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Cover: Rufous-headed Hornbill *Rhabdotorrhinus waldeni* © Philip Godfrey C. Jakosalem.



## Dragonflies and damselflies (Insecta: Odonata) of Jabalpur, Madhya Pradesh, India

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**Abstract:** The present study was carried out to reveal the odonate diversity in Jabalpur city and its surrounding area in Madhya Pradesh, central India. During the study period of 2008–2019 a total of 75 species of odonates belonging to two suborders and nine families were recorded. Twenty-one new species were recorded for Jabalpur district and four for Madhya Pradesh; 37% (28) species were abundant or very common, 19% (14) were common, 16% (12) were frequent, 24% (18) rare, and 4% (3) very rare. The maximum number of odonates were found in family Libellulidae (n= 32), followed by Coenagrionidae (n= 17), Gomphidae (n= 09), Platycnemididae (n= 06), Aeshnidae (n= 05), Lestidae (n= 03), Macromiidae (n= 02), and Chlorocyphidae (n= 01). Of 75 species recorded from Jabalpur city, 72 come under the IUCN Red List. Among them, *Indothemis carnatica* come under Near Threatened (NT) category, 65 species come under Least Concern (LC) Category, six species under Data Deficient (DD), and three species remain not assessed. The study supports the value of the city area in providing habitat for Odonata.

**Keywords:** Central India, checklist, conservation, distributional gaps, diversity, habitat, IUCN Red List, new records, Odonata.

वर्तमान अध्ययन मध्य भारत के मध्य प्रदेश में जबलपुर शहर और इसके आसपास के क्षेत्र में ओडोनेट विविधता को प्रकट करने के लिए किया गया था। 2008-2019 की अध्ययन अवधि के दौरान दो उपसमूहों और नौ परिवारों से संबंधित ओडोनेट्स की कुल 75 प्रजातियों को दर्ज किया गया था। जबलपुर जिले के लिए इक्कीस और मध्य प्रदेश के लिए चार नई प्रजातियां दर्ज की गईं; 37% (28) प्रजातियां प्रचुर या बहुत आम थीं, 19% (14) आम थीं, 16% (12) अक्सर दिखाई देने वाली, 24% (18) दुर्लभ और 4% (3) अति दुर्लभ थीं। लिबेलुलिडे (संख्या=32) परिवार में ओडोनेट्स की अधिकतम संख्या पाई गई, उसके बाद अन्य परिवार जिनमें प्रजातियां दर्ज की गईं वे संख्या के क्रम में इस प्रकार हैं- कोएनाग्रियोनिडे (संख्या=17), गोम्फिडे (संख्या=09), प्लैटिसिनेमिडीडे (संख्या=06), एशनिडे (संख्या=05), लेस्टिडे (संख्या=03), मैक्रोमिडी (संख्या=02), और क्लोरोसाइफिडे (संख्या=01)। जबलपुर शहर से दर्ज 75 प्रजातियों में से 72 आईयूसीएन रेड लिस्ट में आती हैं। उनमें से, इंडोथेमिस कार्नाटिका नियर थ्रेटेंड (एनटी) श्रेणी के अंतर्गत आती है, 65 प्रजातियां लीस्ट कंसेर्न (एलसी) श्रेणी के अंतर्गत आती हैं, छह प्रजातियां डेटा डेफिसिएंट (डीडी) के अंतर्गत आती हैं, और तीन प्रजातियों का मूल्यांकन नहीं किया जाता है। प्रस्तुत अध्ययन ओडोनाटा के लिए आवास प्रदान करने में शहर के क्षेत्र के महत्व का समर्थन करता है।

