

# Diversity And Distribution of Damselflies (Zygoptera) In Varied Ecological Zones of Kolhapur District, Maharashtra

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**Abstract-** The present study investigates the diversity and distribution of damselflies (suborder Zygoptera) across five tehsils in Kolhapur district, Maharashtra, spanning a range of ecological zones from the eastern Deccan plateau to the western foothills of the Sahyadri mountains. Field surveys were conducted biweekly from January 2023 to December 2024, using standardized net-sweeping methods during morning and evening hours. A total of 22 species were recorded, of which 15 were identified, representing 11 genera and 4 families, while 7 remained unidentified. Species richness varied across study sites, with higher diversity observed in regions featuring intact riparian vegetation and relatively undisturbed freshwater bodies. Frequently observed species included *Ceriagrion coromandelianum*, *Pseudagrion rubriceps*, and *Prodasineura verticalis*, while *Ichnura aurora* and *Vestalis gracilis* were reported from specific localities for the first time.

The findings highlight the ecological sensitivity of damselflies to microhabitat conditions, emphasizing their utility as bioindicators of freshwater ecosystem health. This study provides a valuable baseline for regional biodiversity assessments and underlines the need for site-specific conservation strategies to mitigate ongoing habitat degradation.

**Keywords:** - Bioindicators, Damselflies, Freshwater Biodiversity, Kolhapur, Zygoptera

## I. INTRODUCTION

Among the oldest and ecologically significant orders in Insecta, the order Odonata comprises dragonflies (Anisoptera) and damselflies (Zygoptera). Especially damselflies are well known for their quick response to environmental changes, which makes them reliable bioindicators for assessing the state of freshwater ecosystems (Subramanian & Babu, 2017; Chippindale et al., 1999). Their restricted habitat options, specific biological requirements, and unique life cycle traits allow for exact evaluation of aquatic habitat quality and stability (Adarsh et al., 2015;

Gain&Kulkarni,2024). Worldwide, great effort has been made on several facets of Odonata, including their taxonomy, ecology, and geographic distribution. Especially for peninsular India, comprehensive regional studies have provided fundamental content for the Indian subcontinent (Fraser, 1933, 1934, 1936; Subramanian, 2005; Andrew et al., 2008).

Notwithstanding these efforts, some biogeographic areas especially ecotonal ones like the northern Western Ghats where hill systems change into the Deccan plateau remain under-researched. Kolhapur district, situated in this transitional zone, boasts a remarkable variety of habitats ranging from riparian areas and semi-evergreen forests to human-altered wetlands offering suitable conditions for different damselfly populations (Bharamal et. al.,2014; Koparde et al., 2014). The Odonata diversity of the region is still underreported, which indicates a lack of current research (Talmale & Tiple, 2013; Kulkarni & Talmale, 2012).

Great geographical diversity characterizes Maharashtra, the third-largest state in India, which covers more than 307,713 square kilometres.

This includes coastal plains along the Arabian Sea, the rough terrain of the Western Ghats, vast plateaus, and riverine ecosystems. These various settings contribute to the formation of several biological zones that support a great diversity of biodiversity, particularly among insect species (Tiple et al., 2015). Located in the southwestern part of Maharashtra (16°41'28.7052"N, 74°14'51.40"E), Kolhapur district is fairly close to the Western Ghats, a UNESCO World Heritage Site. The district, which offers ideal homes for freshwater invertebrates including members of the order Odonata (Gaikwad 2021), is characterized by varied climatic zones and a mix of landscapes including forested areas, rivers, marshes, and artificial water bodies. Odonates are usually recognized as steady bioindicators of the condition of freshwater ecosystems.

Their sensitivity to environmental changes, especially water pollution and habitat degradation, allows researchers to use them as proxies for assessing the ecological integrity of aquatic environments (Manjula et al., 2024). Particularly the presence and abundance of damselflies often imply well-oxygenated, unpolluted water; their absence could signal environmental damage (Gain & Kulkarni, 2024). Classed into 652 genera, more than 6,000 species of Odonata have been documented all over the world. Spread across 154 genera and 18 families, the odonate fauna in India consists of 488 species and 27 subspecies (Schorr & Paulson 2014). Maharashtra's 134 species include 87 Anisoptera and 47 Zygoptera (Tipale & Koparde, 2015). Many local habitats, however, stay under-researched in spite of these data. For example, Zygopteran species in Kolhapur have not been well recorded (Gaikwad & 2021). Similar research in India and neighbouring countries reveal significant regional Zygoptera diversity. While Bashar et al. (2014) discovered 23 species under five categories in selected Bangladesh wetlands, Rathod et al. (2016) identified 18 species in South Gujarat. By discovering seven species in Jasaan, Misamis Oriental, Philippines, Villaraza et al. (2024) helped to confirm the global ecological significance of these insects. But local data from places like Kolhapur is scant, indicating a need for focused faunal study.

