JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Correlated Search of Odonata Diversity in Divergent Ponds of Bhilai, Chhattisgarh, India.

Roli O.Mishra, Dr.Chetna Rahangdale
Department of Life Science (Zoology), Shri Shankaracharya Professional University, Bhilai, Durg C.G, India

Abstract- Odonata (Dragonflies and damselflies) have a significant impact on ecosystems since they act as regulators for food insect pests. Dragonflies serve as bioindicators to evaluate environmental changes in both long-term researches, such as in their field, and short-term studies, such as biology for conservation. The purpose of this research was to scrutinize how diverse the dragonflies are in the different ponds of Bhilai, Chhattisgarh. The study occurred between June 2023 to May 2024 in two separate sites: Nagar Nigam Pond and Bhelwa Pond. Every sample was gathered bimonthly in different seasons: monsoon or heavy rain, post-monsoon, and pre-monsoon. By using an aerial net each habitat category had four 250-meter-longs transect lines. An enormous total of 19 distinct species and 2 sub-orders Anisoptera and Zygoptera, belonging to four families (***Coenagrionidae, Platycnemididae, Gomphidae, and Libellulidae***) were meticulously gathered and accurately classified. The family Libellulidae had the biggest proportion, accounting for 63.2% of the total with a count of 12 individuals. The families Gomphidae and Platycnemididae had the lowest percentage composition, accounting for only 5.3% of the total, with a total of 1 individual each. Coenagrionidae had 26.3% of the total. Applying the Shannon and Simpson indexes as well species-level variety was found. Show the taxonomic classification and evolutionary relationships of the Odonata phylogeny tree.

Keywords- Dragonflies, Phylogeny tree, Diversity Anisoptera and Zygoptera.

Introduction - Dragonflies have become a highly researched taxonomic group due to their growing global recognition for their survival significance. The International Union for the Conservation of Nature (IUCN) has conducted a global assessment of drone fly groups, which supports the aforementioned fact. Dragonflies, being a taxonomic category of freshwater invertebrates, are regarded as biomarkers of good habitat conditions and health of the environment in aquatic ecosystems. Adult dragonflies are highly susceptible to weather at the reproductive site and the adjacent terrestrial area; consequently, they respond swiftly to fluctuations in the natural environment through vigorous propagation, according to studies. Odonata fauna is evidenced in the site “A” Nagar nigam Pond and “B” Bhelwa Pond by the abundance of species that are native. **[1]** The degradation of freshwater ecosystems is estimated to be five times more severe in certain freshwaters

compared to the most severely impacted ecosystems on earth, despite the fact that human reliance on aquatic resources contributes to a multitude of cumulative threats to these areas. A clear understanding of the surrogate's taxonomy is one factor influencing the establishment of habitat connectivity and the selection and establishment of priorities of conservation areas. Therefore, fish diversity is the prevailing criterion for the designation of freshwater protected areas; however, water beetles and dragonflies have also been employed in aquatic substitute reserve selection studies. **[2]** Dragonflies are attractive insects that are classified under the order Odonata. They are of significant importance in maintaining biodiversity and facilitating ecosystem functioning. Dragonflies, which number in excess of 6,000 recognized species globally, have engrossed the attention of both biological researchers and scholars **[3]** Nevertheless, their populations are confronted with substantial risks due to escalating development and pollution of their habitats **[4]** The comprehension of dragonfly diversity and the application of efficacious preservation methods in urban regions emerge as critical concerns in light of the ongoing rapid expansion of world cities.

In nowadays, scholars have shifted their focus towards the investigation of dragonflies inhabiting urban habitats. **[3]** Conduct an exhaustive review to investigate the correlation between dragonfly conservation and diversity in urban environments. They emphasize the ways in which urbanization impacts the accessibility of appropriate sites for such creatures. The unfavorable consequences of human activities on dragonfly populations may appear as isolated regions or "islands" due to the fragmentation of natural spaces, which restricts the ability of dragonflies to spread around.

