



## Odonata diversity of Singoda Lake, Visnagar, North Gujarat

Hiteshkumar Parmar<sup>1\*</sup>, Aditya Parihar<sup>2</sup>, Vishal Parihar<sup>3</sup>

<sup>1</sup> Department of Zoology, School of Science, Dr. Subhash University, Juangadh, Gujarat, India

<sup>2</sup> Department of Zoology, Conestoga college, 299 Doon Valley, Dr. Kitchener, Ontario N2G 4M4, Canada

<sup>3</sup> Department of Biology, Madhyamik ashram shala, Nani Tudiya, Danta, Banaskantha, Gujarat, India

### Abstract

The current studies intend to study the Odonata diversity in Singoda lake, Visnagar, North Gujarat. Three main habitats (Tree Dominated Habitat Scrubs, Herbs dominated and Water Body and Edges) surveyed extensively. The survey was done in morning (07:00 to 10:00 hrs.) and evening (17:00 to 19:00 hrs.) time, employed 8 visits in a month (2 visit/Week) from June to September 2020. The Visual Encounter Survey method used for sample collection with total of 32 visits and 40 transects (10m x 100m), and sampling was done by random method. Total of 28 species of lepidoptera distributed in 05 family and 20 genera. The Month of July has maximum diversity ( $H=2.63$ ) and species richness ( $d=4.31$ ) was observed. The recorded Odonata diversity in study area suggest that Singoda lake is very important for a nursing ground to larvae and food for the adults to grow.

**Keywords:** Odonata, dragonflies, damselflies, diversity, conservation

### Introduction

Odonata are a group of insects belonging to the Class Insecta, which includes dragonflies and damselflies. They play very important role as a Predators<sup>[1]</sup>, Larvae prey on other insects<sup>[2]</sup>, Bioindicators<sup>[3]</sup>, Resources Cycling<sup>[4]</sup> and Pollinators<sup>[5]</sup>. However now days these marvellous creatures facing many challenges due to urbanization<sup>[6][7]</sup>.

Globally total of approximate 7000 species of ozonates distributed in 31 genera and families, among them 21 families, 21 genera and 1665 species found in Oriental region<sup>[8]</sup>. In India total of 508 species of odonates distributed in 18 families and 56 genera<sup>[9]</sup>. Gujarat have many localities for the odonata such as 37 species and 28 genera from south Gujarat<sup>[10]</sup>, 42 species and 27 Genera from central Gujarat<sup>[11]</sup>, 48 species from Gir National Park of Saurashtra region<sup>[12]</sup>, Very scarce records found from North Gujarat and Kutch region of Gujarat<sup>[13]</sup>. A total of 60 species distributed in 40 genera and 8 families from Protected areas of Gujarat<sup>[14]</sup>.

### Study Area

Singoda lake (N 23.7013017, E 72.5719817) is small water body that expand in total of 248283.03 m<sup>2</sup> (Fig. 1 A, B). Water availability in the lake is depends on the rainfall of the area. The lake is located near Sunshi village, Visnagar. The name Singoda lake is came from previously used for