The present work aims to assess and document the range of damselflies in Kolhapur district. Given their ecological importance and sensitivity to environmental conditions, such a study will not only add to taxonomic knowledge but also help establish baselines for conservation and monitoring of freshwater ecosystems in the region. This study is mostly meant to accomplish two main goals: to record the species diversity of damselflies (Zygoptera) in several ecosystems around Kolhapur district, and to evaluate their spatial distribution across different habitat types including rivers, reservoirs, wetlands, and semi-forested zones. These objectives aim to provide baseline data necessary for biodiversity assessments and to explore the ecological relevance of Zygoptera as sensitive indicators of freshwater habitat quality. By means of species occurrence comparison across several ecological niches, the study will help to identify habitat specific assemblages and potential environmental stresses influencing community composition.

Previous regional surveys in India and neighboring countries have emphasized the need of such localized biodiversity inventories in guiding conservation planning and enhancing our knowledge of insect-mediated ecosystem dynamics (Patel et al., 2016; Rathod et al, 2016; Bashar et al.,2014; Villaraza et al., 2024).Particularly in the underrepresented transitional regions of the northern Western Ghats, this work contributes to the expanding body of odonatological research and supports the use of damselflies as reliable bioindicators in environmental monitoring systems (Gain & Kulkarni, 2024; Tipale & Koparde, 2015; Gaikwad & 2021; Manjula et al., 2024).

## II. METHODS AND MATERIALS

### 1. Methodology

From January 2023 to December 2024, field surveys aiming at damselfly diversity were carried out within the selected study region during a two-year span. To provide thorough spatial coverage, quarterly random sampling was used. Collections took place during times of maximum damselfly activity morning (08:00 –11:00 am) and late afternoon (04:00-06:00) as these timeframes correspond with high flight activity among Odonata (Corbet, 1999). Using an insect sweep net, specimens were caught and promptly moved to marked containers. Chloroform was utilized following accepted entomological procedures to temporarily immobilize the specimens for inspection (Silsby, 2001).

A Sony A7 M4 digital camera captured high-resolution photos of each species to help further morphological study and documentation. Using exterior diagnostic characteristics including wing venation, body colour, and terminal appendages, morphological identification of gathered damselflies was done. Fraser's classical taxonomic keys (1933, 1934, 1936), still authoritative for South Asian Odonata, mostly directed identification. Recent checklists and revised field guides provided extra confirmation (Subramanian, 2005; Kakkasery et al., 2021). Following ethical standards in biodiversity research, all specimens were released back into their original habitat to minimize ecological disturbance after identification and photographic documentation (Hardersen & Leo, 2011). This method guaranteed correct species identification and preserved the native population's integrity.

### 2. Study Area

Spanning five tehsils in Kolhapur district, Maharashtra, which the survey covered several ecological areas from the eastern Deccan plateau (Desh) to the western foothills of the Sahyadri mountains. The five selected regions are:

- S1 - Karveer (16.6566°N, 74.1968°E)
- S2 - Hatkanangale (16.7503°N, 74.4317°E)
- S3 - Panhala (16.8107°N, 74.1040°E)
- S4 - Shirol (16.8318°N, 74.4480°E)

- S5 - Kagal (16.5938°N, 74.3181°E)

Between 15°43' and 17°11' North latitude and 73°40' and 74°42' East latitude, Kolhapur district lies in the southwestern section of Maharashtra. Covering a total geographical area of 7,746 sq. km, which is around 2.5% of the state's land area (Sri YN College, 2022), it shares boundaries with Goa to the south and Karnataka to the east.

