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# Species composition, distribution insights and seasonal variation of Odonata in the Madhuranthagam Block of Chengalpattu district, Tamil Nadu, India

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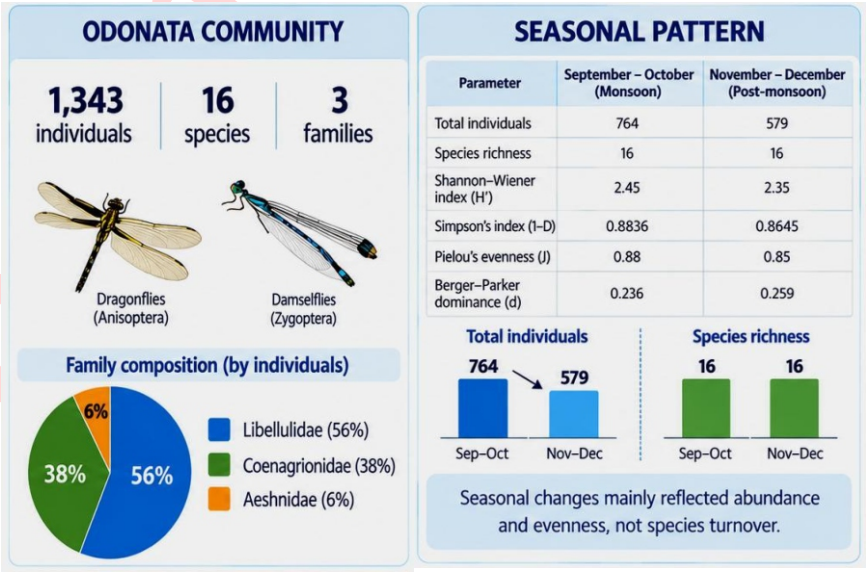
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## Abstract

**Aim:** To assess species composition, diversity, seasonal variation, and habitat preference of Odonata in the Madhuranthagam Block of Chengalpattu district, Tamil Nadu, India. The study also examined the influence of seasonal changes, if any, on the abundance and community structure of odonates.

**Methodology:** Field surveys were conducted from September to December 2025 across wetlands, paddy fields, and associated habitats using fixed-area transect and visual encounter methods. Species were identified using standard taxonomic keys, and the species abundance data were analyzed using diversity indices such as Shannon-Wiener, Simpson's, Margalef's richness, Pielou's evenness and Berger-Parker dominance indices.

**Results:** A total of 1,343 individuals representing 16 species across three families were recorded in the study area, with Libellulidae being the dominant family (56%), followed by Coenagrionidae (38%) and Aeshnidae (6%). Species belonging to the suborder, Anisoptera contributed 63 per cent and Zygoptera accounted 37 per cent. Species such as *Pantala flavescens, Diplacodes trivialis* and *Ischnura rubilio* were found dominant throughout the study period. Higher abundance and diversity were recorded during September–October 2025 compared to November–December 2025, although species richness remained constant.




| Parameter | September – October (Monsoon) | November – December (Post-monsoon) |
|---|---|---|
| Total individuals | 764 | 579 |
| Species richness | 16 | 16 |
| Shannon–Wiener index (H') | 2.45 | 2.35 |
| Simpson's index (1–D) | 0.8836 | 0.8645 |
| Pielou's evenness (J) | 0.88 | 0.85 |
| Berger–Parker dominance (d) | 0.236 | 0.259 |

**Interpretation:** The findings revealed that the monsoon-driven wetland conditions significantly enhanced the Odonata abundance and evenness, while seasonal decline affected relative abundance rather species composition. Wetlands and paddy ecosystems play a critical role in sustaining odonate assemblages in the region. The study provides a baseline data for Chengalpattu district and highlights the need for wetland conservation and habitat restoration to maintain biodiversity and ecological stability.

**Key words:** Diversity indices, Dragonfly, Odonata, Seasonal variation, Species distribution

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## Introduction

Odonata, an insect order that includes dragonflies (suborder: Anisoptera) and damselflies (suborder: Zygoptera), are ecologically significant taxa and widely recognized for their predatory role in both aquatic larval and terrestrial adult stages (Corbet, 1999). Globally, 6,335 Odonata species have been documented, and distributed across 693 genera. In India, 493 species and 27 subspecies belonging to 152 genera and 18 families have been recorded (Subramanian and Babu, 2017; Paulson *et al.,* 2025; Goswami *et al.,* 2025). They play a crucial role in maintaining the ecological balance by preying on various pest species, thereby contributing to natural pest management. Odonates are considered as effective bio-indicators due to their sensitivity towards environmental changes, particularly those invading freshwater ecosystems (Paulson *et al.,* 2008).

Recent studies have further highlighted the ecological significance of odonates in assessing freshwater habitat quality, climate-driven biodiversity changes, and agroecosystem sustainability across tropical landscapes (Mukherjee *et al.,* 2024; Vijayakumaran *et al.,* 2025; Castillo-Perez *et al.,* 2025). Their habitat and diversity often reflects on ecological health, making them valuable for biodiversity assessments and conservation planning. Agricultural landscapes dominate much of the Indian subcontinent, offering a mosaic of habitats influenced by irrigation systems, cropping patterns, and the use of agrochemicals. Previous studies have demonstrated that wetlands and paddy ecosystems provide highly suitable habitats for odonates because they support standing water, aquatic vegetation, abundant prey organisms, and suitable oviposition sites for larval development (Arulprakash and Gunathilagaraj, 2010; Paul *et al.,* 2024). Rice-field ecosystems often function as semi-natural wetlands during crop growth stages, therefore sustain diverse dragonfly and damselfly assemblages.