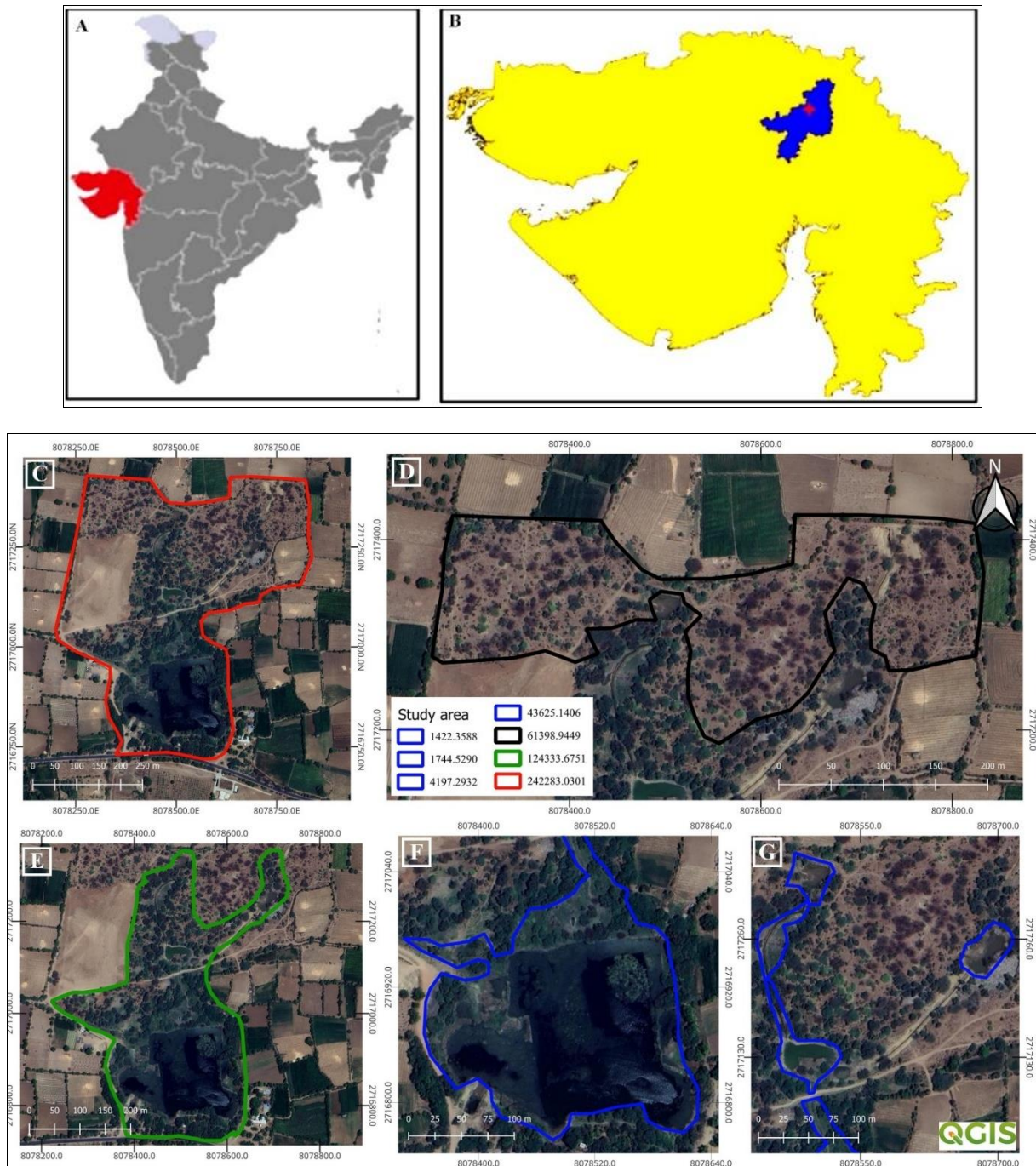
the harvesting of Singoda (Water Chestnut). The climate of the area is during winter is cold and dry, in summer the water is evaporated and water body is screamed, but in monsoon early monsoon (June and July) is very humid and medium ranged of rainfall followed by in the month of August and September the lake is recharge. Background of the habitat is as per Parmar *et al.*, 2024<sup>[16]</sup>.

### Methodology

Survey starts from June 2020 to Sep 2020 to measure the diversity of odonata in each possible niche in study area (Fig 1.C). Visual Encounter Survey<sup>[15]</sup> used for observing dragonflies and damselflies, i.e., On the fixed paths while observing and counting the species. The observation width was limited to about 5m with time concerned (5 min. for each stop). Odonata species were observed throughout the morning (07:00 to 10:00 hrs.) and evening (17:00 to 19:00 hrs.). Total of 32 visits (8 visit / month) and 40 transects (10m x 100m) were encompass for observations by random method.

### Data Analysis

PAST v4.16 used to calculate diversity indices. Map and habitat analyse is done in QGIS v3.34.3. Identification purposes DSLR cameras (Canon 700d, Nikon 5800). Dragonflies and damselflies identification were by field guides, and online databases<sup>[17, 18]</sup>.



**Fig 1:** A. B., Location of Mehsana District in Gujarat, B. Study area, C. Tree Dominated Habitat (Medium Dry), D. Scrubs and Herbs dominated Habitat (Moist Habitat), E. F. G, Water body and Edges

**Result and Discussion**

Total of 28 species distributed in two sub order, 05 super families and 06 families out of 309 individuals of odonata (Table 1., Fig. 4, 5, 6).