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## INTRODUCTION

Odonates (damselflies and dragonflies) are an ancient insect order with origins in the Carboniferous era about 250 million years ago. They probably mark the first time that evolution experimented with the ability to hover in the air over an object of interest (Andrew et al. 2008). They are beautifully coloured, primarily aquatic in their pre-adult stages, and closely tied to freshwater ecosystems such as rivers, streams, lakes, marshes, and rice fields. Species are usually highly specific to habitats, but some have adapted to using man-made water bodies (Tiple & Chandra 2013). Odonates are important for water-rich habitats such as wetlands, lakes and rainforests, and they are also significant for habitats where water is scarce. Thus the Odonata are regarded as vital to the survival of life (Dijkstra 2007). Odonates are economically significant and act as useful biocontrol agents, since adults prey on mosquitoes, flies, moths, aphids, termites, and small beetles, while larvae feed on mosquito larvae and other soft-bodied aquatic invertebrates. Odonata are reliable indicators of overall ecosystem health, since they are highly sensitive to environmental changes (Dijkstra & Lewington 2006; Andrew et al. 2008).

Globally, 6,356 species in 693 genera of odonates have been reported (Schorr & Paulson 2022), of which 498 species and 27 Subspecies in 154 genera and 18 families are known from India (Subramanian & Babu 2020; Joshi & Sawant 2020; Bedjanič et al. 2020; Payra et al. 2020, 2021; Dawn 2021). Fraser (1933–1936) published three volumes on Odonata in the 'Fauna of British India' and included 536 species and subspecies of Odonata from India, including Bangladesh, Bhutan, Myanmar, Nepal, Pakistan, and Sri Lanka and included many species from Madhya Pradesh. After Fraser's work, some additions were made by Bhasin (1953), Prasad & Ghosh (1988), Mitra (1988, 1995), Srivastava & SuriBabu (1997), Prasad & Varshney (1995), and Mishra (2007). Many additions have been made to the fauna of Madhya Pradesh by Tiple et al. (2011, 2012) with the latest updated checklist being Tiple & Chandra (2013) revealing 106 species under 53 genera and 12 families with 14 new records from Madhya Pradesh and Chhattisgarh. Recently Tiple & Payra (2020) reported *Epophthalmia frontalis* as a new record for Madhya Pradesh. Though the diversity of Odonata had been well documented from Madhya Pradesh, no consolidated checklist of Odonata of Jabalpur city and its surrounding areas is available and hence the present one with an objective of exploring the diversity and abundance.