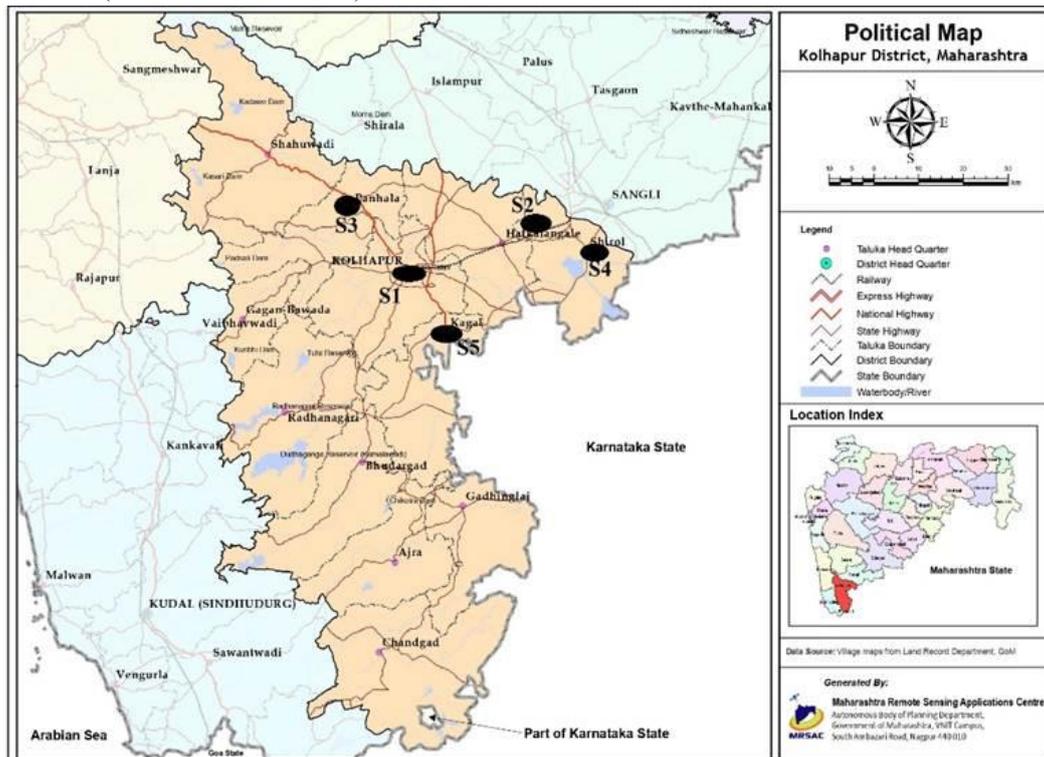


Figure 1. Geographical distribution of the five study sites (From S1 to S5) across Kolhapur district, Maharashtra, India.

### III. RESULT

A total of 22 damselfly species were documented across the five selected sites within Kolhapur district (Karveer, Hatkanangale, Panhala, Shirol, and Kagal) over the survey period. Among these, 15 species were successfully identified to the species level, representing 11 genera *Ceriagrion*, *Ischnura*, *Pseudagrion*, *Agriocnemis*, *Copera*, *Prodasineura*, *Vestalis*, *Elattonneura*, *Disparoneura*, *Libellago*, and *Heliocypha*—and belonging to four families: Coenagrionidae, Platycnemididae, Chlorocyphidae, and Calopterygidae. The remaining seven species were observed but remained taxonomically unresolved due to limitations in morphological data or life stage at the time of collection.

The *Coenagrionidae* family (commonly referred to as pond damselflies) was the most represented, with seven species from four genera. *Ceriagrion*

*coromandelianum* (Fabricius, 1798) was the most frequently encountered species, widely distributed across the sites. *Pseudagrion rubriceps* was predominantly found near aquatic habitats and was consistently recorded around ponds and streams. *Ischnura aurora* appeared to be less common, with sightings limited to the Panhala region. Members of *Disparoneura* and *Elattonneura* were generally observed in more terrestrial habitats, occurring sporadically near water bodies. *Vestalis gracilis* (commonly known as the Clear-winged Forest Glory) was recorded primarily in open grassland patches, while *Heliocypha bisignata* (Selys, 1853) and *Libellago lineata* (Burmeister, 1839) were restricted to clear, fast-flowing streams. *Prodasineura vertcalis* (Selys, 1860), the red striped black thread tail, showed a strong preference for riparian zones. The diversity and occurrence patterns of Zygoptera species appeared closely linked to local habitat

characteristics, particularly vegetation type and canopy cover. Shaded microhabitats supported higher species richness, consistent with previous findings from urban green spaces in Maharashtra (Dutta Saha & Gaikwad, 2014), where nine Zygoptera species

were recorded in the parks and gardens of Pune city. This suggests that damselfly assemblages in the region are strongly influenced by habitat heterogeneity and vegetation structure.