Odonates are highly sensitive and react immediately to even a small change in their habitat. Wetland ecosystems are very important for their life cycle, particularly for oviposition and nymphal development. Odonate females deposit eggs directly in water or on aquatic vegetation. The larval (nymphal) stage is fully aquatic, necessitating appropriate water depth, oxygen levels, and prey availability for successful development (Corbet, 1999; Subramanian, 2005). Any changes in the structure of wetlands, water quality, or vegetation can directly affect their populations. Odonates are commonly associated with wetlands and rice-field ecosystems, where their occurrence and abundance reflect habitat quality, water availability, and seasonal environmental conditions. This makes them good indicators of health of agricultural landscapes. Consequently, the examination of Odonate diversity, species composition, and seasonal variation in wetland-associated rice fields yields significant insights into freshwater ecosystem health and facilitates conservation planning in agro-ecosystems (Simaika and Samways, 2012; Janssen *et al.,* 2018). Application of diversity indices to measure species richness, dominance and evenness facilitates the assessment of biodiversity of insect communities. Diversity indices are commonly used in Odonata ecology to learn about the structure of communities, the habitat quality and stability of ecosystems in freshwater and agricultural areas (Subramanian, 2005; Simaika and Samways, 2012; Mukherjee *et al.,* 2024). Shannon–Wiener diversity index (H') is commonly used as it accounts both species richness and relative abundance, and thus it makes a good measure of overall diversity (Shannon, 1948). Another useful way to determine the common species of odonates available at a particular ecosystem is Simpson's diversity index (1–D). This measures the likelihood that two randomly selected individuals are from different species (Simpson, 1949). Margalef's richness measure (d), shows how many species are present based on the size of the sample and allows by comparing the species variety across environments and seasons (Margalef, 1996). On the other hand, Pielou's evenness index (J) measures how evenly individuals are spread across species. Berger and Parker's dominance index, measures how the most common species shape the structure of a community (Berger and Parker, 1970). Collectively, these indices provide a comprehensive review of biodiversity trends in odonates within their environments (Subramanian, 2005; Simaika and Samways, 2012).

Previous studies have reported the presence of Odonates in various water bodies throughout India (Fraser 1933, 1936; Prasad and Singh 1976, Ram *et al.,* 1982; Kaushik *et al.,* 1990; Arulprakash and Gunathilagaraj, 2010; Anbalagan and Ishwarya, 2024; Mukherjee *et al.,* 2024; Paul *et al.,* 2024; Parmar *et al.,* 2025; Vijayakumaran *et al.,* 2025). These studies have considerably improved the understanding of Odonata species composition, habitat preferences, seasonal occurrence, and their importance as indicators of freshwater ecosystem health. However, recent investigations have largely focused on species documentation and diversity assessments, while comparatively fewer studies have evaluated seasonal community dynamics in rice-based wetland ecosystems, particularly in rapidly changing agricultural landscapes of Tamil Nadu. Furthermore, information on Odonata diversity from Chengalpattu district remains unavailable despite the district containing extensive rice-growing wetlands that potentially support diverse odonate assemblages. Therefore, the present study provides the first systematic assessment of Odonata diversity in the Madhuranthagam Block of Chengalpattu district by documenting species composition, distribution patterns, habitat associations, and seasonal variation. The findings establish baseline biodiversity data for this unexplored region and provide valuable information for future ecological monitoring, wetland conservation, and sustainable management of rice agroecosystems.

## Materials and Methods

**Study area:** The study was conducted in the wetlands and paddy fields located in the Madhuranthagam Block, Chengalpattu. (12° 30' 42.01" N latitude and longitude 79° 53' 5.46" E) district, Tamil Nadu (India). The study area experiences a tropical wet-and-dry

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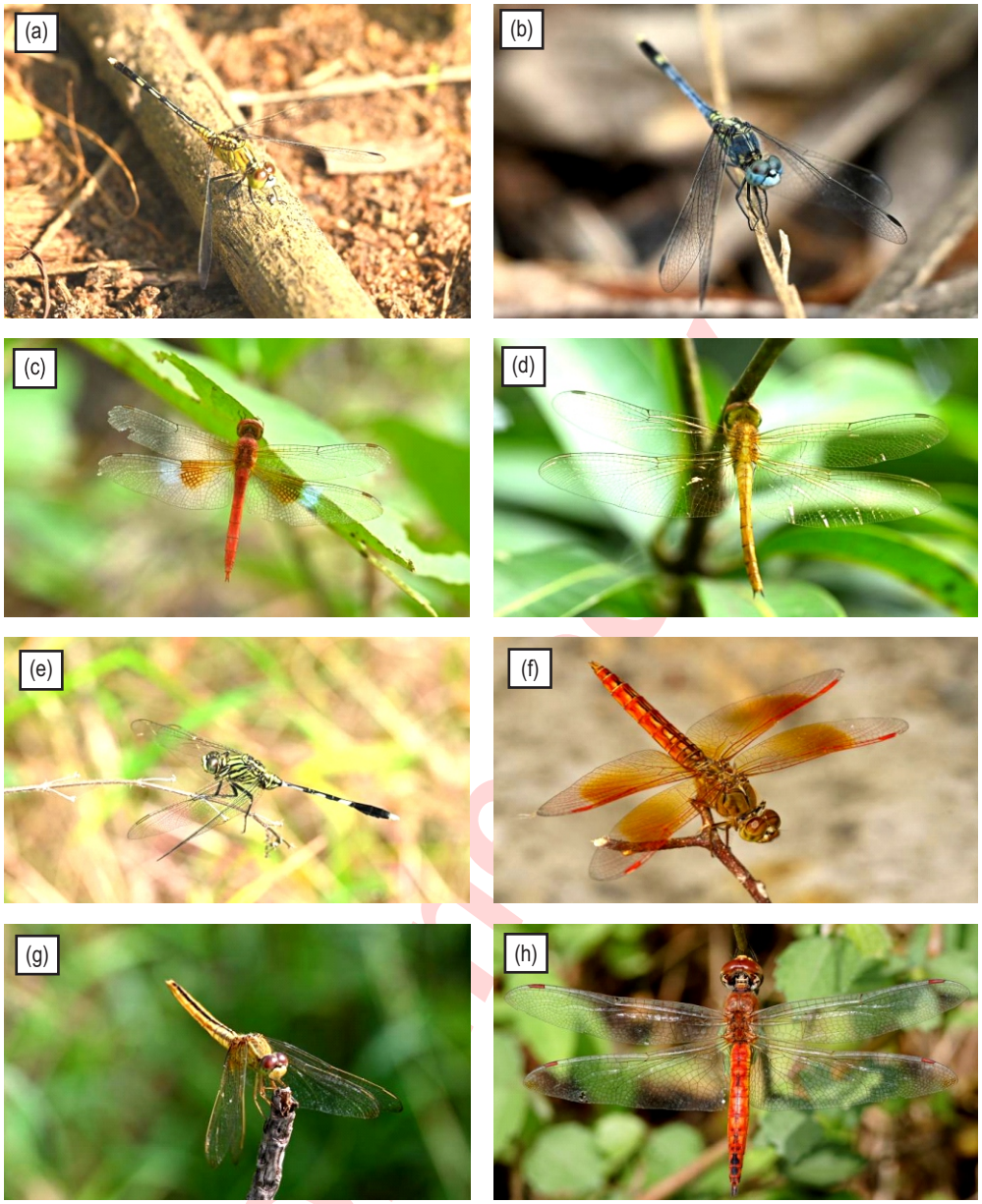