## MATERIALS AND METHODS

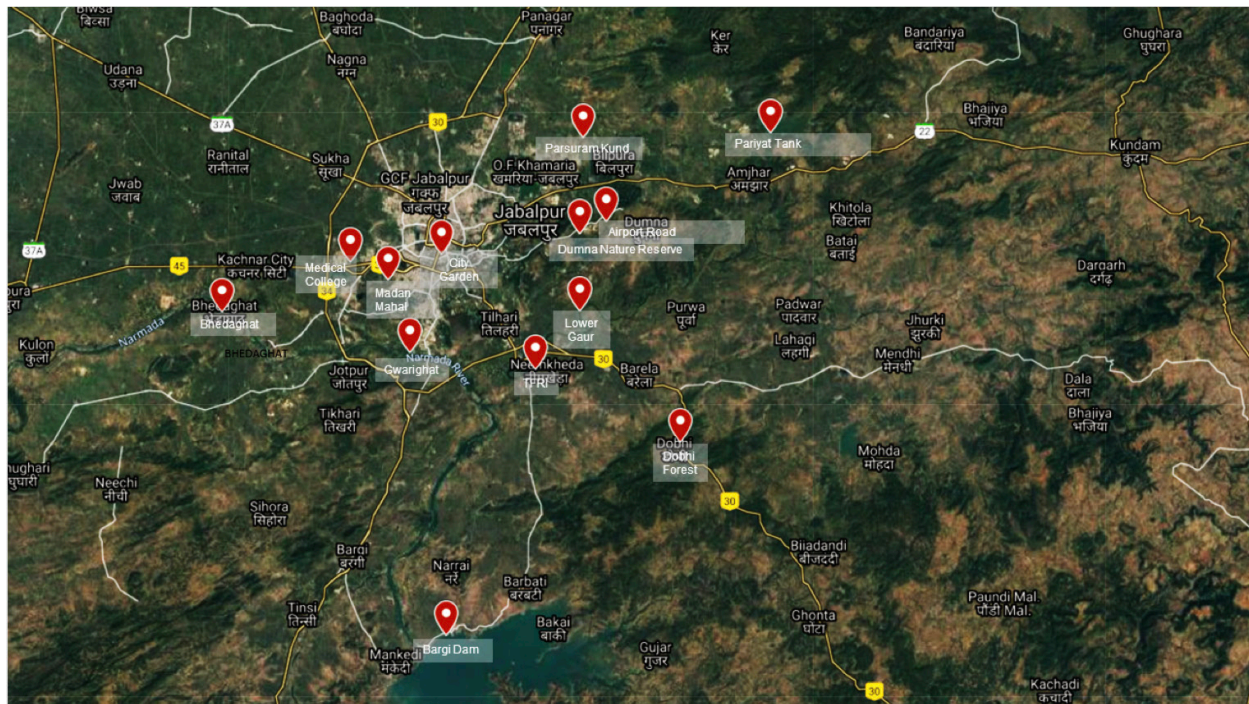
Opportunistic sampling and photo documentation were conducted in selected areas of Jabalpur city and its surrounding areas. Surveys were carried out from 2008 to 2019. Most of the samplings were done between 1000 h and 1400 h, when odonates control their body temperature in sunlight (Subramanian 2009; Koli et al. 2014; Payra & Tiple 2019). Identification of odonates was primarily made directly in the field from specimens collected with handheld aerial sweep nets and subsequently released without harm. Photographs of specimens taken from various angles aided their identification using field guides (Andrew et al. 2008; Subramanian 2009; Nair 2011). Specimens that were difficult to identify in the field were collected and preserved in 70% alcohol or acetone, and carried to the laboratory for further identification with the help of taxonomic keys (Fraser 1933, 1934, 1936; Mitra 2002). All scientific names follow Kalkman et al. (2020). The species were categorized on the basis of number of sightings in the Jabalpur city as: VC very common (>100 sightings), C common (50–100 sightings), FC frequently common (15–50 sightings), R rare (2–15 sightings), VR very rare (<2 sightings) (Tiple et al. 2008).

### Study area

Jabalpur is one of the largest and the most crowded cities in Madhya Pradesh, located in the north-center region of India at 23.16°10'7.57"N & 79.93°55'54.64"E. It is situated on the Deccan Plateau at an altitude of 411 m and is surrounded on all sides by ancient basalt rocks and forests. Jabalpur consists of a long, narrow plain running from south-west to north-east flanked by the Bhanrer and Kaimur ranges of the Vindhyan system on the west and the various hills of the Mahadeo range and Maikal range on the east. The Bhitrigarh range and a few subsidiary hills intrude upon in the middle of the district and practically join the Vindhyan and the Satpura systems, which together form the great central watershed of India. It lies in the catchment of the longest river of central India, the Narmada, along with its tributaries, Hiran, Gour, Ken, and Sone. Jabalpur city is surrounded by low, rocky, and barren hillocks, which include Kariapathar hillock to the north-east, SitaPahad and Kandhari hills to the east and Madan Mahal hills to the south-west (Chandra 2008; Flora et al. 2020).

Jabalpur city has a humid subtropical climate, having three main seasons: June/July wet monsoon and its aftermath from June till October, the cool dry winter from October/November to February/March and the





**Figure 1. Map of the surveyed localities of Jabalpur City. Source: Google Earth**

hot dry season from April till the onset of rains. The temperature of the city ranges from minimum of 10–25 °C to maximum 30–45 °C with a relative humidity 10–15 % to 60–95 %. Annual precipitation is 1,386 mm.