Table 1 Overview of damselfly diversity recorded at five different locations, including details on species count, population levels, and ecological importance at each site. (C- Common, R- Rare)

Sr. No.	Family	Scientific Name	Common Name	Status	Sites				
					S1	S2	S3	S4	S5
1.	Coenagrionidae	<i>Ceriagrion coromandelianum</i> (Fabricius,1798)	Coromandel marsh dart	C	+	+	+	+	+
2.		<i>Pseudagrion decorum</i> (Rambur,1842)	Common blue dart	C	+	+	+	-	-
3.		<i>Pseudagrion microcephalum</i> (Rambur,1842)	Blue grass dart	C	+	+	+	+	+
4.		<i>Pseudagrion rubriceps</i> (Selys 1876b)	Saffron-faced blue dart	C	+	+	+	+	+
5.		<i>Ishnura senegalensis</i> (Rambur,1842)	Senegal golden dartlet	C	+	+	+	+	+
6.		<i>Ishnura aurora</i> (Brauer,1865)	Golden dartlet	R	+	-	-	-	+
7.		<i>Agriocnemis pygmaea</i> (Rambur, 1842)	Pigmy dartlet	C	+	+	+	+	+
8.	Platycnemididae	<i>Copera marginipes</i> (Rambur,1842)	Yellow bush dart	C	+	+	+	-	+
9.		<i>Copera vittata</i> (Selys,1863)	Blue bush dart	C	+	+	+	+	+
10.		<i>Disparoneura quadrimaculata</i> (Rambur,1842)	Black winged bamboo tail	R	-	+	+	-	-
11.		<i>Prodasineura verticalis</i> (Selys,1860)	Red striped black bamboo tail	R	-	+	-	-	-
12.		<i>Elatoneura nigerrim</i> (Laidlaw,1917)	Deccan thread tail	R	+	+	-	-	-
13.	Calopterygidae	<i>Vertalis gracilis</i> (Rambur,1842)	Clear winged forest glory	R	-	+	-	-	-
14.	Chlorocyphidae	<i>Heliocypha bisignata</i> (HageninSelys,1853)	Stream Ruby	R	-	-	-	-	+
15.		<i>Libellago lineata</i> (Burmeister,1839)	River Heliodo	R	-	-	-	-	+

Photo plate I



Figure 2. Photo plate showing representative damselfly species observed during the study. Images include both male and female individuals where available: 1a–b. *Ceriagrion coromandelianum*; 2a–b. *Ischnura senegalensis*; 3a–b. *Disparoneura quadrimaculata*; 4a–b. *Pseudagrion microcephalum*; 5a–b. *Agriocnemis pygmaea*; 6a–b. *Pseudagrion decorum*; 7. *Vestalis gracilis*; 8. *Pseudagrion rubriceps*; 9. *Elatoneura nigerrima*; 10. *Ischnura aurora*; 11–12. *Copera marginipes* (male and female); 13. *Heliocypha bisignata* (male); 14. *Libellag lineata* (male); 15. *Prodasineura verticalis*; 16–22. Unidentified damselfly

#### IV. DISCUSSION

The present survey across five tehsils of Kolhapur district Karveer, Hatkanangale, Panhala, Shirol, and Kagal resulted in the documentation of 22 damselfly species. Of these, 15 species were morphologically identified, representing 10 genera and 4 families, while 7 remained unidentified due to insufficient diagnostic features. The dominant family, *Coenagrionidae*, accounted for the highest number of genera and species, consistent with prior reports from peninsular India (Subramanian et al., 2018). Among the recorded taxa, the widespread presence of *Ceriagrion coromandelianum*, *Pseudagrion rubriceps*, and *Prodasineura verticalis* across all study sites highlights their ecological plasticity and generalist habitat preferences. In contrast, *Ischnura aurora* was found exclusively at Panhala, suggesting a possible microhabitat or altitudinal specialization. This localized occurrence is comparable to findings by Gaikwad (2021), who also reported species specific habitat affinity in a study around Rankala Lake, Kolhapur. The presence of *I. aurora* in Panhala represents a first report for this tehsil, indicating the need for further elevation-based studies to understand species turnover.

Several species indicative of habitat quality were also observed. *Heliocypha bisignata* and *Libellago lineata*, both associated with well-oxygenated, clear stream environments, were primarily located in Karveer and Panhala—regions characterized by intact stream ecosystems and forest edges. These species are known bioindicators of pristine freshwater systems, echoing findings from Subramanian (2005) and Deshpande et al. (2017), who emphasized the conservation value of Chlorocyphidae and Calopterygidae in monitoring freshwater integrity.

