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Investigation of Dragonfly Diversity and Distribution in Sulur Lake, Coimbatore District, Tamilnadu, India

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Abstract:
Coimbatore district is home to numerous wetlands, with Sulur Lake chosen for the current study. The study examined the physico-chemical properties of the water in wetland, revealing that Sulur Lake is heavily polluted, as its water quality exceeds the permissible limits set by the WHO. Since dragonflies are considered both indicators and flagship species of wetland ecosystems. The survey identified a total of 10 species of dragonflies. Among the wetlands surveyed, Sulur had the highest dragonfly diversity, which also corresponded with its high pollution levels. The study concluded that dragonfly diversity is not directly influenced by water quality, but rather the vegetation (both aquatic and marginal) in these wetlands may play a significant role in their abundance.

Keyword: **Sulur lake, Odonates, Physico-chemical parameter and Diversity**

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INTRODCUTION

Odonata is an order of predatory flying insects that includes both dragonflies and damselflies (as well as the *Epiophlebia damsel*-dragonflies). The two main groups are differentiated by dragonflies (Anisoptera), which are generally bulkier with large, together compound eyes and wings held out or upward when at rest, while damselflies (suborder: Zygoptera) are typically slenderer, with eyes placed apart and wings folded together along the body when resting. Adult odonates can land and perch, but they rarely walk. All odonates have aquatic larvae known as naiads or nymphs, and both larvae and adults are carnivorous, primarily feeding on insects. However, during the larval stage, they may consume any small prey they can overpower, including small fish, tadpoles, and even adult newts. As adults, they are exceptional aerial hunters, with specialized legs designed to capture prey while in flight. The phylogenetic tree of the orders and suborders of odonates, as presented by Bybee et al. 2021, illustrates their evolutionary relationships.
Odonates are aquatic or semi-aquatic during their juvenile stage. As a result, adults are typically found near bodies of water and are often referred to as aquatic insects. However, some species can be found far from water. Throughout their life, odonates are carnivorous, primarily feeding on smaller insects (May et al., 2019). Male odonates possess complex genitalia, which are different from those of other insects. These include grasping cerci at the tip of the abdomen to hold onto the female, and a secondary set of copulatory organs located between the second and third abdominal segments, where spermatozoa are

stored after being produced by the primary genital organs. The external opening of the primary genitals is called the genital pore, located on the ninth abdominal segment. This process, known as intra-male sperm translocation (ST), is described by Kirti et al. (2004) and the U.N. Food and Agriculture Organization (2019). Since the male copulatory organ evolved independently of other insects, it is believed that stem-group dragonflies initially had external sperm transfer. During mating, the male uses his claspers to grasp the female by the thorax (Zygoptera) or head (Anisoptera), while the female bends her abdomen to align her genitalia with the male's copulatory organ, where the sperm is stored. This is called the "wheel" position. In Anisoptera, mating often occurs while the male is flying, lifting the female into the air. The process typically lasts from a few seconds to a couple of minutes. In Zygoptera, males' mate while perched and may move to different locations during mating, which can extend the process to five to ten minutes. Male odonates are highly competitive during mating, and in some species, males use the cerci at the tip of their abdomen to remove sperm from a rival male and replace it with their own (Mating and Reproduction in Odonata and Odonata: Dragonflies and Damselflies, Retrieved: 2024).

Dragonflies and damselflies, collectively known as odonates, are among the most common insects seen flying over forests, fields, meadows, ponds, and rivers, and are often referred to as bio-indicators of aquatic ecosystems. As flagship insect species, they indirectly influence the trophic balance of lake ecosystems. Globally, there are about 5,740 known species of odonates, with 470 species in 139 genera across 19 families found in India (Subramanian, 2009). In Tamil Nadu, Kandibane et al. (2005) recorded 12 species in irrigated rice fields in Madurai, while Gunathilagaraj et al. (1999) documented 16 species of odonates in the rice fields of Coimbatore. A more recent study by Arulprakash and Gunathilagaraj (2010) found 21 species of odonates (14 species of Anisoptera and 7 species of Zygoptera) across 17 genera and four families in 13 temporary water bodies in the Coimbatore and Salem districts of Tamil Nadu. Vincent et al. (2008) noted that certain families of Anisoptera depend on water habitat characteristics; for example, members of Coenagrionidae and Libellulidae are more common in stagnant water systems (Rehn, 2003). There may be a connection between the nature of water systems and the preference of specific anisopteran groups for certain environments. Several studies have indicated that environmental and temperature conditions can influence species diversity, a view supported by Fraser (1933) and Subramanian (2005), who found that shade and aquatic vegetation favor Zygoptera over Anisoptera. Based on these findings, this survey aims to study the impact of biotic factors, such as water characteristics and aquatic vegetation, on the species diversity of dragonflies in selected wetlands of Coimbatore, Tamil Nadu.

