiads, and perching areas for adult dragonflies. Consequently, habitats with diverse and well-structured vegetation tend to support higher dragonfly diversity. In recent years, dragonflies have increasingly been used as bioindicators in freshwater ecosystem assessments. Their relatively long aquatic larval stage, combined with their responsiveness to habitat alteration, makes them effective indicators of ecological integrity (Clausnitzer et al., 2021). Changes in dragonfly community composition often reflect broader environmental degradation caused by pollution, land-use change, and climate variability. Therefore, monitoring dragonfly diversity can provide early warning signals of ecosystem imbalance.

Studies conducted in tropical regions, including Southeast Asia, indicate that artificial lakes and urban water bodies can still support diverse dragonfly communities when suitable habitat conditions are maintained (Rahman et al., 2019; Dolny et al., 2022). However, urbanization and increasing anthropogenic pressure may lead to habitat simplification, which negatively affects species with specialized ecological requirements. Generalist species often dominate such environments, resulting in reduced overall diversity. Given the ecological importance of dragonflies and the limited data available for the Tun Telanai Lake area, this study is expected to contribute valuable baseline information on local dragonfly diversity. The findings can serve as a reference for future ecological monitoring and conservation planning within the Jambi University campus. Furthermore, this research may support sustainable management strategies aimed at maintaining aquatic ecosystem health and preserving insect biodiversity in urban and semi-urban environments. Climate change is another factor that increasingly affects dragonfly populations worldwide. Alterations in rainfall patterns, temperature increases, and prolonged dry seasons can disrupt the availability of aquatic habitats required for dragonfly reproduction and larval development (Hassall & Thompson, 2020). In tropical regions, fluctuations in water levels may influence breeding success and larval survival, ultimately affecting species composition and seasonal abundance. As ectothermic organisms, dragonflies are particularly sensitive to temperature changes, making them useful indicators for assessing the ecological impacts of climate variability.

From a conservation perspective, documenting insect diversity, including dragonflies, is essential, as insects are experiencing global population declines. Recent studies emphasize that habitat loss, pollution, and urban expansion are major drivers of insect biodiversity reduction (Sánchez-Bayo & Wyckhuys, 2019). Despite their ecological importance, insects often receive less conservation attention compared to vertebrates. Baseline data on species diversity and distribution are therefore critical for developing effective conservation strategies and preventing further biodiversity loss. Moreover, biodiversity studies in university-managed areas such as Tun Telanai Lake offer strategic value, as campuses can function as semi-natural refuges within urban landscapes. Research conducted in such areas can promote environmental awareness and support evidence-based management policies (McDonnell & Hahs, 2015; Aronson et al., 2017). By integrating biodiversity research with campus planning, universities can contribute to conservation efforts while enhancing educational and ecological functions. Thus, the present study not only provides scientific documentation of dragonfly diversity but also supports the broader goal of sustainable ecosystem management within the university environment.

MATERIALS AND METHOD

The research was conducted in the Tun Telanai Lake area of Jambi University in May 2025. Data collection was carried out in three replications, with sampling conducted in both the morning and afternoon sessions. Morning sampling took place from 08:00 to 11:00 PM, while afternoon sampling was conducted from 15:00 to 18:00 AM. The equipment used in this study included insect nets, sample bottles, HVS paper, reference journals, a camera, writing tools, and identification books for dragonflies. The material used was 70% alcohol.

This study employed a descriptive quantitative method. The sampling technique used was direct sweeping. Direct Sweeping is an observation and insect collection technique in which insects are caught directly (hand collecting) using an insect net (Nugroho et al., 2021). Dragonfly sampling was carried out along the edges of Tun Telanai Lake, starting from the water inlet point to the outlet of the lake. Once the dragonflies were captured, the next step was to identify the species. The identification process was conducted using identification keys and relevant scientific journals to ensure accuracy in species determination. Data analysis was conducted by

calculating the species diversity index using the Shannon-Wiener formula (H'). This value provides an overview of species variation within the dragonfly community studied.

$H' = - \sum pi \ ln \ pi$

Where:

H' = Species diversity index

pi = ni/N

ni = Number of individuals of a given species

N = Total number of individuals of all species

The criteria for interpreting the diversity index are as follows:

a. H' > 3 = High species diversity

b. 1 ≤ H' ≤ 3 = Moderate species diversity

c. H' < 1 = Low species diversity

RESULTS AND DISCUSSION

Dragonflies found in the Tun Telanai Lake area of Jambi University consisted of 3 families and 10 species. Of these, 9 species belonged to the suborder Anisoptera and 1 species to the suborder Zygoptera. Members of the suborder Anisoptera identified in the study belonged to the families Libellulidae and Gomphidae, while the single Zygoptera species belonged to the family Coenagrionidae. Most stages of the dragonfly life cycle are aquatic. Aquatic ecosystems serve as essential habitats for dragonflies due to their life cycle requirements. Their primary habitats include freshwater environments such as rivers, reservoirs, ponds, lakes, and rice fields. These aquatic habitats typically require surrounding vegetation such as trees, forests, or shrubs. The habitat condition of Tun Telanai Lake is characterized by a relatively open and extensive vegetative structure, with abundant trees and shrubs. This favorable habitat contributes to the relatively high number of dragonfly individuals found in the area. According to Zumar et al. (2024), factors that influence the presence and distribution of dragonfly species include habitat conditions, resource availability, sufficient food to support their life cycle, and migration ability that allows them to relocate to areas with more favorable environmental conditions.

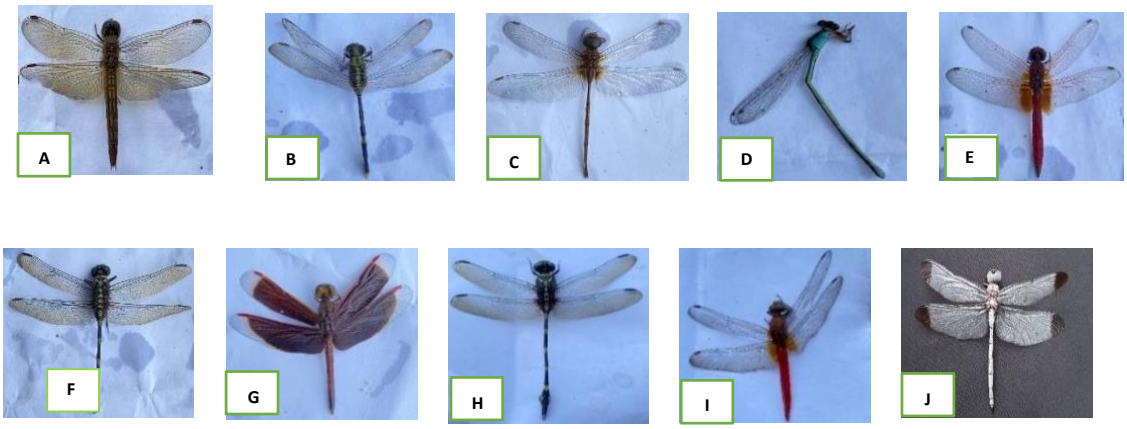

Figure 1. The species of dragonflies found at the research site include: (A) *Brachythemis contaminata*, (B) *Orthetrum sabina*, (C) *Zyxomma petiolatum*, (D) *Amphicnemis gracilis*, (E) *Orthetrum testaceum*, (F) *Common flangetail*, (G) *Neurothemis fluctuans*, (H) *Igtinoghompus decoratus*, (I) *Orthetrum chrysis*, (J) *Zyxomma obtusum*.

Based on observations conducted in the Tun Telanai Lake area of Jambi University, dragonflies from 3 families and 10 species were recorded, namely: the family Libellulidae (7 species), Gomphidae (2 species), and Coenagrionidae (1 species). Libellulidae is a family of dragonflies within the suborder Anisoptera, and it was the most frequently found family in the Tun Telanai Lake area. The identified species include *Brachythemis contaminata, Neurothemis fluctuans, Orthetrum chrysis, Orthetrum sabina, Orthetrum testaceum, Zyxomma obtusum*, and *Zyxomma petiolatum*. The Libellulidae family is one of the most diverse within the order Odonata

and is cosmopolitan in distribution, allowing its members to be found in various habitats (Ruslan, 2020). Additionally, Siregar (2016) noted that most members of the Libellulidae family are aggressive predators with high survival capabilities. From the Gomphidae family, two species were found: the Common flangetail and Ictinogomphus decoratus. Gomphidae was the least represented Anisoptera family in this study. This family is typically found only in clean, flowing waters, making it rarely encountered in the Tun Telanai Lake area. This finding aligns with Muktitama et al. (2018), who reported that Gomphidae was the least frequently observed family in university campus areas.

Only one species, *Amphicnemis gracilis,* was found from the Coenagrionidae family. Among the three families found in the Tun Telanai Lake area, Coenagrionidae was the only representative of the Zygoptera suborder and was rarely observed. Dragonflies from the Coenagrionidae family are typically preyed upon by those from the Libellulidae family. To avoid predation, Coenagrionidae members often hide within plant foliage, making them more difficult to detect (Putri et al., 2019).