Interestingly, genera such as *Elatoneura* and *Disparoneura*, generally associated with terrestrial and semi-shaded zones, were found both in forested and anthropogenically influenced habitats. This suggests a degree of resilience, although population density was noticeably higher in less disturbed locations. *Vestalis gracilis* (clear-winged forest glory) was recorded only in grassland patches within Panhala, representing another first-time record for this habitat in Kolhapur district. Its detection underscores the importance of non-aquatic adjacent ecosystems for certain Zygoptera.

In a broader context, the species richness recorded in this study aligns well with regional surveys across Maharashtra. For example, Dutta Saha and Gaikwad (2014) documented 9 species in urban green spaces of Pune, while Deshpande et al. (2017) recorded 18 species in Satara district. The current total of 22 species, including novel records, indicates that Kolhapur's position at the confluence of the Deccan plateau and the Sahyadri foothills fosters high habitat heterogeneity, promoting damselfly diversity. Furthermore, this study builds on the work of Gaikwad (2021), who reported 3 damselfly species from Rankala Lake, including three genera also recorded in the current study. The broader spatial survey presented here expands the distributional data and highlights several previously undocumented species for specific tehsils, providing a critical baseline for future biodiversity assessments.

These findings reinforce the importance of maintaining natural freshwater habitats and semi-natural buffer zones in peri-urban and rural landscapes. Given the sensitivity of many damselfly taxa to environmental changes, regular monitoring and habitat conservation efforts are essential to safeguard the region's freshwater biodiversity.

#### V. CONCLUSION

This study demonstrates the significant influence of Kolhapur district's diverse landscape comprising varied cropping systems, numerous freshwater sources, and transitional ecological zones on damselfly diversity and distribution. The variation in species composition across the five tehsils reflects the importance of site-specific factors such as aquatic vegetation, riparian structure, and localized climate in shaping damselfly assemblages.

The presence of habitat-specialist and widely distributed species highlights the ecological sensitivity of Zygoptera and their potential role as bioindicators of freshwater ecosystem health. Notably, the first-time records from certain tehsils underscore the ecological uniqueness of these areas and the need for continued exploration. Given the growing pressures of habitat modification and land-use change, targeted conservation strategies focusing on the protection of water bodies and surrounding vegetation are essential. Long-term ecological monitoring and habitat management will be key to preserving damselfly diversity and ensuring the

ecological resilience of freshwater ecosystems in this region.