**Fig. 1:** Photographs of Odonata species. (a,b) *Diplacodes trivialis,* (c,d) *Tholymis tillarga,* (e) *Orthetrum sabina*, (f) *Brachythemis contaminata,* (g) *Crocothemis servilia* and (h) *Pantala flavescens*.

climate with warm temperature throughout the year and moderate seasonal variation.

**Sampling sites:** The sampling sites selected for conducting the study were wetlands, predominantly rice fields surrounded by water bodies such as ponds and lakes. Also, rice fields are well suited for the aquatic insects, as deep water layer provides an appropriate habitat for odonates to complete their life cycle. On the basis of these criteria, the following ten sites were selected for the study: S1-Orathy, S2-Baburayanpettai, S3-Elapakkam, S4-Acharapakkam, S5-Madhuranthagam, S6-L. Endathur, S7-Chithamur, S8-Karunguzhi, S9-Perumbakkam and S10-Veppankaranai.

**Sampling and data collection:** For sampling of Odonata, the fixed-area transect method and visual encounter surveys were used. This method involves an observer walking along the fixed transect lines that mark the perimeter of rice fields, documenting each Odonata species encountered (Ganeswari and Rajendran, 2025). Each study location featured two transect lines, spanning around 200 m, with Odonates observed along the transects being identified and recorded. Field surveys were conducted at each

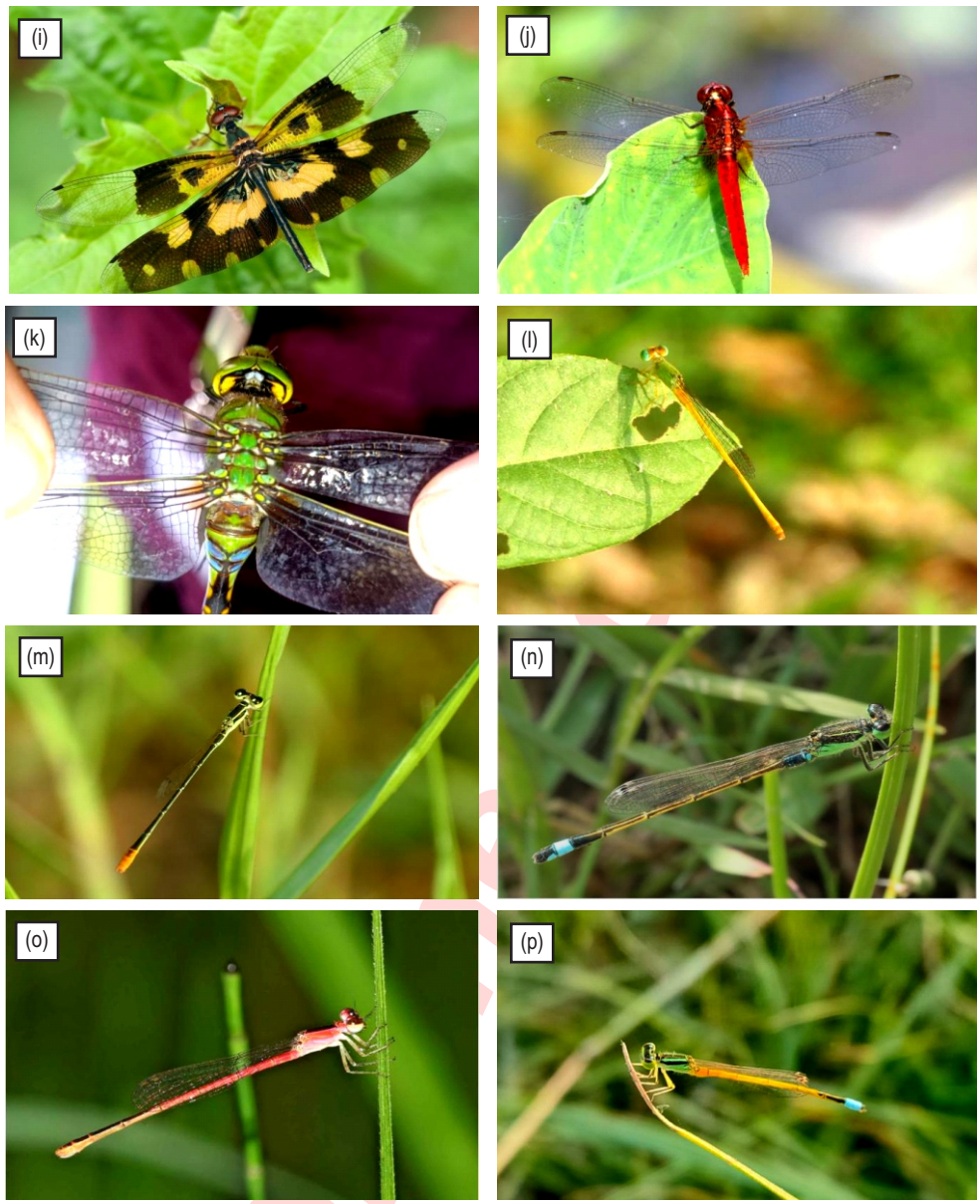



**Fig. 1:** Photographs of Odonata species. (i) *Rhyothemis variegata,* (j) *Rhodothemis rufa,* (k) *Anax indicus*, (l) *Ceriagrion coromandelianum*, (m) *Agriocnemis pygmaea*, (n) *Ischnura senegalensis*, (o) *Agriocnemis femina* and (p) *Ischnura rubilio*.

site from September 2025 to December 2025. Visits were scheduled from 10 am - 1 pm., as Odonates are most active during this time, especially on sunny and warm days, when they regulate their body temperature in sunlight. Species were documented via photography using a Nikon Z50 II mirrorless digital camera equipped with a 20.9-megapixel APS-C (DX-format) CMOS sensor. An aerial net was used, to capture the species that were difficult to identify in the field followed by taking photographs before their release.