MATERIALS AND METHODS

1.Study Area: The survey was conducted in Sulur being located at 11°01′31″N 77°07′29″E in the Coimbatore region, during November 2024.

2.Collection and Preservation: Dragonflies were collected using a hand sweep net, and a random field sampling method was employed to cover the entire study area. The insects were pinned and photographed using images from The Odonata of India Website Team. Identification was based on wing venation, color patterns, and genitalia, as described in available identification keys and guides such as those by Fraser (1957), Subramanian (2005), and Emiliyamma (2005). The date of collection, locality, and other relevant details for each specimen were recorded.

3.Physico-Chemical Parameters: The physico-chemical parameters were determined following the standard methods outlined by APHA (1998). Parameters like pH, temperature, salinity, total dissolved solids (TDS), and electrical conductivity (EC) were recorded on-site using a portable μ-Water and Soil Analysis Kit (Model -1160). Dissolved oxygen was measured using the Winkler method, and other parameters such as alkalinity, total hardness, chloride, and chemical oxygen demand (COD) were determined using standard titrimetric methods.

FIGURES

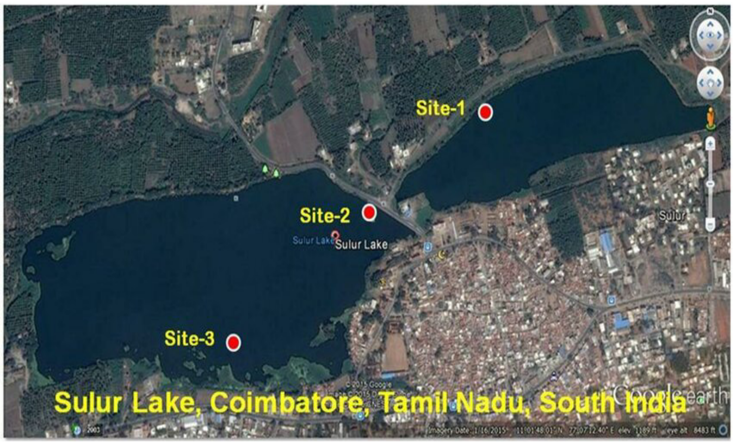
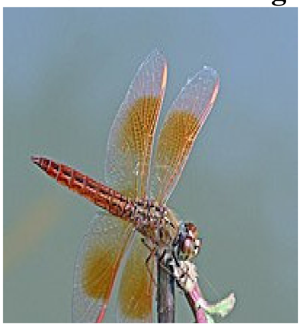
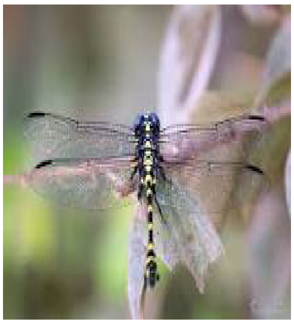


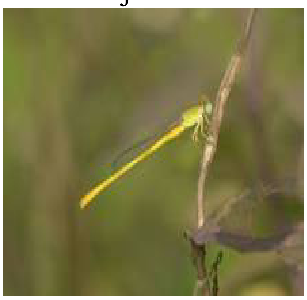
Figure:1. The survey was conducted in Sulur lake being located at 11°01′31″N 77°07′29″E

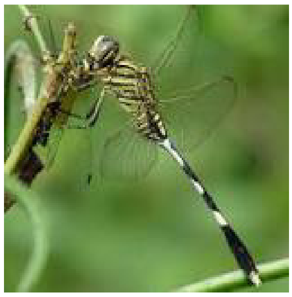

1.Ruddy marshy

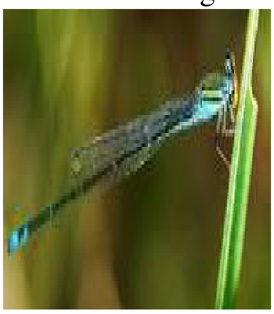

2. Ditch jewel

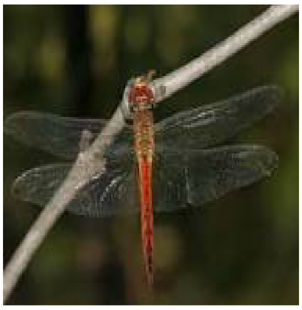

3.Club tail

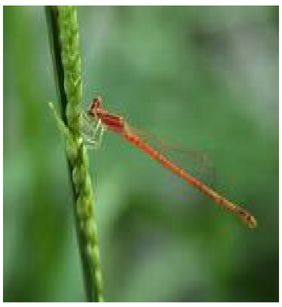

4. Picture wing


5. Coromandel marsh dot


6. Green marsh hawk


7.Saffron based blue dot


8.Wandering glider


9.Agriocnemis (Genus)


10.Black march trotter

Figure:2. (1 to 10) The insects were pinned and photographed using images from The Odonata of India Website Team.