Achieving this difficulty necessitates the implementation of policy interventions and ecological research that contribute to the preservation of existing habitats while fostering the development of new ones in urban environments **[4]** It is imperative to acknowledge the critical nature of this intervention requirement, as dragonflies serve as significant predators that regulate the quantity of insects within ecosystems and not only serve as indicators of ecological wellness **[5]** However, although laboratory research has been dedicated to the study of insect declining for several decades, comprehensive studies on the topic in natural insects have only been documented within the last eight years. The ecological veracity of laboratory findings cannot be determined in the absence of such field research, which precludes the evaluation of the nature of selection influencing lifespan under natural conditions. **[6]** Predominantly via trophic interactions, a variety of behaviors are expected to be impacted, which will subsequently affect other components of the aquatic ecosystem. By altering the abundance of suitable environments, reshaping the fundamental niches of species, and causing variations in the dispersal capabilities of species, temperature may impact changes in global allocations. **[7]** Researching the ramifications of urbanization has become imperative in order to comprehend urban ecosystems and alleviate the adverse effects of cities, considering that over 50% of the global population currently lives in large cities

[8] and the effects extend beyond metropolitan areas **[9]** Urbanization gives rise to various consequences, one of which is a notable elevation in temperature between urban and rural regions, a phenomenon known as an Urban heat island" (UHI) consequence. Greater expanses of dark, impermeable surfaces and a dearth of vegetation are the primary contributors to this effect in urban areas and Odonata may be used to measure biodiversity, water body quality, and habitat stability. **[10, 11]**

Materials & Methods

Study sites: The study was executed between June 2023 to May 2024. The sample size consisted of two freshwater areas, namely the Nagar Nigam Pond and the Bhelwa Pond of Bhilai **(Fig.1).** The sampling was conducted inside the watershed. Every sample was gathered bimonthly in different seasons, (monsoon season June–September), (post-monsoon season October–January) and (pre-monsoon season February–May).

(A) **(B)**

Fig 1 **(A)** Nagar nigam pond and **(B)** Bhelwa pond of Bhilai

Sampling and equipment- Using an aerial net, we were able to gather mature dragonflies on sunny days and Surveying was conducted by documenting The diversity of the dragonfly type is determined by the number of individuals present at each pre-determined location. The explore path was ascertained through the implementation of the belt transect and transect methodologies. By drawing a straight line, one may observe using the transect technique starting 7:00 a.m. toward 5:00 p.m. It is essential to ensure that no damage is done to the species throughout the collecting and identification process and that they are securely released without any injury. **[12, 13]**

Sampling Identification- After that, every individual who has been gathered is recognized through the species group. Dragonfly species were identified using morphological characteristics that included tail form, abdomen color pattern, wing pattern, and body color. The identification of the activity was conducted using a handbook authored. The investigation employs much equipment like GPS, cameras, watches, insect nets, and reconnaissance books. **[14, 15]**

Result and Discussion- This delves plans to evaluate the species variety of dragonflies along the waterside of Bhilai ponds in the Durg district, Chhattisgarh. A total of 19 dragonfly species from various families were discovered in this research **(Tab.1).** The ***LIBELLULIDAE*** family has the highest number of species, with a total of 12 species. The ***GOMPHIDAE*** family was comprised of a single species. The family ***PLATYCNEMIDIDAE was*** represented by just one species. The ***COENAGRIONIDA family*** was represented by a total of 5 species. Several previous researchers worked for an abundance of the ***Libellulidae*** family, consisting of 12 species, in the Durg district. **[16]** Before researcher's demonstrations showed that dragonflies display strong responses to climate change. Rainfall, temperature, humidity, and other climatic factors all have an impact on the diversity of dragonflies. The rain is observed from June to September during the research period. The warmest months were April and May. The greatest number of species occurs in