A. *Brachythemis contaminata*

This is a widely distributed terrestrial dragonfly species characterized by an orange-colored body **(Figure 1a)**. It has yellowish-brown compound eyes, and both the thorax and abdomen are orange-brown in color, with an abdominal length ranging from 18 to 21 mm. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata Subordo
: Anisoptera Family
: Libellulidae
Genus : *Brachythemis*
Species : *Brachythemis contaminata*

B. *Orthetrum sabina*

This dragonfly has a medium-sized, slender body **(Figure 1b)**. The thorax is dark green with black lateral stripes. Its abdomen is slender, black and white in color, and the wings are transparent with brown pterostigma. The eyes are green, and there are dark orange bristly hairs present on the anterior lamina. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata
Subordo : Anisoptera
Family : Libellulidae
Genus : *Orthetrum*
Species : *Orthetrum sabina*

C. *Zyxomma petiolatum*

This dragonfly has eyes that are brown on the upper part and green on the lower part **(Figure 1c)**. The thorax is light brown, the wing bases are black, and the pterostigma is also black, with visible genitalia. The body is light brown with a black stripe running along it. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata
Subordo : Anisoptera
Family : Libellulidae
Genus : *Zyxomma*
Species : *Zyxomma petiolatum*

D. *Amphicnemis gracilis*

This is a medium-sized blue damselfly with an orange face **(Figure 1d)**. The synthorax is bright olive green on the dorsal side and bluish on the lateral sides. The abdomen is mostly black with bluish markings. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata Subordo
: Zygoptera Family
: Coenagrionoidae
Genus : *Amphicnemis*
Species : *Amphicnemis gracilis*

E. *Orthetrum testaceum*

This is one type of dragonfly that has compound eyes which are reddish-brown on the upper part and yellowish-green on the lower part **(Figure 1e)**. It possesses two pairs of transparent wings with yellow spots at the tips. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata
Subordo : Anisoptera
Family : Libellulidae
Genus : *Orthetrum*
Species : *Orthetrum testaceum*

F. *Common flangetail*

This is a type of dragonfly with widely separated eyes and large appendages, including a prominent inferior anal appendage that curves upward to touch the outer surface of the superior appendage **(Figure 1f)**. It also displays distinct patterns on the thorax and abdomen. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata
Subordo : Anisoptera
Family : Gomphidae
Genus : *Common*
Species : *Common flangetail*

G. *Neurothemis fluctuans*

This species of dragonfly has red coloration on the hindwings **(Figure 1g)**, which curves from the right side of the pterostigma toward the wing base. The wings are transparent with slight yellow markings at the tips, bases, and along the anterior margins. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta
Ordo : Odonata
Subordo : Anisoptera
Family : Libellulidae

Genus : *Neurothemis*

Species : *Neurothemis fluctuans*

H. *Igtinoghompus decorates*

This species of dragonfly has medium-sized eyes that are widely separated and gray to green in color **(Figure 1h)**. It has two relatively narrow black stripes on the sides of the thorax that reach the midline. All four wings display a brown color gradient on the lower part. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta

Ordo : Odonata Subordo
: Anisoptera Family
: Gompihdae Genus
: *Igtinoghompus*

Species : *Igtinoghompus decoratus*

I. *Orthetrum chrysis*

This is a medium-sized species of dragonfly with a dark thorax and a blood-red abdomen. It has a thin black stripe running along the length of the abdomen **(Figure 1i)**. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta

Ordo : Odonata
Subordo : Anisoptera
Family : Libellulidae
Genus : *Orthetrum*

Species : *Orthetrum chrysis*

J. *Zyxomma obtusum*

Morphologically, this dragonfly has a short, thick **(Figure 1j)**, brown-colored abdomen. Its wings are transparent with a slightly brownish tint. The forewings and hindwings are similar in size and shape. It has a dark-colored stigma (a small pigmented patch) near the tip of each wing. The taxonomic classification of this species is as follows.

Kingdom : Animalia
Phyum : Arthropoda
Class : Insecta

Ordo : Odonata
Subordo : Anisoptera
Family : Libellulidae
Genus : *Zyxomma*

Species : *Zyxomma obtusum*

Table 1. Dragonfly Species Data in the Tun Telanai Lake Area, Jambi University

No	Family	Species	Replication			Total
			I	II	III	
1.	Libellulidae	*Brachythemis contaminata*	13	15	10	38
		Neurothemis fluctuans	16	13	5	34
		Orthetrum chrysis	-	1	-	1
		Orthetrum sabina	1	-	-	1
		Orthetrum testaceum	2	-	-	2
		Zyxomma obtusum	-	1	-	1
		Zyxomma petiolatum	1	-	-	1
2.	Ghompidae	*Igtinoghompus decoratus*	-	5	-	5
		Common flangetail	-	1	-	1
3.	Coenagrionoidae	*Amphicnemis gracilis.*	1	-	-	1
						85

The presence of seven species from the Libellulidae family indicates that the habitat of Tun Telanai Lake at Jambi University provides sufficient space and resources to support predator species, which generally dominate open water bodies with high light intensity. Among all dragonfly species identified, *Brachythemis contaminata* was the most abundant, with a total of 38 individuals. The least observed species were *Amphicnemis gracilis, Common flangetail, Orthetrum chrysis, Orthetrum sabina, Zyxomma obtusum,* and *Zyxomma petiolatum,* each of which was represented by only a single individual.