**Table 1:** Odonata fauna of Visnagar city and Vicinity areas.

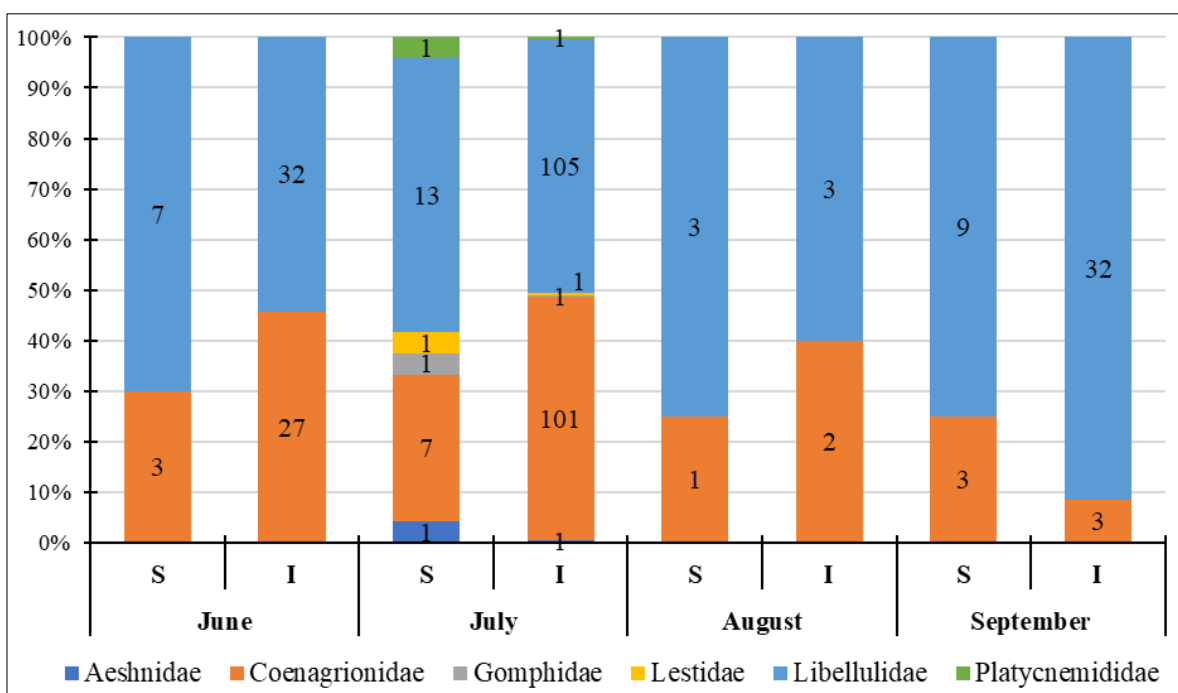
No.	Species	Common name	Months				Total
			J	Ju	A	S	
<b>Suborder:</b> Anisoptera Selys, 1854							
<b>Superfamily:</b> Aeshnoidea							
<b>Family:</b> Aeshnidae							
1	<i>Anax ephippiger</i> (Burmeister, 1839)	Vagrant Emperor	0	1	0	0	1
<b>Superfamily:</b> Gomphoidea							
<b>Family:</b> Gomphidae							
2	<i>Melligomphus acinaces</i> Laidlaw, 1922	-	0	1	0	0	1
<b>Superfamily:</b> Libelluloidea Leach, 1815							
<b>Family:</b> Libellulidae Leach, 1815							