September, while the lowest number occurs in April. The climate in this system was ideal for dragonflies to live in during July, August, and September; during this period, the number of species increased. Because of the rainy season, April and May saw the least amount of diversity in this ecosystem. It results in a reduction in the dragonfly population. Indicates that dragonflies are widely utilized as environmental health indicators in temperate regions of the world. Due to their aquatic larvae's ability to naturally suppress mosquito larvae, several epidemic diseases are kept under control. **[17, 18]**The recognized suborders are Anisoptera and Zygoptera. The suborder Anisoptera comprised 66.7% of the total, making it the most dominant **(Fig.2B).** The data suggests that the Anisoptera species exhibited the highest population density in different environments. The Anisoptera order has two families, namely ***Gomphidae (5.3%)*** and ***Libellulidae (63.2%)*** **(Fig.2A)**, with a total of 13 species together. The Zygoptera, which make up 33.3% of the total, consist of two families: ***Coenagrionidae (26.3 %)*** and ***Platycnemididae (5.3%).*** Together, these families include a total of 6 species. Based on diversity metrics, the Shannon index (H') was used to compare the diversity of dragonflies in each month. The results show that species diversity is maximum for the duration of the post-monsoon season and lowly for the duration of the pre-monsoon season. Overall, it was 2.7770 in both locations and all seasons. The Simpson's index (D) has a value of 0.9288.

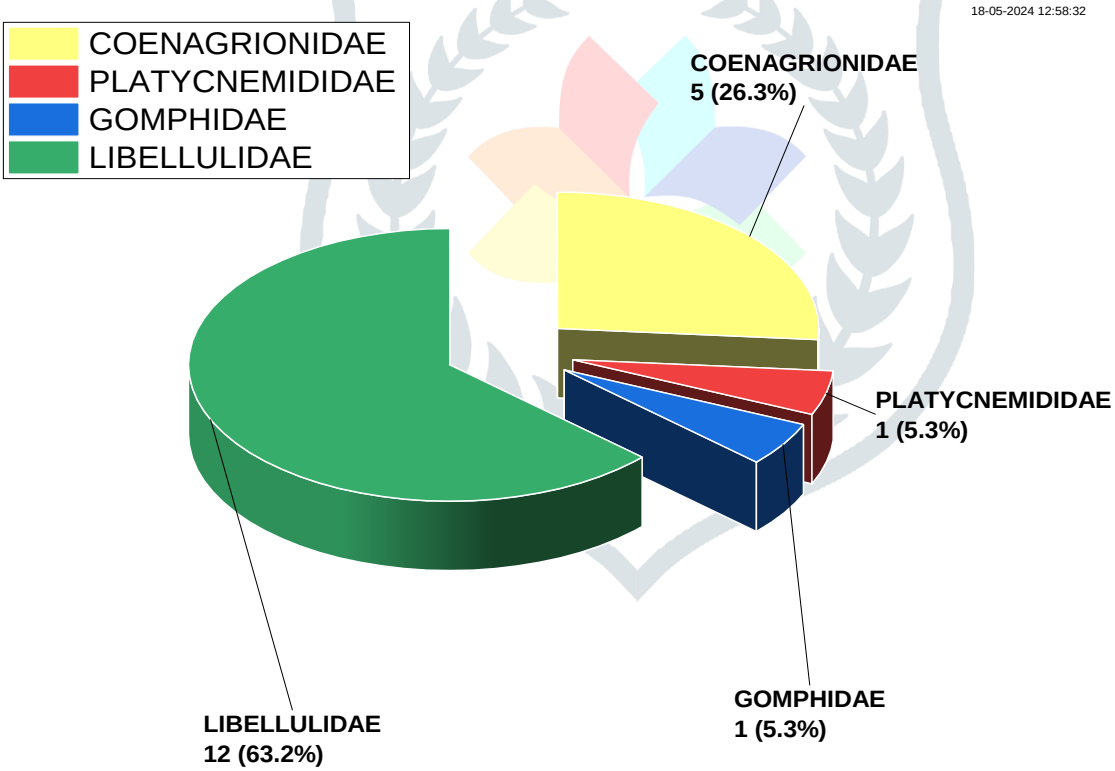
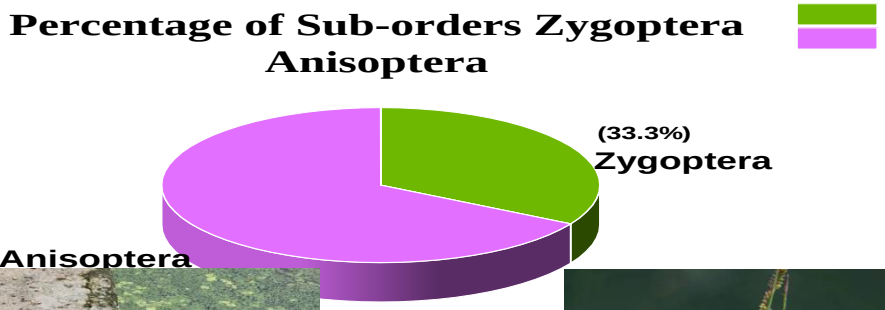
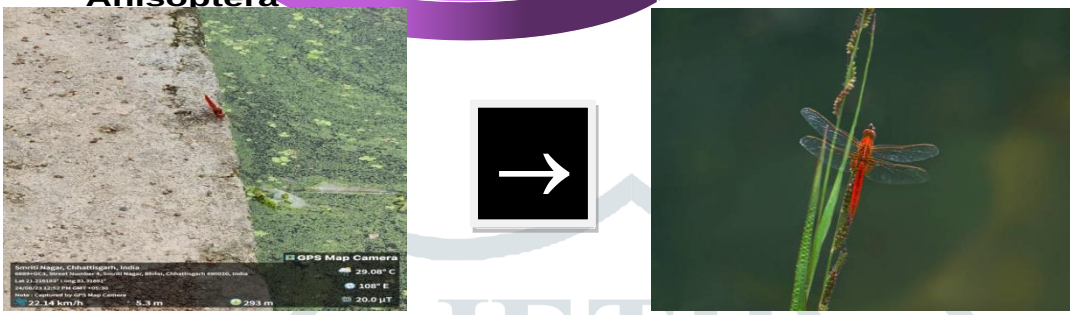