Table 2. Species Diversity Index of Dragonflies

Species	Number (ni)	Pi (ni/N)	Ln Pi	Pi.Ln Pi
Brachythemis contaminata	38	0,447059	-0,80507	-0,35991
Neurothemis fluctuans	34	0,4	-0,91629	-0,36652
Orthetrum chrysis	1	0,011765	-4,44265	-0,05227
Orthetrum sabina	1	0,011765	-4,44265	-0,05227
Orthetrum testaceum	2	0,023529	-3,7495	-0,08822
Zyxomma obtusum	1	0,011765	-4,44265	-0,05227
Zyxomma petiolatum	1	0,011765	-4,44265	-0,05227
Common flangetail	1	0,011765	-4,44265	-0,05227
Igtinoghompus decoratus	5	0,058824	-2,83321	-0,16666
Amphicnemis gracilis	1	0,011765	-4,44265	-0,05227
H’				1,29491

The results of the species diversity analysis of dragonflies (order Odonata) in the Tun Telanai Lake area of Jambi University showed a Shannon-Wiener diversity index (H') of 1.29. This value falls into the moderate category, as it lies within the range of 1.0-3.0. This level of species diversity generally indicates that the habitat conditions are relatively favorable for the survival of dragonflies. Environmental factors in the Tun Telanai Lake area sufficiently support the dragonfly life cycle, suggesting that there are only minimal disturbances threatening their sustainability. An ecosystem with a high diversity index tends to be stable, while one with a low index is often under stress or degradation (Ulum, 2012). The variation in the number of dragonfly species identified in this study may be influenced by multiple factors, particularly environmental conditions that are closely linked to dragonfly activity. Environmental variables can cause differences in the abundance of dragonfly individuals in a given area. According to Putri et al. (2019), dragonflies can only be active when environmental conditions fall within their tolerance range. The effective temperature range for dragonfly activity is between 15-45°C.

Light intensity is also an important factor influencing their behavior. In the morning, when the sun begins to shine, dragonflies become active in foraging and reproduction. Consequently, on sunny days, dragonflies are generally more active and harder to approach. However, according to research by Klym and Quinn (2003), in the afternoon, dragonflies tend to be less active as they have accumulated enough heat energy, prompting them to rest and lower their body temperature. This variation in activity between morning and afternoon aligns with the findings of Syarifah et al. (2018), which reported that dragonfly presence is over 90% more frequent in the morning compared to only around 10% in the afternoon. This supports the idea that differences in activity levels influence the variation in dragonfly species observed throughout the day.

The predominance of dragonfly species in lake habitats indicates that aquatic ecosystems are more favorable to dragonflies than terrestrial environments, although terrestrial habitats still play an important role in their life cycle. This aligns with the general ecological characteristics of dragonflies, which are closely associated with aquatic ecosystems (Ibnusivva and Kurnia, 2023). Dragonflies (Odonata) are among the organisms commonly used as bioindicators. The sensitivity of Odonata nymphs to environmental changes makes them highly visible indicators of ecosystem health. A decline in Odonata populations in a particular area can signal deterioration in water and environmental quality. In addition, Odonata serve as ecological quality indicators in river ecosystems such as the Brantas River, where their existence is increasingly threatened by pollution from both solid and liquid waste (Klym, 2003).

CONCLUSION

Based on the study of dragonfly (Odonata) species diversity in the Tun Telanai Lake area of Jambi University, it can be concluded that 10 species belonging to 3 families were identified, with the Libellulidae family being the most dominant. Observations indicated that Brachythemis contaminata was the species with the highest number of individuals, while several other species were found in very limited numbers.

The scope of this study was limited to a specific observation period and did not include continuous monitoring of dragonfly populations in the Tun Telanai Lake area. Future research is recommended to include regular and long-term monitoring in order to obtain more comprehensive and varied data on population dynamics and the environmental factors influencing them.

AUTHORS CONTRIBUTION

Pasaribu. contributed to data collection, Naily assisted with sample preparation, Ismi Involved in statistical data analysis, Maya participated in conducting the experimental, Sabrina contributed to writing the manuscript and reviewing relevant literature, Amanda and Ade assisted with experiment documentation, Tia supported the experimental procedures and Evrilia supervised for the research, contributed to conceptualizing the study, designing experiments.

CONFLICT OF INTEREST

The authors declare no conflicts of interest and take full responsibility for the content of the article, including any implications of AI-generated art.

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