3	<i>Acisoma panorpoides</i> Rambur, 1842	Trumpet-Tail	3	9	0	0	12
4	<i>Brachydiplax sobrina</i> (Rambur, 1842)	Little Blue Marsh Hawk	3	0	0	0	3
5	<i>Brachythemis contaminata</i> (Fabricius, 1793)	Ditch Jewel	9	30	0	2	41
6	<i>Crocothemis servilia</i> (Drury, 1770)	Scarlet Skimmer	6	24	0	5	35
7	<i>Diplacodes lefebvrii</i> (Rambur, 1842)	Black Ground Skimmer	0	7	0	0	7
8	<i>Diplacodes trivialis</i> (Rambur, 1842)	Blue Ground Skimmer	7	5	0	3	15
9	<i>Hylaeothemis apicalis</i> Fraser, 1942	Blue Hawklet	0	0	1	2	3
10	<i>Indothemis carnatica</i> (Fabricius, 1798)	Light-tipped Demon	0	2	0	0	2
11	<i>Orthetrum sabina</i> (Drury, 1770)	Green Marsh Hawk	0	3	1	2	6
12	<i>Orthetrum triangulare</i> (Selys, 1878)	Blue-Tailed Forest Hawk	0	0	0	1	1
13	<i>Pantala flavescens</i> (Fabricius, 1798)	Wandering Glider	0	1	0	3	4
14	<i>Rhyothemis variegata</i> (Linnaeus, 1763)	Common Picturewing	0	3	0	11	14
15	<i>Tetrathemis platyptera</i> Selys, 1878	Pigmy Skimmer	0	1	0	0	1
16	<i>Tholymis tillarga</i> (Fabricius, 1798)	Coral-Tailed Cloudwing	0	0	0	3	3
17	<i>Trithemis aurora</i> (Burmeister, 1839)	Crimson Marsh Glider	0	1	0	0	1
18	<i>Trithemis festiva</i> (Rambur, 1842)	Black Stream Glider	3	2	0	0	5
19	<i>Trithemis pallidinervis</i> (Kirby, 1889)	Long-Legged Marsh Glider	1	17	1	0	19
<b>Suborder:</b> Zygoptera							
<b>Superfamily:</b> Coenagrionoidea Kirby, 1890							
<b>Family:</b> Coenagrionidae Kirby, 1890							
20	<i>Agriocnemis pygmaea</i> (Rambur, 1842)	Pygmy Dartlet	6	29	0	1	36
21	<i>Amphiallagma parvum</i> (Selys, 1876)	Azure Dartlet	0	11	0	1	12
22	<i>Ceriagrion coromandelianum</i> (Fabricius, 1798)	Coromandel Marsh Dart	7	38	2	0	37
23	<i>Ischnura nursei</i> Morton, 1907	Pixie Dartlet	0	5	0	0	5
24	<i>Ischnura senegalensis</i> (Rambur, 1842)	Senegal Golden Dartlet	14	10	0	0	24
25	<i>Pseudagrion decorum</i> (Rambur, 1842)	Three-lined Dart	0	3	0	1	4
26	<i>Pseudagrion microcephalum</i> (Rambur, 1842)	Blue Sprite	0	5	0	0	5
<b>Family:</b> Platycnemididae Jakobson & Bianchi, 1905							
27	<i>Calicnemia</i> sp. Strand, 1928	-	0	1	0	0	1
<b>Superfamily:</b> Lestoidea							
<b>Family:</b> Lestidae							
28	<i>Lestes viridulus</i> Rambur, 1842	Emerald-striped Spread wing	0	1	0	0	1

**Abbreviation:** J-June, Ju-July, A-August, S-September

Out of total 309 individuals and 28 species, half of the recorded individual (50%, 105 individuals) and recorded species (54%, 13 species) in the month of July were from Family Libellulidae. Also, second most populated group was form month of July is Family Coenagrionidae recorded

total of 48% Individuals (101) and 29% species (07). During survey these individuals of Family Libellulidae is pray on many species of Family Coenagrionidae and also Family Coenagrionidae prey on many Moth and Butterflies species (Fig. 2, Table, 1).