**Identification of species:** Identification of species was done by following the taxonomic literatures (Fraser 1933, 1936) and field guides (Subramanian, 2005). Species name and their classifications were based on the works of Kalkman *et al.* (2020) and checklists given by Subramanian and Babu (2017; 2024). After identifying and counting the total number of specimens, they were released in the field. To ensure that specimens were correctly identified, photographs were used, and specimens that were uncertain were checked against well-known taxonomic literature.

**Analysis of different Species diversity indices:** Shannon–Wiener diversity index (H') was used as a primary measure to assess odonate diversity by incorporating both species richness and relative abundance (Shannon, 1948). Dominance pattern in

the odonata community was studied by Simpson's diversity index (1-D), where 'D' represents Simpson's Dominance Index (Simpson, 1949). Values closer to 1 indicate more diversity and less dominance. Pielou's evenness index (J) was used to assess the uniformity of individual distribution among the recorded odonate species. Values of *J* closer to 1 indicated a more even distribution of individuals among species, whereas lower values suggest dominance by a few species. Margalef's richness index (d) was used to measure species richness in relation to sample size (Margalef, 1996). Berger–Parker dominance index (d), which indicates the prevalence of most dominant species was (Berger and Parker, 1970). PAST 4.03 software was used to calculate the diversity indices. The recorded Odonata were categorized based on their abundance: VC: very common (70–100%); C: common (40–70%); R: rare (20–40%); and VR: very rare (below 20%).

## Results and Discussion

The recorded odonate fauna comprised two suborders, namely Anisoptera (dragonflies) and Zygoptera (damselflies), which were distinguished using standard external morphological characters described by Fraser (1933; 1936) and Subramanian (2005). Dragonflies were recognized by their robust bodies, broader hind wings, horizontally held wings at rest, and closely positioned compound eyes, whereas damselflies were identified by their slender bodies, similarly shaped forewings and hind wings, wings folded over the abdomen at rest, and widely separated compound eyes. Among the identified 16 odonata species, 10 belonged to the suborder Anisoptera and 6 belonged to the suborder Zygoptera (Fig. 1). A total of 16 species of Odonata belonging to three families (Libellulidae, Aeshnidae, and Coenagrionidae) were recorded. Libellulidae was the dominant member (56%), followed by Coenagrionidae (38%) and Aeshnidae (6%). *Pantala flavescens* (Fabricius) and *Diplacodes trivialis* (Rambur) were abundant in Anisoptera, whereas *Ischnura rubilio* (Selys) and *Ceriagrion coromandelianum* (Fabricius) were dominant among Zygoptera in the Madhuranthagam Block of Chengalpattu district. Dragonflies such as *P. flavescens* (Fabricius), *O. sabina* (Drury) and *D. trivialis* (Rambur) were commonly recorded from all the study sites. Only *I. rubilio* (Selys; Coenagrionidae) was predominantly present at all the study sites among the Zygoptera. The abundance of dragonflies (Libellulidae) and damselflies (Coenagrionidae) in the current study might be due to their shorter life cycle, widespread distribution (Norma-Rashid *et al.,* 2001), and tolerance to a wide range of habitats (Gentry *et al.,* 1975; Samways, 1989).

Among the recorded species, *Pantala flavescens, Diplacodes trivialis* and *Orthetrum sabina* were classified as very common and were observed at all ten study sites, indicating their

**Table 1:** List of different Odonata species (Sub Order: Anisoptera) recorded in the Madhuranthagam Block, Chengalpattu district

| Scientific species | Common name | Availability/ status |
|---|---|---|
| | **Family: Libellulidae** | |
| *Pantala flavescens* | Wandering glider | Very common |
| *Diplacodes trivialis* | Ground skimmer | Very common |
| *Tholymis tillarga* | Coral-tailed cloud wing | Common |
| *Crocothemis servilia* | Scarlet skimmer | Common |
| *Brachythemis contaminata* | Ditch jewel | Common |
| *Orthetrum sabina* | Green marsh hawk | Very common |
| *Rhodothemis rufa* | Rufous marsh glider | Rare |
| *Rhyothemis variegata* | Common picture wing | Common |
| *Zyxomma petiolatum* | Brown dusk hawk | Very rare |
| | **Family: Aeshnidae** | |
| *Anax indicus* | Elephant emperor | Very rare |

**Table 2:** List of different Odonata species (Sub Order: Zygoptera) recorded in the Madhuranthagam Block, Chengalpattu district

| Scientific species | Common name | Availability/ status |
|---|---|---|
| | **Family: Coenagrionidae** | |
| *Ceriagrion coromandelianum* | Coromandel marsh dart | Common |
| *Agriocnemis pygmea* | Pygmy dartlet | Common |
| *Ischnura senegalensis* | Senegal marsh dart | Rare |
| *Agriocnemis femina* | Pruinosed dartlet | Very rare |
| *Ischnura rubilio* | Western golden dartlet | Common |
| *Ceriagrion olivaeceum* | Rusty marsh dart | Very rare |

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**Table 3:** Different Population indeices of Odonata species recorded in the Madhuranthagam Block, Chengalpattu district

| Diversity indices | September–October (2025) | November–December (2025) |
|---|---|---|
| Species richness | 16 | 16 |
| Total individuals | 764 | 579 |
| Shannon–Wiener index (H') | 2.45 | 2.35 |
| Simpson's index (1-D) | 0.8836 | 0.8645 |
| Margalef's richness index (d) | 2.26 | 2.36 |
| Pielou's equitability | 0.8838 | 0.8473 |
| Berger–Parker dominance index (d) | 0.2356 | 0.2591 |