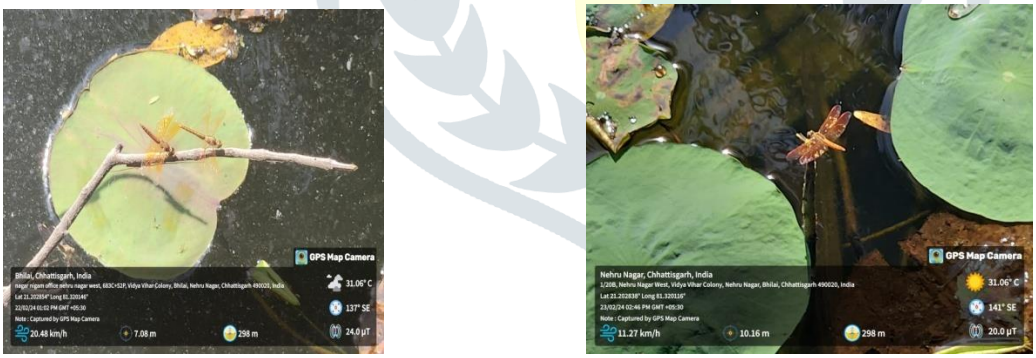
Figure 2 A Displays a 3D Pie Chart that represents the proportion and quantity of individual species belonging to the Odonata order families. **B** Displays a 3D Pie Chart that represent percentage of suborders



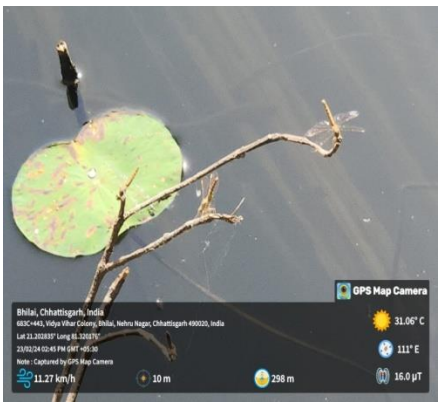


Rhodothemis rufa (Red color)

Orthetrum luzonicum (Blue color) **Orthetrum sabina (Green color)**



Crocothemis servilia (Yellow-orange color)