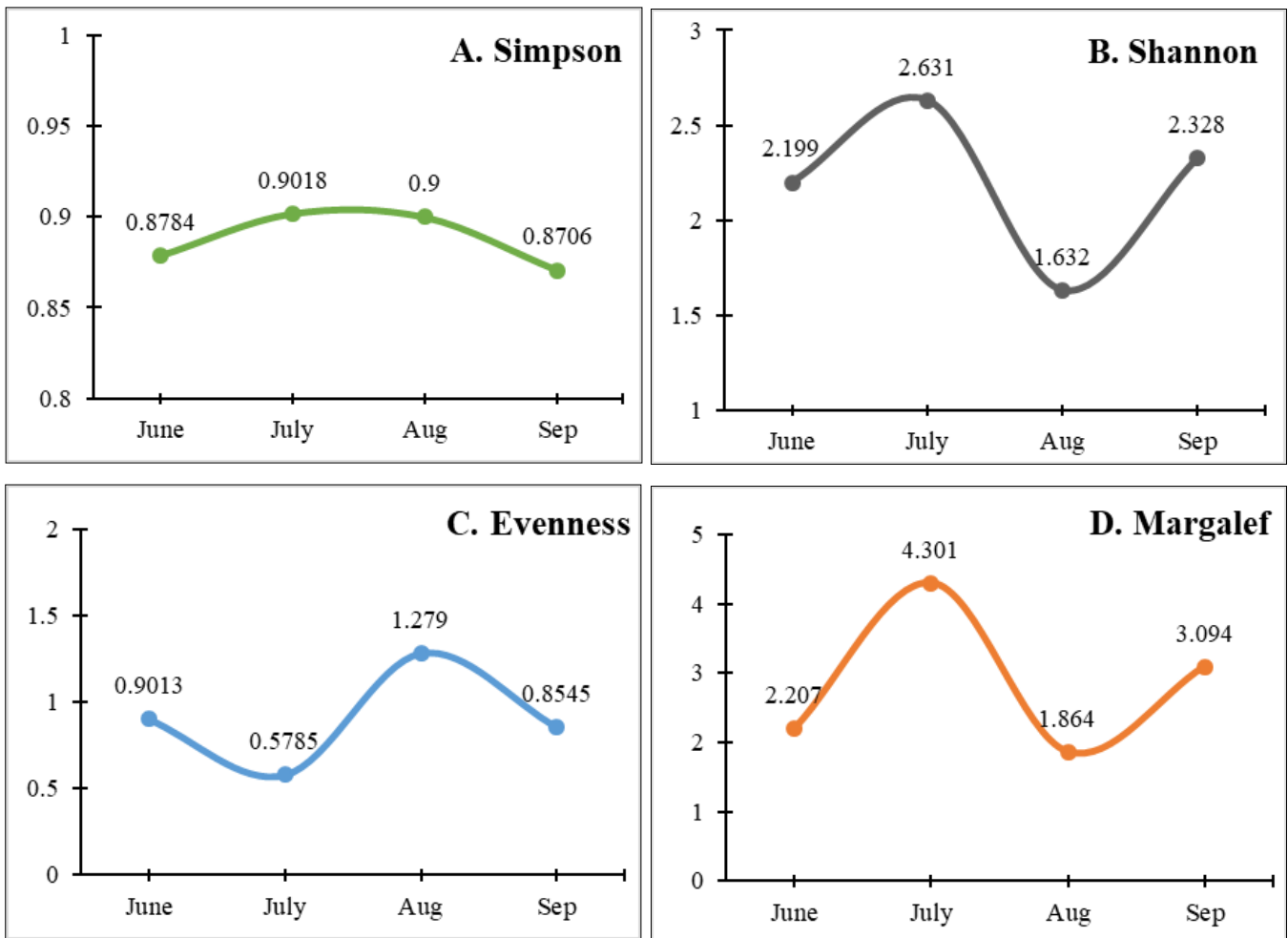


**Fig 2:** Month-wise individual and species of Odonata.

The time duration is making available tremendous amount of pray to feed and also support for their prey population (Parmar et al., 2024). Also, in the month of June recorded only two families among them; Family Libellulidae (32 individuals and 07 species) and second most populated Family Coenagrionidae (27 individuals and 03 species). In the September and August these individuals and species were declined rapidly due to have rainfall in the month of August (Fig. 2).

**Diversity indices and ecological status**

Diversity indices suggest that in the month of July ( $D=0.9018$ ) and August ( $D=0.90$ ) Simpson diversity found significant, and also found low in the month of June ( $D=0.8784$ ) and September ( $D=0.8706$ ) (Fig. 3A). However, Shannon diversity and Margalef's diversity show different trend in month of July ( $H=2.631$ ,  $d=4.301$ ) and September ( $H=3.382$ ,  $d=3.094$ ) it shows significant richness and even distribution of species. While in June ( $H=2.199$ ,  $d=2.207$ ) and August ( $H=1.632$ ,  $d=1.864$ ) is shows compare lees richness and species diversity (Fig. 3A, B, C, D).



**Fig 3:** Diversity indices of recorded odonata fauna.

In the month of August, due to have rainfall the are some low ground habitat were submerged in water, this will affect the directly pray and predator's species, later on these habitat submerged in water lack of food and livestock these species will show very less diversity.

However, evenness effected differently in the month of August ( $e=1.279$ ) it shows highly evenly distribution of odonata fauna (Fig 3C). It may due to rainfall is act as an environment control of these specie and peris some, this will help to other species to grow and provide opportunities. Due

this phenomena the specie has less competition and more evenly distributed in these habitat.