**Table 4:** Relative abundance of Odonata across the study sites in the Madhuranthagam Block, Chengalpattu district

| Scientific names | S1 | S2 | S3 | S4 | S5 | S6 | S7 | S8 | S9 | S10 |
|---|---|---|---|---|---|---|---|---|---|---|
| *Pantala flavescens* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| *Diplacodes trivialis* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| *Tholymis tillarga* | X | ✓ | ✓ | X | ✓ | X | X | ✓ | ✓ | ✓ |
| *Crocothemis servilia* | X | ✓ | X | ✓ | X | X | X | ✓ | ✓ | X |
| *Brachythemis contaminata* | X | X | ✓ | X | X | ✓ | ✓ | X | X | ✓ |
| *Orthetrum sabina* | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| *Rhodothemis rufa* | ✓ | X | X | X | X | X | X | X | ✓ | X |
| *Rhyothemis variegata* | ✓ | ✓ | ✓ | X | ✓ | X | ✓ | ✓ | X | X |
| *Zyxomma petiolatum* | X | X | X | X | X | X | ✓ | X | X | X |
| *Anax indicus* | X | X | X | X | X | X | X | ✓ | X | X |
| *Ceriagrion coromandelianum* | ✓ | ✓ | X | X | ✓ | X | ✓ | X | X | X |
| *Agriocnemis pygmea* | ✓ | X | ✓ | ✓ | X | X | X | ✓ | X | X |
| *Ischnura senegalensis* | X | X | ✓ | X | X | X | X | X | X | X |
| *Agriocnemis femina* | X | X | X | X | X | X | X | X | ✓ | X |
| *Ischnura rubilio* | X | ✓ | X | ✓ | ✓ | X | X | X | X | ✓ |
| *Ceriagrion olivaeceum* | X | X | X | X | X | ✓ | X | X | X | X |

*S1-S10 - Study sites; ✓ - Present; X - Absent

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wide distribution and ecological adaptability. In contrast, *Zyxomma petiolatum, Anax indicus, Agriocnemis femina,* and *Ceriagrion olivaeceum* were recorded only at one or a few locations and were categorized as very rare, reflecting their restricted occurrence in the study area. Overall, the Odonata community was dominated by the members of family Libellulidae, while Coenagrionidae represented the majority of the damselflies (Tables 1, 2). The diversity indices (Table 3) indicated slightly higher diversity and evenness during September-October than during November-December, whereas species richness remained unchanged between seasons.

The site-wise relative abundance data (Table 4) further revealed that *Orthetrum sabina* was the only species recorded across all ten study sites, highlighting its status as a habitat generalist tolerant of a wide range of disturbed and undisturbed water bodies, whereas species such as *Zyxomma petiolatum, Anax indicus,* and *Ischnura senegalensis* were confined to a single site each, reflecting their dependence on specific microhabitat conditions such as shaded or less-disturbed water bodies. During the study period, in total 1,343 numbers of odonata individuals were recorded in the Madhuranthagam Block of Chengalpattu district. In this context, Anisoptera contributed the maximum composition of 63%, whereas Zygoptera contributed around 37% for the overall species composition throughout the period of study (Fig. 2). The Shannon–Wiener diversity index showed that there was moderate to high diversity in both the seasons. The value was slightly higher in September and October (H = 2.45) than in November and December (H = 2.35). Simpson's diversity index (1-D) also showed high diversity with low dominance during the monsoon season (0.8836), later a marginal decrease during early winter season (0.8645). These results showed that the structure of the odonate community remains pretty stable, with only minor changes from season to season. Similar observations have been reported in wetland and agricultural ecosystems where dominant odonate species persist throughout seasonal transitions due to their ecological adaptability and broad habitat tolerance (Arulprakash and

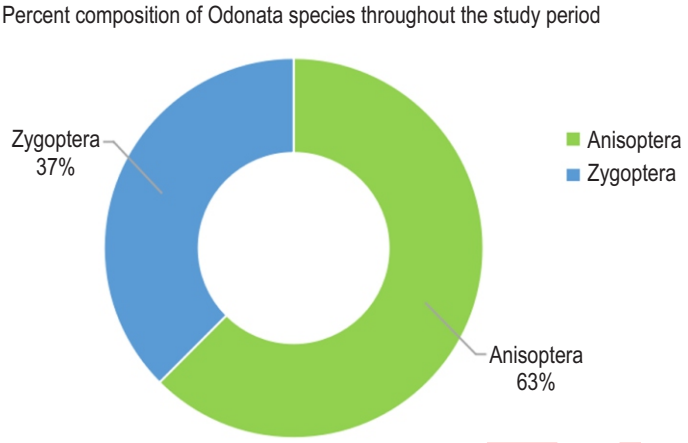



**Fig. 2:** Percent composition of suborders Anisoptera and Zygoptera

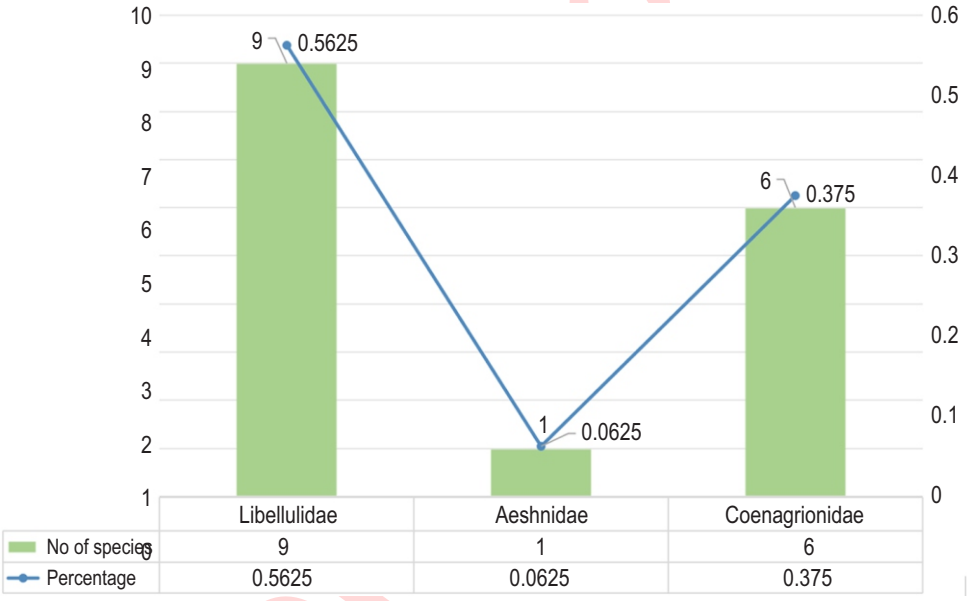



**Fig. 3:** Composition of families of Odonates observed during the study period.

Gunathilagaraj, 2010; Simaika and Samways, 2012; Mukherjee *et al.,* 2024) Margalef's Richness Index showed that the richness values were similar across all seasons.