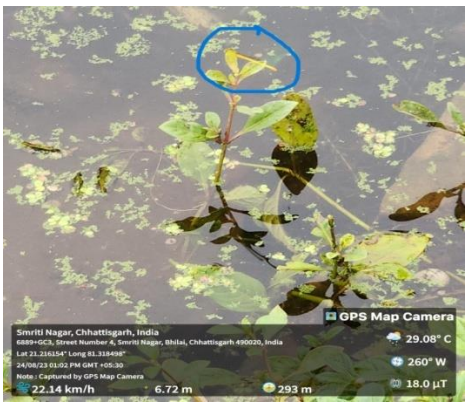


Table 1 shows a checklist of species Odonata were that gathered from multiple locations in two distinct ponds in Bhilai. + denotes species shown in this article; - denotes species that are absent here.

S.No.	Family	Sub-Order	Observed Species Name	Nagar Nigam Pond	Bhelwa Pond
1.	COENAGRIONIDAE	Zygoptera	Enallagma parvum	+	+
2.	COENAGRIONIDAE	Zygoptera	Ceriagrion coromandelianum	+	+
3.	COENAGRIONIDAE	Zygoptera	Agriocnemis pygmaea	-	+
4.	COENAGRIONIDAE	Zygoptera	Ischnura aurora	+	-
5.	COENAGRIONIDAE	Zygoptera	Ischnura senegalensis	+	+
6.	PLATYCNEMIDIDAE	Zygoptera	Onychargia atrocyana	-	+
7.	GOMPHIDAE	Anisoptera	Ictinogomphus rapax	+	-
8.	LIBELLULIDAE	Anisoptera	Crocothemis servilia	-	+
9.	LIBELLULIDAE	Anisoptera	Urothemis signata	+	+
10.	LIBELLULIDAE	Anisoptera	Trithimis festiva	-	+
11.	LIBELLULIDAE	Anisoptera	Trithemis aurora	+	-
12.	LIBELLULIDAE	Anisoptera	Tholymis tillarga	+	+
13.	LIBELLULIDAE	Anisoptera	Rhodothemis rufa	+	-
14.	LIBELLULIDAE	Anisoptera	Diplacodes Trivialis	+	+
15.	LIBELLULIDAE	Anisoptera	Trithemis pallidinervis	+	+
16.	LIBELLULIDAE	Anisoptera	Orthetrum sabina	+	+
17.	LIBELLULIDAE	Anisoptera	Pantala flavescens	-	+
18.	LIBELLULIDAE	Anisoptera	Orthetrum pruinosum	+	-
19.	LIBELLULIDAE	Anisoptera	Orthetrum luzonicum	+	+

Figure 4 the taxonomic classification and evolutionary relationships of Odonata phylogeny tree and the life cycle of a solitary dragonfly.

Phylogenetics data- Phylomatic, an informatics tool, was used to generate a phylogeny for every species in our database. **(19)** Among the surviving data of the earliest ancient flying insects are dragonflies and damselflies **(Fig.4).** This group's evolutionary position is of major importance in comparative research on the development of genomic innovations related to the beginnings of physiological mechanisms. Hence, a concise and comprehensive phylogeny would present an accurate construction to assess change in genome arrangement over time and acquire insights into the beginning of evolutionary improvements inside odonates and entomology as a whole. **(20, 21, 22, 23, 24, 25)**

Conclusion- Aquatic insect diversity, abundance, and distribution especially that of Odonata are significantly influenced by the quality of freshwater. This research has shown that the ponds are a lot contaminated, as shown by the regularities in the species groupings observed at the study locations. The

members of the insect suborder **Anisoptera** are considered individuals because they occupy areas that have previously been impacted by human activities. Specialist **Zygoptera** species only occur at protected sites. The ecological link between these insects and their environment is an important area of study, especially due to the present information imbalance. A ***Shannon index* (H')** was used to assess dragonfly variety in each month. Pre-monsoon species diversity is lowest and post-monsoon greatest. The average was 2.7770 across all seasons and regions. ***Simpson's index* (D)** is 0.9288. This is due to some species being highly niche-specific and dependent on undisturbed habitats, while others are more adaptive. Maintaining a healthy ecology requires monitoring and treating chemicals and beneficial microorganisms in the pond according to standards.