**Ecological status**

Total of 28 species of odonata distributed in five different categories, among them two species were found abundant (Ditch Jewel and Coromandel Marsh Dart), 2 common (Scarlet Skimmer and Pygmy Dartlet) and 2 Frequent (Long-Legged Marsh Glider and Senegal Golden Dartlet) (Fig 4 and 5). While 4 species of Occasional and 18 species were found rare as per frequency based ecological status.

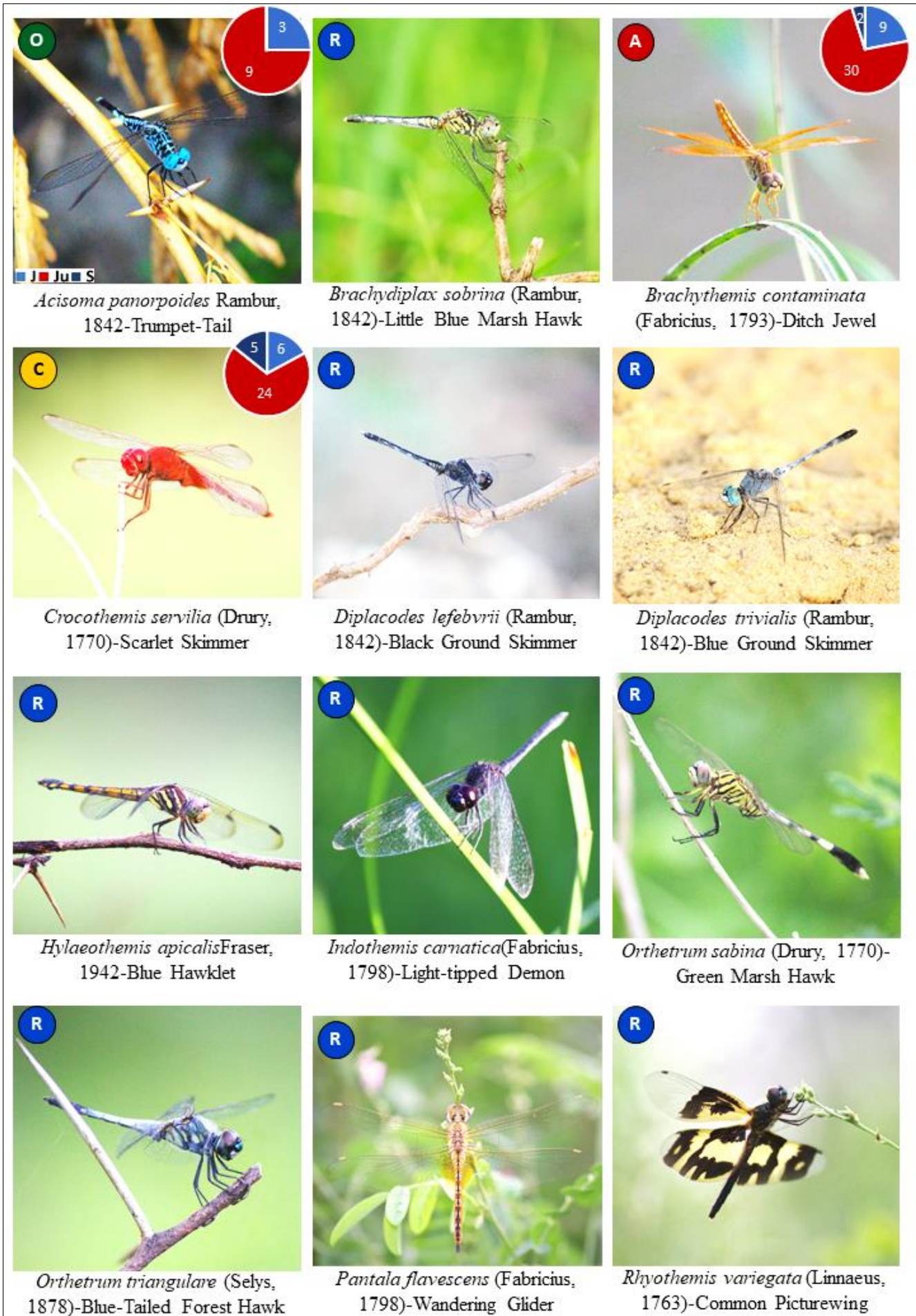


Fig 4: Recorded odonata fauna with their local status.