Table:1. Physico-Chemical Parameters of Sulur Wetland

S. No.	Parameter	Sulur lake
1.	pH	6.728 ± 0.61
2.	Temperature (°C)	31.057 ± 4.18
3.	EC (µs/cm)	1133.680 ± 122.97
4.	Salinity (ppt)*	1.9406 ± 0.562
5.	Alkalinity (mg/L of CaCO3)	367.311 ± 72.42
6.	TDS (ppt)*	2.538 ± 0.700
7.	Total Hardness (mg/L)	310.871 ± 64.460
8.	Chloride (mg/L)	170.55 ± 51.789
9.	DO (mg/L)	1.935 ± 0.541
10.	BOD (mg/L)	44.665 ± 2.836
11.	COD (mg/L)	20.925 ± 4.851

Water and Soil Analysis kit model -1160

Table:2. The overall count of individuals recorded in Sulur Lake during November 2024.

S. No.	Species name	Total Number of Individuals Recorded
1.	Ruddy marshy	1
2.	Ditch jewel	168
3.	Club tail	11
4.	Picture wing	2
5.	Coromandel marsh dot	5
6.	Green marsh hawk	2
7.	Saffron based blue dot	4
8.	Wandering glider	65
9.	Agriocnemis (Genus)	1
10.	Black march trotter	1

RESULTS

Physico-Chemical Parameters of Sulur Wetland

The physico-chemical parameters of Sulur Lake were analyzed in November 2024 to understand the water quality of the wetland. The pH of the water was found to be 6.728 ± 0.61, indicating slightly acidic conditions. The temperature of the water was recorded as 31.057 ± 4.18°C, which is typical of tropical wetlands. Electrical conductivity (EC) was measured at 1133.680 ± 122.97 µs/cm, suggesting a moderate level of ion concentration in the water. Salinity was recorded at 1.9406 ± 0.562 ppt, indicating a mildly saline environment.

The alkalinity of the water, represented as mg/L of $CaCO_3$, was 367.311 ± 72.42, reflecting a moderately alkaline condition. Total Dissolved Solids (TDS) was recorded as 2.538 ± 0.700 ppt, which is typical for freshwater bodies with some saline influence. The total hardness of the water was found to be 310.871 ± 64.460 mg/L, suggesting moderate hardness levels, likely due to the presence of calcium and magnesium ions.

The chloride concentration was 170.55 ± 51.789 mg/L, which is a significant indicator of salinity. The Dissolved Oxygen (DO) levels were recorded at 1.935 ± 0.541 mg/L, suggesting that oxygen availability in the water was relatively low, which may be associated with organic decomposition processes. The Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) were found to be 44.665 ± 2.836 mg/L and 20.925 ± 4.851 mg/L, respectively, both of which are relatively high, indicating moderate pollution or organic load in the lake. All measurements were taken using the Water and Soil Analysis kit model -1160.

Dragonfly Species Recorded in Sulur Lake

A total of 138 dragonflies were recorded in Sulur Lake during the survey period of November 2024. Ten species were identified, each with varying population sizes. Among the species recorded, the Ditch Jewel (*Nannophya pygmaea*) was the most abundant, with 168 individuals. This was followed by the Wandering Glider (*Pantala flavescens*) with 65 individuals, and the Club Tail (*Ictinogomphus sp.*) with 11 individuals.

Other species included the Ruddy Marshy (*Orthetrum pruinosum*), Picture Wing (*Rhinagrion kennedyi*), and Coromandel Marsh Dot (*Ceriagrion coromandelianum*), each with low individual counts (1, 2, and 5, respectively). The Green Marsh Hawk (*Aeshna viridis*), Saffron-based Blue Dot (*Ceriagrion aureum*), and Agriocnemis (*Agriocnemis sp.*) had even lower counts of 2, 4, and 1 individual, respectively. The Black March Trotter (*Brachythemis contaminata*) was the least abundant, with only 1 individual recorded. The overall diversity of species in Sulur Lake suggests that the wetland provides a suitable habitat for a variety of dragonfly species, although the population of certain species, such as the Ditch Jewel and Wandering Glider, is notably higher compared to others.