References-

[1] Adu, B., Dada, O., & Tunwase, V. (2022). An ecological study of freshwater ecosystem and its colligation to Odonates assemblages in Ipogun, Southwest Nigeria. Bulletin of the National Research Centre, 46(86), 1–12. https://doi.org/10.1186/s42269-022-00774-4

[2] Suárez-Tovar, C. M., Rocha-Ortega, M., Juen, L., & Córdoba-Aguilar, A. (2023). From the forest to the city: the persistence of dragonflies and damselflies in the urban jungle. *Biodiversity and Conservation*, 33(1), 91–113. https://doi.org/10.1007/s10531-023-02733-5

[3] Combes, S. A. (2014). Dragonflies predict and plan their hunts. *Nature*, 517(7534), 279–280. https://doi.org/10.1038/nature14078

[4] Emiliyamma, K. (2005). On the Odonata (Insecta) fauna of Kottayam district, Kerala, India. Zoos' Print Journal, 20(12), 2108–2110. https://doi.org/10.11609/jott.zpj.1338.2108-10

[5] Kalkman, V. J., Clausnitzer, V., Dijkstra, K. D. B., Orr, A. G., Paulson, D. R., & van Tol, J. (2007). Global diversity of dragonflies (Odonata) in freshwater. Hydrobiologia, 595(1), 351–363. https://doi.org/10.1007/s10750-007-9029-x

[6] Sherratt, T. N., Laird, R. A., Hassall, C., Lowe, C. D., Harvey, I. F., Watts, P. C., Cordero-Rivera, A., & Thompson, D. J. (2010). Empirical evidence of senescence in adult damselflies (Odonata: Zygoptera). Journal of Animal Ecology, 79(5), 1034–1044. https://doi.org/10.1111/j.1365-2656.2010.01719.x

[7] Hassall, C., & Thompson, D. J. (2008). The effects of environmental warming on Odonata: a review. International Journal of Odonatology, 11(2), 131–153. https://doi.org/10.1080/13887890.2008.9748319

[8] Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global Change and the Ecology of Cities. Science, 319(5864), 756–760. https://doi.org/10.1126/science.1150195

[9] Faeth, S. H., Bang, C., & Saari, S. (2011). Urban biodiversity: patterns and mechanisms. Annals of the New York Academy of Sciences, 1223(1), 69–81. https://doi.org/10.1111/j.1749-6632.2010.05925.x

[10] Simaika, J. P., Samways, M. J., Kipping, J., Suhling, F., Dijkstra, K. D. B., Clausnitzer, V., Boudot, J. P., & Domisch, S. (2013). Continental-scale conservation prioritization of African dragonflies. Biological Conservation, 157, 245–254. https://doi.org/10.1016/j.biocon.2012.08.039

[11] Nafisah, N. A., & Soesilohadi, R. H. (2021). Community structure of dragonfly (Ordo: Odonata) in natural forest and tourist sites petungkriyono Forest, Central Java, Indonesia. *Journal of Tropical Biodiversity and Biotechnology*, 6(3), 67328. https://doi.10.22146/jtbb.67328

[12] Koneri, R., Nangoy, M., & Maabuat, P. V. (2020). Composition and Diversity of Dragonflies (Insecta: Odonata) in Tunan Waterfall Area, North Minahasa, North Sulawesi, Indonesia. Pakistan Journal of Zoology, 52(6), 2091–2100. https://doi.org/10.17582/journal.pjz/20181214071225

[13] Susanto, M. A. D (2022). Diversity and Composition of Dragonfly (Odonata) at The Punden Sumur Bumi Area, Surabaya, East Java. International Journal of Applied Biology, 6(2), 43–56. https://doi.org/10.56025/IJARESM.2023.11723894

[14] Dawn, P., & Chandra, K. (2014). Dragonflies and damselflies (Insecta: Odonata) of Chhattisgarh, India. Check List, 10(5), 1104–1109. https://doi.org/10.15560/10.5.1104