It was slightly higher in November to December (2.36) than during September to October (2.26). This suggests that the number of species remained same even though the total number of individuals decreased. Using Pielou's Equitability Index, evenness was higher in September and October ($J = 0.88$) than in November and December ($J = 0.85$). This reduction during November to December may be associated with declining water availability, reduction in emergent vegetation, lower prey density, and decreased breeding activity following the monsoon season. Similar seasonal decline in odonate abundance have been reported from wetland and agricultural ecosystems, where post-monsoon reduction in aquatic habitat quality and food availability significantly influenced species activity and population density (Arulprakash and Gunathilagaraj, 2010; Anbalagan, 2024).

This indicates that during monsoon period, individuals were more evenly distributed among species. Although Pielou's evenness values differed marginally between two seasons, this decline during November to December suggests a relatively greater dominance of certain adaptable species during early winter period. The Berger-Parker dominance index was lower in September and October (0.236) and higher in November and

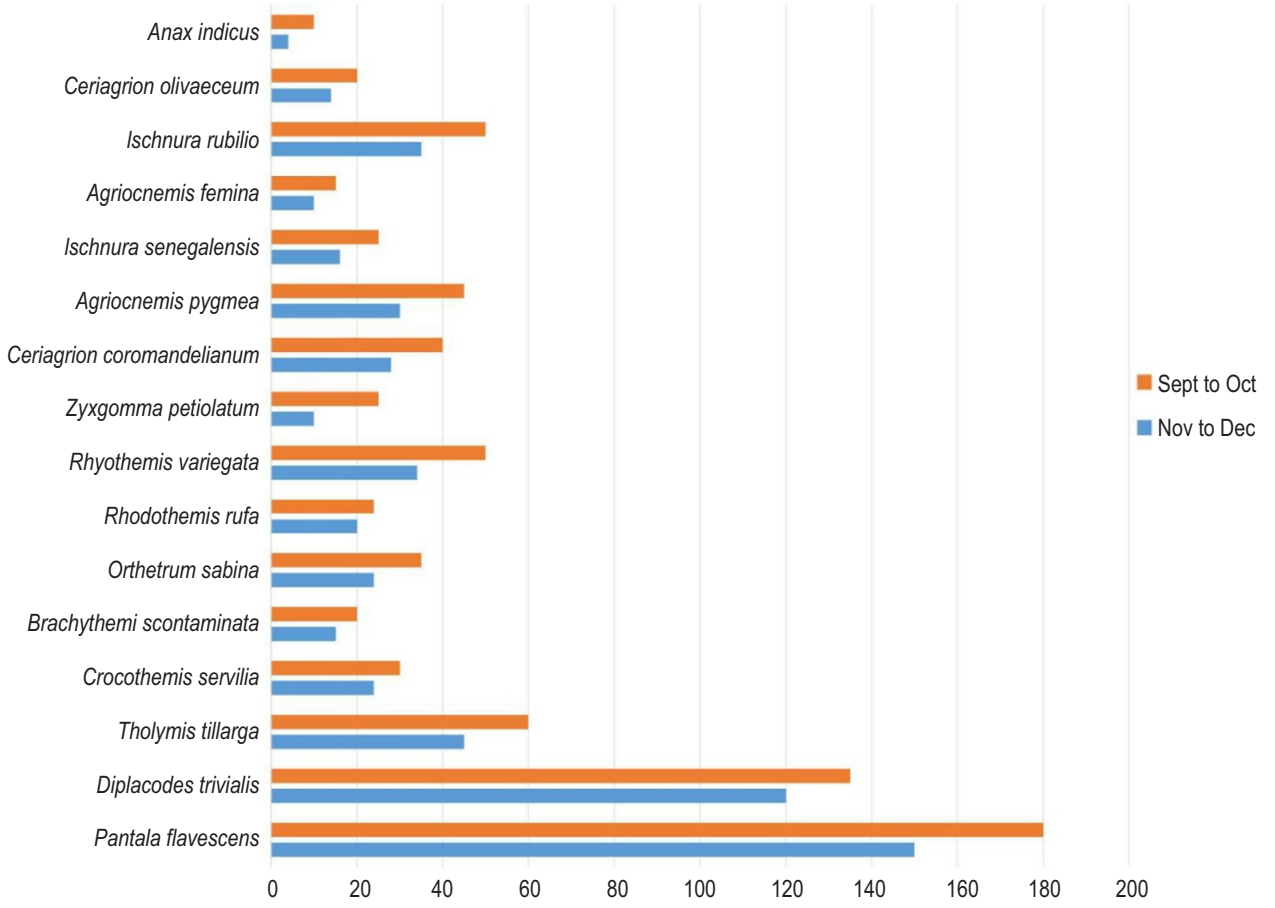



**Fig. 4:** Seasonal variation of Odonata individuals recorded during the study period.

December (0.259), which shows that a few species were more dominant during early winter season. Dominant species such as *P. flavescens* and *D. trivialis* played a big role in this pattern because they can adapt to environment changes that occur with seasons, due to their broad ecological tolerance, high dispersal capacity, rapid colonization ability, and adaptability to fluctuating environmental conditions. Also, the species richness remained constant across both seasons. This indicates that there were no local extinctions or complete seasonal disappearance of species during the study period. Although evenness remained high in both the periods, a small decline suggests that individuals became less evenly distributed among species in November to December.