DISCUSSION

Coimbatore city is home to 28 major wetlands, mostly fed by the river Noyyal. These river and river-fed lakes support a wide range of plants (Chandrabose and Nair, 1988) and animals, including migratory bird species. Wetlands play a crucial role in urban biodiversity by supporting species diversity and regulating the ecological balance. However, many of these wetlands dry up in the summer and are often used as dumping grounds for garbage and industrial waste. Several studies have analyzed the physico-chemical parameters of these wetlands, examining pollution from industrial, municipal, and domestic sources, as well as heavy metal contamination. Mohanraj et al. (2000) assessed the pollution status of 8 lakes in Coimbatore (Selvachinthamani Lake, Singanallur Lake, Ukkadam Lake, Perur Lake, Valankulam, Ammankulam, Selvampatti Lake, and Kumarasamy Lake), and reported that the pH, COD, and DO levels of Kumarasamy wetland were significantly low. In contrast, our results show high levels of EC, alkalinity, TDS, BOD, and chloride, indicating maximum pollution. Regarding the Singanallur wetland, Mohanraj et al. (2000) found that pH, EC, alkalinity, chloride, total hardness, DO, and COD were higher in their study compared to our results, but TDS and BOD levels were lower. The increase in pH observed in the current study suggests a rise in pollution levels in the wetland.

Odonate species belonging to the "percher" behavioral guild may rely on riparian understory vegetation, as adults use plant perches to guard breeding territories, thermoregulate, and watch for prey (Corbet, 1999). Previous studies have shown that adult dragonfly populations are most abundant in areas with tall lake plants (Foote and Hornung, 2005), likely because these plants serve as suitable perching structures. In the present study, all the wetlands had riparian vegetation, but Sulur and Singanallur wetlands, in particular, had abundant marginal vegetation that supported the distribution of dragonflies, encouraging their abundance and diversity. These wetlands provided favorable conditions for perching, oviposition, territorial behavior by male dragonflies, and prey capture. These factors were key reasons for the high diversity of dragonflies in the Sulur and Singanallur wetlands.

Dragonfly diversity was highest in December, as the water levels were considerably higher and the temperature was lower compared to the other months in the study period. The water levels were maintained from the previous monsoon rains, even though there was little rainfall in December and January. From the combined analysis of the physico-chemical parameters and dragonfly diversity in the wetlands studied, it is clear that Sulur Lake had the highest diversity, despite the water quality of this lake exceeding the permissible limits set by WHO.

During the study period, Singanallur and Kumarasamy wetlands exhibited a significant presence of floating aquatic plants, mainly *Eichhornia crassipes*. This distribution of *Eichhornia* was previously reported by Mohanraj et al. (2000) in Singanallur wetland. According to Steytler and Samways (1995), nine types of vegetation were identified as key factors influencing dragonfly abundance: tall emergent sedges, bush, grasses (short grass, broad-bladed grass), water-surface plants, water-lilies, and forests. In the present study, water-surface plants, such as *Eichhornia*, were widely distributed along the margins of Singanallur and Sulur wetlands. These plants likely enhanced dragonfly distribution by supporting ovipositional activity, prey capture, and territorial behavior. Additionally, the marginal vegetation in both wetlands mainly consisted of tall grasses and weeds. Studies by Kandibane et al. (2005) suggested that dragonfly species preferred ecosystems with a tillering stage because the canopy of weed plants and rice crops covered the surface area, creating a favorable microclimate for dragonfly abundance. Therefore, the riparian vegetation in Singanallur and Sulur wetlands facilitated perching and oviposition behavior, which could explain the higher distribution of dragonflies in these wetlands. In contrast, Narasampathy wetland lacked aquatic vegetation and had only trees along the lake's banks, providing shaded areas. As a result, the absence of vegetation likely contributed to the lower distribution of dragonflies in this wetland, despite its relatively low pollution levels.

CONCLUSION

In conclusion, Sulur Lake provides a habitat that supports a range of dragonfly species, but variations in abundance between species could be indicative of environmental factors affecting their distribution. The physico-chemical parameters highlight the need for continued monitoring to assess the impact of water quality on biodiversity and to ensure the sustainable management of this wetland. Future studies focusing on the ecological interactions within the lake will provide further insights into the conservation needs of this important habitat.

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