[15] Subramanian, K. A., & Gadgil, M. (2005). Dragonflies and Damselflies of peninsular India-A field Guide. Project Lifescape. (1.0). Centre for Ecological Sciences, Indian Institute of Science Bangalore and Indian Academy of Sciences, Bangalore. https://www.researchgate.net/publication/325035600_Dragonflies_and_Damselflies_of_India-A_field_Guide_Project_Lifescape

[16] Thomas, C., Tom, J., Zecharia, A. P., & Abraham, N. P. (2018). Dragonfly species diversity along the waterside of Kallar river base of Pathanamthitta district, Kerala. *International Journal of Research and Analytical Reviews*, *5*(4), 901-903. http://ijrar.com/upload_issue/ijrar_issue_20542667.pdf

[17] Samways, M. J. (2005, January 20). Insect Diversity Conservation. Cambridge University Press. http://books.google.ie/books?id=mie7tAEACAAJ&dq=Flenner.I.+and+Sahlen.G.2008.+Insect+Conservation+and+Diversity.+Vol+6,+Issue+3.169-179.&hl=&cd=2&source=gbs_api

[18] Manwar, N. A., Rathod, P. P., & Raja, A. (2012). Diversity and abundance of Dragonflies and Damselflies Of Chatri Lake Region, in Pohara – Malkhed Reserve Forest, Amravati, Maharashtra (India). International Journal of Engineering Research and Applications (IJERA), 2(5), 521–523. https://www.researchgate.net/publication/317580388_Diversity_and_abundance_of_Dragonflies_and_Damselflies_Of_Chatri_Lake_Region_in_Pohara_-_Malkhed_Reserve_Forest_Amravati_Maharashtra_India

[19] Webb, C. O., & Donoghue, M. J. (2005). Phylomatic: tree assembly for applied phylogenetics. *Molecular ecology notes*, 5(1), 181-183.https://doi.org/10.1111/j.1471-8286.2004.00829.x

[20] Misof, B., Liu, S., Meusemann, K., Peters, R. S., Donath, A., Mayer, C., & Zhou, X. (2014). Phylogenomics resolves the timing and pattern of insect evolution. *Science*, 346(6210), 763-767. https://doi.org/10.1126/science.1257570

[21] Bybee, S. M., Ogden, T. H., Branham, M. A., & Whiting, M. F. (2008). Molecules, morphology and fossils: a comprehensive approach to odonate phylogeny and the evolution of the odonate wing. *Cladistics*, 24(4), 477-514. https://doi/full/10.1111/j.1096-0031.2007.00191.x

[22] DIJKSTRA, K. D. B., Kalkman, V. J., Dow, R. A., Stokvis, F. R., & Van Tol, J. A. N. (2014). Redefining the damselfly families: a comprehensive molecular phylogeny of Z ygoptera (O donata). *Systematic entomology*, 39(1), 68-96. https://doi/full/10.1111/syen.12035

[23] Ware, J., May, M., & Kjer, K. (2007). Phylogeny of the higher Libelluloidea (Anisoptera: Odonata): an exploration of the most speciose superfamily of dragonflies. *Molecular phylogenetics and evolution*, 45(1), 289-310. https://doi.org/10.1016/j.ympev.2007.05.027

[24] Blanke, A., Greve, C., Wipfler, B., Beutel, R. G., Holland, B. R., & Misof, B. (2013). The identification of concerted convergence in insect heads corroborates Palaeoptera. *Systematic Biology*, 62(2), 250-263. https://doi.org/10.1093/sysbio/sys091

[25] Carle, F., Kjer, K., & May, M. (2015). A molecular phylogeny and classification of Anisoptera (Odonata). *Arthropod Systematics & Phylogeny*, 73(2), 281-301. https://scholar.google.com/scholar?hl=en&as_sdt=0%2C5&q=Carle%2C+F.%2C+Kjer%2C+K.%2C+%26+May%2C+M.+%282015%29.+A+molecular+phylogeny+and+classification+of+Anisoptera+%28Odonata%29.+Arthropod+Systematics+%26+Phylogeny%2C+73%282%29%2C+281-301.+&btnG=