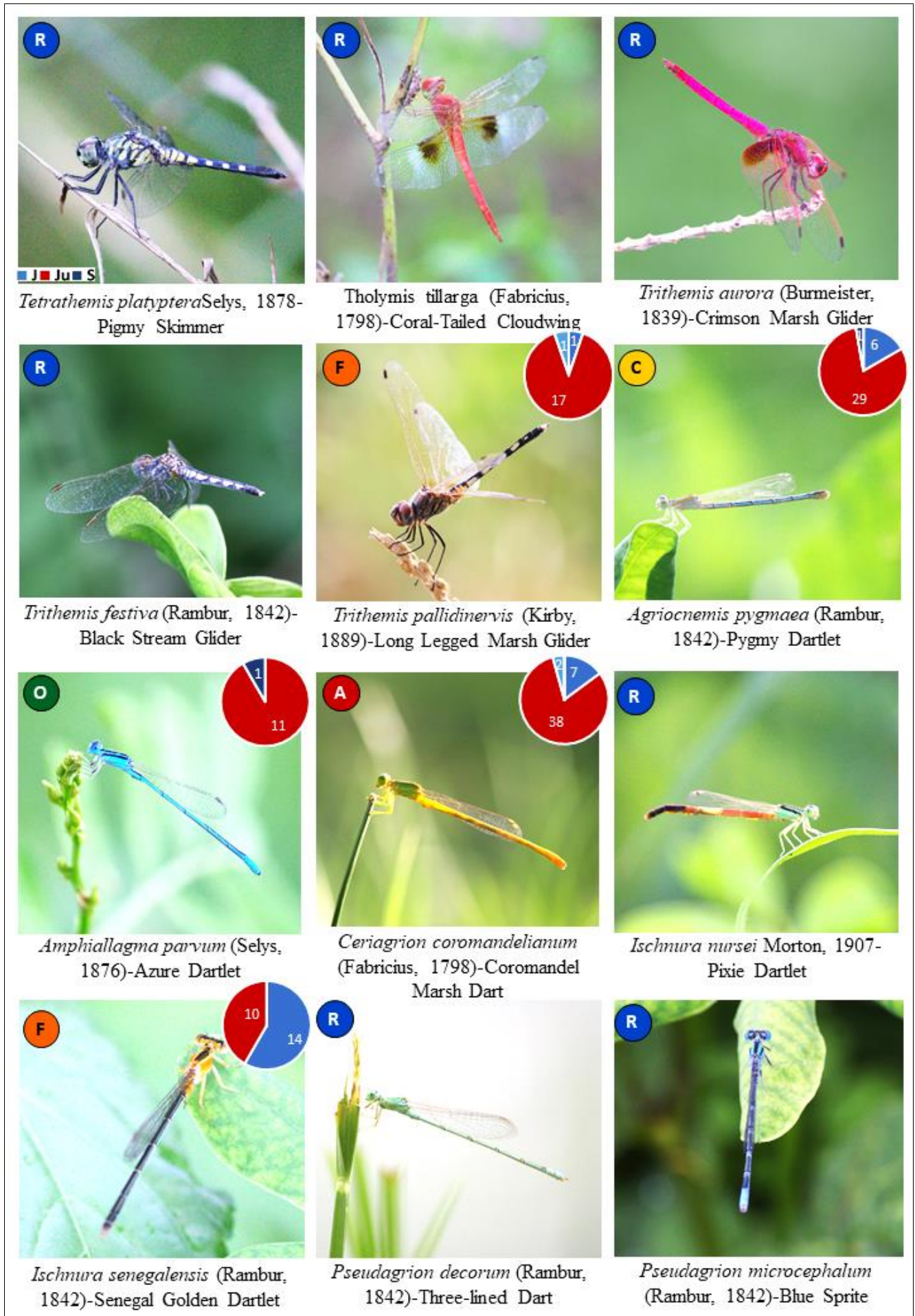


Fig 5: Recorded odonata fauna with their local status.

Among these rare species 7 species (Vagrant Emperor, *Meligomphus acinaces* Laidlaw, 1922; Blue-Tailed Forest Hawk, Pigmy Skimmer, Crimson Marsh Glider, Emerald-striped Spreadwing, *Calicnemia* sp. Strand, 1928) is cited only single time during study period (Fig 4, 5, 6.).