Among three families encountered, Libellulidae contributed maximum dominance and species diversity with nine species (56%), followed by Coenagrionidae with six species (38%) and Aeshnidae with only one species (6%) (Fig. 3). Dominant species such as *P. flavescens, D. trivialis* and *I. rubilio* persisted both seasons, highlighting their ecological tolerance and adaptability. No species from the families Gomphidae and Lestidae were recorded in the study areas, suggesting that they were not distributed in the area. The diversity of Odonata recorded was highest during monsoon, followed by winter. This aligns with the reproductive pattern of most of the Odonates which primarily emerge and reproduce during monsoon under Indian conditions (Subramanian, 2005). The principal driver of this phenomenon is the life cycle of the Odonates, which is closely associated with aquatic ecosystems due to their nymphal stage and egg-laying habitat. The increased availability of water during monsoon, positively pushes the richness of Odonata species. On the contrary, diversity is disrupted during winter and summer, primarily due to reduced water levels and dependent crop canopy diversity. Differences in temperature, availability of water, vegetation cover, precipitation, and food resources substantially shape Odonata diversity, impacting their abundance and variety (Kittelson, 2004; Goldsmith, 2007). Further, optimal temperature regimes are crucial for their metabolic activities and ideal nymphal growth and development (Corbet, 1999).

According to Subramanian (2005), monsoon conditions favour emergence and reproductive activity in many Indian odonate species. Increased water availability, aquatic vegetation and prey abundance during monsoon provide favourable breeding habitats for both larval and adult stages. However,

prolonged heavy rainfall events accompanied by sudden temperature fluctuations may temporarily reduce adult flight activity and foraging efficiency in certain species (Castillo-Perez *et al.,* 2025). Therefore, moderate monsoon conditions appear highly favourable for sustaining odonate diversity in agro-wetland ecosystems. In this study, a significant presence of dragonflies and damselflies was found, with increased activity and abundance in September to October post monsoon, which reduced during November to December (Fig. 4).

During September to October, 764 individuals were recored, whereas 579 insects were observed during November to December which clearly revealed reduction in the odonata population, with progress in season. The higher abundance and diversity of odonates recorded during September to October indicate the positive influence of post-monsoon environmental conditions on odonate assemblages. Increased water availability, emergent aquatic vegetation, and greater prey abundance during this period likely provided favourable conditions for breeding, larval development and adult activity (Corbet, 1999; Subramanian, 2005; Paul *et al.,* 2024). Similar post-monsoon increase in odonate diversity has been reported from wetland and agricultural ecosystems in Tamil Nadu and other parts of India (Arulprakash and Gunathilagaraj, 2010; Anbalagan, 2024; Mukherjee *et al.,* 2024). Although total abundance declined during November–December, species richness remained constant, indicating that seasonal variation primarily affected relative abundance rather than species composition. The marginal increase in dominance and marginal decline in evenness during early winter season suggest that ecologically tolerant species such as *Pantala flavescens* and *Diplacodes trivialis* remained highly persistent under changing environmental conditions. These habitat-generalist species are known for their broad ecological tolerance, strong dispersal ability, and adaptability to fluctuating agro-wetland habitats (Simaika and Samways, 2012; Castillo-Perez *et al.,* 2025).

The relatively stable community structure observed across seasons further suggests that the wetland-associated paddy ecosystems of the study area provided continuous ecological support for resident odonate fauna despite moderate seasonal fluctuations. Similar observations have been documented in tropical freshwater ecosystems where seasonal changes influenced abundance more strongly than species turnover (Mukherjee *et al.,* 2024; Vijayakumaran *et al.,* 2025). Even though the number of individuals of each species decreased during winter, it remained same (16 species) during both periods. This shows that community composition was stable, with seasonal variations due to changes in relative abundance rather than species turnover.

The present study documented 16 species of odonates across three families from the wetland and paddy ecosystems of Madhuranthagam Block, Chengalpattu district, with higher diversity and abundance recorded during the post-monsoon period. The persistence of tolerant species such as *Pantala flavescens, Diplacodes trivialis* and *Ischnura rubilio,* alongside the presence of rare species like *Zyxomma petiolatum, Anax indicus* and *Ceriagrion olivaceum,* underscores the ecological value of wetland-paddy landscapes and their microhabitat heterogeneity in sustaining odonate diversity. These findings provide the first baseline data for the district and highlight the practical need for wetland conservation, reduced pesticide use, and sustainable farming practices to safeguard odonate populations and support long-term biodiversity monitoring in agricultural landscapes.

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**Authors' contribution: N. Santhoshraj:** Survey and photography records of Odonata fauna writing manuscript; **N. Murugan:** Writing manuscript, compilation of data and interpretation of results; **D. Kamaraj, R.A. Silviya:** Writing manuscript, diversity indices calculation and interpretation of results; **N. Vairam:** Methodological development, interpretation of the results, revision and editing of the manuscript.

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## References

Anbalagan, V.: Species composition and diversity of Odonata fauna in Cauvery River of Mettur dam, Salem district, Tamil Nadu, India. *Entomon,* **49**, 87-92 (2024).

Arulprakash, R. and K. Gunathilagaraj: Abundance and diversity of Odonata in temporary water bodies of Coimbatore and Salem districts in Tamil Nadu. *J. Threat. Taxa.,* **2**, 1099-1102 (2010).

Berger, W.H. and F.L. Parker.: Diversity of planktonic foraminifera in deep-sea sediments. *Science,* **168**, 1345-1347 (1970).

Castillo-Perez, E.U., J.D. Rivera-Duarte, P. Abellan, E. del Val, D. González-Tokman and A. Cordoba-Aguilar: Thriving in the heat: How high temperatures and habitat disturbance shape odonate taxonomic and functional diversity in the tropics. *Insect Conser. Diver,* **18**, 343-356 (2025).

Online Copy

Chovanec, A. and J. Waringer: Ecological integrity of river-floodplain systems-assessment by dragonfly surveys (Insecta: Odonata). *Regul. Rivers. Res. Mgmt.,* **17**, 493-507 (2001).