REFERENCES

- [1] Adarsh, C. K., Arunraj, R., & Nameer, P. O. (2015). Odonata (Insecta) diversity of Chinnar Wildlife Sanctuary, the southern Western Ghats, India. *Journal of Threatened Taxa*, 7(2), 6910–6919. <https://doi.org/10.11609/JoTT.o4126.6910-9>
- [2] Andrew, R. J. (2013). Odonates of Zilpi Lake of Nagpur (India) with a note on the emergence of the libellulid dragonfly, *Trithemis pallidinervis*. *Journal on New Biological Reports*, 2, 177–187.
- [3] Andrew, R. J., Subramanian, K. A., & Tiple, A. D. (2008). *A handbook on common odonates of Central India*. Hislop College.
- [4] Bashir, M. A., Sultana, S., & Khan, M. (2014). Odonata (Insecta) fauna of some selected areas in Bangladesh. *International Journal of Fauna and Biological Studies*, 1(6), 106–111.
- [5] Bharamal, D. L., Koli, Y. J., Korgaonkar, D. S., & Bhawane, G. P. (2014). Odonata fauna of Sindhudurg district, Maharashtra, India. *International Journal of Current Microbiology and Applied Sciences*, 3(9), 98–104.
- [6] Chankapure, P. N., & Barsagade, V. G. (2020). Diversity of damselfly (Suborder-Zygoptera) in the Jam Lake, Katol, District-Nagpur (Maharashtra), India. *Aquatic*, 14(3), 8.
- [7] Chippindale, P. T., Dave, V. K., Whitmore, D. H., & Robinson, J. V. (1999). Phylogenetic relationships of North American Damselflies of the genus *Ischnura* (Odonata: Zygoptera: Coenagrionidae) based on sequences of three mitochondrial genes. *Molecular Phylogenetics and Evolution*, 11(1), 110–121. <https://doi.org/10.1006/mpev.1998.0569>
- [8] Corbet, P. S. (1999). *Dragonflies: Behaviour and Ecology of Odonata*. Cornell University Press.
- [9] Fraser, F. C. (1933). *Odonata. Vol. 1*. In: The Fauna of British India, Including Ceylon and Burma. Taylor and Francis Ltd., London. 423 pp.
- [10] Fraser, F. C. (1934). *Odonata. Vol. 2*. In: The Fauna of British India, Including Ceylon and Burma. Taylor and Francis Ltd., London. 398 pp.
- [11] Fraser, F. C. (1936). *Odonata. Vol. 3*. In: The Fauna of British India, Including Ceylon and Burma. Taylor and Francis Ltd., London. 461 pp.
- [12] Gaikwad, S. S., (2021). Faunal diversity of Odonata at Rankala Lake, Kolhapur, Maharashtra. *ResearchGate*. <https://www.researchgate.net/publication/350965710>
- [13] Gain, B. I., & Kulkarni, R. R. (2024). Study on diversity of Odonata (Dragonflies and Damselflies) fauna of Lohara lake, District Chandrapur (MS), India. *Environment Conservation Journal*, 25(2). <https://doi.org/10.36953/ECJ.2024.25201>
- [14] Gyeltshen, T., Nidup, T., Dorji, P., Dorji, T., & Kalkman, V. J. (2016). Bibliographies and checklist of the dragonflies and damselflies of Bhutan. *Journal of Threatened Taxa*, 9(1), 9743–9747. <https://doi.org/10.11609/jott.2745.9743-7>
- [15] Koparde, P., Mhaske, P., & Patwardhan, A. (2014). New records of dragonflies and damselflies (Insecta: Odonata) from the Western Ghats of Maharashtra, India. *Journal of Threatened Taxa*, 6(5), 5744–5754. <https://doi.org/10.11609/JoTT.o3683.5744-54>
- [16] Kulkarni, P. P., & Talmale, S. S. (2012). Insecta: Odonata. In: *Fauna of Maharashtra: State Fauna Series* (pp. 397–428). Zoological Survey of India, Kolkata.
- [17] Manjula, K. T., Manjula, S. N., & Arun, P. R. (2024). Dragonflies and Damselflies: A Review on their Role as Heavy Metal Bioindicators in Aquatic Ecosystems. *ResearchGate*. <https://www.researchgate.net/publication/383745935>
- [18] Patel, F., Solanki, D., Mehta, D., & Shukla, A. (2016). Diversity of damselfly (Suborder-Zygoptera) in the Victoria Park, reserved forest, Bhavnagar, Gujarat, India. *Journal of Entomology and Zoology Studies*, 4(5), 153–156.
- [19] Rathod, B., Pandya, M., & Patel, B. (2016). Checklist of Odonata from South Gujarat. *International Journal of Advanced Research*, 4(12), 1771–1774.
- [20] Saha, P. D., & Gaikwad, S. M. (2014). Diversity and abundance of Odonata in parks and gardens of Pune city. *Journal of Entomology and Zoology Studies*, 2(5), 308–316.

- [21] Schorr, M., & Paulson, D. (2014). World Odonata List. *Slater Museum of Natural History*. University of Puget Sound
- [22] Silsby, J. (2001). *Dragonflies of the World*. Smithsonian Institution Press
- [23] Sri YN College. (2022). *Impact of Climate Change on Biodiversity in India*.
- [24] Subramanian, K. A. & Babu, R. (2017). Insecta: Odonata (damselflies and dragonflies). In: *Current Status of Freshwater Faunal Diversity in India* (pp. 401–418). Zoological Survey of India, Kolkata.
- [25] Subramanian, K. A. (2005). *Damselflies and dragonflies of peninsular India – A field guide*. E-Book, Zoological Survey of India.
- [26] Talmale, S. S., & Tiple, A. D. (2013). New records of damselfly *Lestes thoracicus* Laidlaw, 1920 (Odonata: Zygoptera: Lestidae) from Maharashtra and Madhya Pradesh states, Central India. *Journal of Threatened Taxa*, 5(1), 3552–3555.  
<https://doi.org/10.11609/JoTT.o3127.3552-5>
- [27] Tipale, R. D., & Koparde, P. (2015). Odonata of Maharashtra, India with notes on species distribution. *Journal of Insect Science*, 15(1), 1–9.
- [28] Villaraza, A. F., Madlos, E. E., Dacar, M. R., & Butron, J. A. (2024). Damselflies (Odonata: Zygoptera) in selected areas at Jasaan, Misamis Oriental, Philippines. *Journal of Threatened Taxa*, 16(2), 23300–23310.  
<https://doi.org/10.11609/jott.8779.16.2.23300-23310>