**Fig 6:** Recorded odonata fauna with their Local status

### Conclusion

Overall, recorded diversity of odonata suggests that these species where mass breeder and they take an opportunity to breed in hot summer and monsoon to sustain their aquatic as well as terrestrial life, they need aquatic medium to support the larval growth these larva were predator and prey in aquatic food chain. While adults are paly crucial role in control of other species in environment and also act as a prey for some vertebrates. Conservation of these species very important for sustainment of ecosystem, because of their dual mode of life. However, rainfall very important factor for recorded diversity, but latter on in the month of august heavy rainfall submerge all the habitat in to water. Due to drastic changes in habitat species of odonata rapidly decline in the month of September. These seasonal wetlands are most viable habitat to conserve these species for the future.

### Acknowledgements

Authors very much thank full to Dr. Darshna Rathod for the help in the identification of odonatan species. Also special thanks to Mr. Dharmik Parmar for continuous field support during the research work.

### Sources of funding

This study did not receive financial support from any specific grant or funding agencies in the public, commercial, or not-for-profit sectors.

### References

- Subramanian KA, Babu R. Dragonflies and Damselflies (Insecta: Odonata) of India. In: Indian Insects. CRC Press, 2019, 29-45.
- Priyadarshana TS, Slade EM. A meta-analysis reveals that dragonflies and damselflies can provide effective biological control of mosquitoes. *J Anim Ecol*,2023;92(8):1589-1600.
- Bulánková E. Dragonflies (Odonata) as bioindicators. *Biologia (Bratislava)*,1997;52(2):177-180.
- Tennessee KJ. Odonata: Dragonflies, Damselflies. In: Encyclopedia of Insects. Academic Press, 2009, 721-9.
- Clark TE, Samways MJ. An inventory of the damselflies and dragonflies (Odonata) of the Kruger National Park, with three new South African records. *Afr Entomol*,1994;2(1):61-4.
- Hassall C, Thompson DJ. The effects of environmental warming on Odonata: a review. *Int J Odonatol*,2008;11(2):131-53.
- Córdoba-Aguilar A, Rocha-Ortega M. Damselfly (Odonata: Calopterygidae) population decline in an urbanizing watershed. *J Insect Sci*,2019;19(3):30.
- Kalkman VJ, Clausnitzer V, Dijkstra KDB, Orr AG, Paulson DR, Van Tol J. Global diversity of dragonflies (Odonata) in freshwater. *Freshw Anim Divers Assess*,2008:351-63.
- Joshi S, Sawant D, Kunte K. ODONATA SPECIES LIST. In: (Chief Editors). Butterflies of India, v. Indian Foundation for Butterflies, 2025.
- Rathod DM, Parasharya BM, Talmale SS. Odonata (Insecta) diversity of southern Gujarat, India. *J Threat Taxa*,2016;8(11):9339-49.
- Rohmare VB, Rathod DM, Dholu SG, Parasharya BM, Talmale SS. An inventory of odonates of central Gujarat, India. *J Threat Taxa*,2015;7(11):7805-11.
- Kapadi P, Ram M, Sahu A, Koparde P, Jhala LS. Odonata assemblage of the Gir National Park with three additional records for Gujarat state, India. *Notul Odonatol*,2023;10(2):31-7.
- Prasad M. Insecta: Odonata. Fauna of Gujarat. State Fauna Series,2004;8(Part 2):19-40.
- Dholu S, Rathod DM, Parasharya BM. Odonate diversity reflected by wetland quality in Gujarat, India. *J Biol Control*,2023;37(2):123-30.
- Scott NJ, Crump ML, Zimmermann BL, Jaeger RG, Inger RF, Corn PS, *et al.* Standard techniques for inventory and monitoring. Measuring and monitoring biological diversity. Standard methods for amphibians. Heyer WR, editor.
- Parmar H, Parihar A, Parihar V. Lepidopteran diversity of Singoda lake, Visnagar, North Gujarat. *Int J Entomol Res*,2024;9(4):84-97.
- Kalkman V, Babu R, Bedjanic M, Conniff K, Gyeltshen T, Khan K, *et al.* Checklist of the dragonflies and damselflies (Insecta: Odonata) of Bangladesh, Bhutan, India, Nepal, Pakistan and Sri Lanka. *Zootaxa*,2020;4849(1):1-84. <https://doi.org/10.11646/zootaxa.4849.1.1>.
- Joshi S, Sawant D, Kunte K. Odonata Species List. In: (Chief Editors). Butterflies of India, v.0 Indian Foundation for Butterflies, 2025. Available from: <https://www.indianodonata.org/species-list>.