Chutia, P. and P. Sonowal: Assessing seasonal occurrence of Odonates in the Joysagar Area, Sivasagar District, Assam, India. *UPJOZ*, **47**, 166-178 (2026)

Corbet, P.S.: Dragonflies: Behavior and Ecology of Odonata. Cornell University Press, 829 pages (1999).

Fraser, F.C.: The Fauna of British India, including Ceylon and Burma. Odonata. (Ed.: W. T. Blanford). **Vol. I**, Taylor and Francis, London. 423 pages (1933).

Fraser, F.C.: The Fauna of British India including Ceylon and Burma, Odonata. **Vol. III**. Taylor and Francis Ltd., London, 461 pages (1936).

Ganeswari, C. and P. Rajendran.: Diversity and seasonal variation of odonates in selected wetlands of Madurai District. *Int. J. Ecol. Environ. Sci.,* **51**, 531-542 (2025).

Gentry, J.B., C.T. Garten, F.G. Howell and M.H. Smith: Thermal ecology of dragonflies in habitats receiving reactor effluent, In: Environmental Effect of Cooling Systems at Nuclear Power Plants. International Atomic Energy Agency, Vienna, pp. 563-574 (1975).

Goldsmith, S.: Density of long horned beetles (Coleoptera: Cerambycidae) differs at different elevations in Hawaiian montane forest. *S.W. Nat.,* **52**, 364-370 (2007).

Goswami, R., D. Rawat and C. S. Negi: Indian Odonata: Diversity, ecology, and conservation challenges. *Ind. J. Ecol.*,**52**, 1023-1030 (2025).

Janssen, A., H. Hunger, W. Konold, G. Pufal and M. Staab: Simple pond restoration measures increase dragonfly (Insecta: Odonata) diversity. *Biodiver. Conserv.,* **27**, 2311-2328 (2018).

Kalkman, V.J., R. Babu, M. Bedjanic, K. Conniff, T. Gyeltshen, M.K. Khan, K.A. Subramanian, A. Zia and A.G. Orr: Checklist of the dragonflies and damselflies (Insecta: Odonata) of Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. *Zootaxa,* **4849**, 1-84 (2020).

Kaushik, S., S. Sharma, M.N. Saxena and D.N. Saksena: Habitat ecology of Anisopteran nymphs in certain water bodies of Madhya Pradesh. *Acta Hydrochimica et Hydrobiologica,* **18**, 443-447 (1990).

Kittelson, P.M.: Sources of variation in insect density on *Lupinus arboreus* Sims: effects of environment, source population and plant genotype. *Am. Midl. Nat.,* **152**, 323-335 (2004).

Margalef, R.: Information and uncertainty in living systems, a view from ecology. *Biosystems,* **38**, 141-146 (1996).

Mukherjee, A., S. Adhurya, S. Roy, S. Pal, G.D. Bhowmick and S.K. Mukhopadhyay: Odonata assemblages at two urban wetlands in West Bengal, India. *Int. J. Odonatol.,* **27**, 199-212 (2024).

Norma-Rashid, Y., M. Sofian-Azirun and M. Zakaria-Ismail: Diversity and distribution of Odonata (dragonflies and damselflies) in the fresh water swamp lake Tasek Bera, Malaysia. *Hydrobiologia,* **459**, 135-146 (2001).

Parmar, D., A. Payra, A. Paranjpe, S. Khangar, A. Patchaiyappan, J. Ganguly and P. Koparde: Odonata of Puducherry, Union Territory of Puducherry, India: an updated check list and distributional insights. *Nat. Somogyi.,* **46**, 37-48 (2025).

Paul, G., P. Karnaver, I. Sreelekshmi, A. Joseph and P. Suresh: Water quality and odonate diversity in Peruvelichal paddy fields of Vettiyar village in Alappuzha district of Kerala. *Rec. Zool. Surv. India,* **124**, 491-500 (2024).

Paulson, D., V. Kalkman, A. Orr and J.V. Tol.: Global diversity of dragonflies (Odonata) in freshwater. *Hydrobiologia,* **595**, 351-363 (2008).

Prasad, M. and A. Singh: Odonata of Doon valley. 2. Zygoptera. Records of the Zoological Survey of India, **70**, 121 (1976).

Ram, R., V.D. Srivastava and M. Prasad: Odonata (Insecta) fauna of Calcutta and surroundings. *Rec. Zool. Surv. India,* **80**, 169 (1982).

Samways, M.J.: Taxon turnover in Odonata across a 3000 m altitudinal gradient in Southern Africa. *Odonatologica,* **18**, 263-274 (1989).

Shannon, C.E.: A mathematical theory of communication. *Bell Syst. Tech. J.,* **27**, 379-423 (1948).

Simaika, J.P. and M.J. Samways: Using dragonflies to monitor and prioritize fresh water habitats for conservation. *Biodivers. Conserv.,* **21**, 1467-1480 (2012).

Simpson, E.H.: Measurement of diversity. *Nature,* **163**, 688 pages (1949).

Subramanian, K.A. and R. Babu: Fauna of India Checklist: A Checklist of Odonata (Insecta) of India. Version 3.0, Records of the Zoological Survey of India, Kolkata, India, 488 pages (2017).

Subramanian, K.A. and R. Babu: Dragonflies and Damselflies (Insecta: Odonata) of India. In: Indian Insects, CRC Press, pp. 29-45 (2019).

Subramanian, K.A.: Dragonflies and damselflies of Peninsular India-A field guide. Project Lifescape Series. (Ed. M. Gadgil), 1st Edn., A collaborative project of Centre for Ecological Sciences, Indian Institute of Science, Bangalore and Indian Academy of Sciences, Bangalore, 35 pages (2005).

Subramanian, K.A. and R. Babu: Fauna of India Checklist: Arthropoda: Insecta: Odonata. Version, 1, Zoological Survey of India, Chennai, India, 15 pages (2024).

Vijayakumaran, V., K. Sadasivan and V.P. Nair: Odonata diversity of mid-elevation catchments of the Bavaliriver from Coorg landscape of central Western Ghats, peninsular India. *Entomon,* **50**, 47-60 (2025).

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