## Survey sites

All the study sites were within and around Jabalpur city within a radius of 20 km. Odonates were surveyed in Dumna Nature Reserve (includes Kakartala), Dhoobi Reserve Forest, Lower Gaur Reserve Forest, City Gardens, Tropical Forest Research Institute (TFRI), Airport Road, Vijaynagar, Garha, Adhartal, Medical College Campus, Bhedaghat, Pariyat Tank, Narrai forest, Parashuram Kund, Madan Mahal Hills (includes Thakurtal, Pisanhaari Temple and SangramSagar), areas adjacent to River Narmada, Bargi dam, temporary and permanent flowing or still water bodies, and rivers (Figure 1).

## RESULTS AND DISCUSSION

Seventy-five species of Odonata belong to nine families were recorded. The present study adds 21 new species recorded for Jabalpur district, and four species for Madhya Pradesh. Of the total, 37% (28) species were abundant or very common, 19% (14) were common, 16% (12) were frequently common, 24% (18) rare and 4% (03) very rare (i.e., *Aethriamanta brevipennis*, *Agriocnemis*

*pieris*, *Caconeura ramburi*). The observed and identified species, their status in and around of Jabalpur city are listed in Table 1.

The highest number of odonates belonged to the family Libellulidae (32 species) with 10 new records (i.e., *Aethriamanta brevipennis*, *Diplacodes lefebvrii*, *Diplacodes nebulosa*, *Indothemis carnatica*, *Neurothemis fulvia*, *Orthetrum chrysis*, *Rhodothemis rufa*, *Tramea limbata*, *Rhyothemis triangularis*, *Urothemis signata*), followed by Coenagrionidae (17 species) with one new record (*Pseudagrion hypermelas*), Gomphidae (09 species) with five new records (i.e., *Cyclogomphus ypsilon*, *Cyclogomphus wilkinsi*, *Ictinogomphus distinctus*, *Ictinogomphus angulosus*, *Microgomphus torquatus*), Platycenemididae (06 species) with three new records (i.e., *Caconeura ramburi*, *Elattoneura nigerrima*, *Onychargia atrocyana*), Aeshnidae (05 species) with one new record (*Anax indicus*), Lestidae (03 species), Macromiidae (02 species) with one new record (*Macromia cingulata*) and Chlorocyphidae (1 species) (see Figure 2). *Ictinogomphus distinctus*, *Rhyothemis triangularis*, *Onychargia atrocyana*, and *Anax indicus* are recorded for the first time in Madhya Pradesh. *I. distinctus* has been reported from Santragachi, Howrah, West Bengal (Image 1). *R. triangularis* is a widely distributed species; it was recorded only from Assam, Karnataka, Kerala, Tamil Nadu states (Dow & Sharma 2010) (Image 4). *O. atrocyana* is a widely distributed

**Table 1.** Checklist of Odonata of Jabalpur city: OS—Occurrence status | TS—Threat status as assigned from IUCN (2014). NA—Not available | LC—Least concern | DD—Data deficient | VU—Vulnerable | NT—Near Threatened. The species recorded for the first time from the Jabalpur are asterisked by (\*), and those which were previously unrecorded in the Madhya Pradesh state are marked by #.

	Scientific name	OS	TS
<b>Suborder: Anisoptera (Dragonflies)</b>			
<b>Family: Aeshnidae (05)</b>			
1	<i>Anax guttatus</i> (Burmeister, 1839)	VC	LC
2	<i>Anax immaculifrons</i> (Rambur, 1842)	C	LC
3	<i>Anax indicus</i> Lieftinck, 1942*#	R	LC
4	<i>Anax ephippiger</i> (Burmeister, 1839)	FC	LC
5	<i>Gynacantha bayadera</i> Selys, 1891	C	LC
<b>Family: Gomphidae (09)</b>			
6	<i>Burmogomphus pyramidalis</i> Laidlaw, 1922	R	NA
7	<i>Cyclogomphus ypsilon</i> Selys, 1854*	R	NA
8	<i>Cyclogomphus wilkisi</i> Fraser, 1926*	R	DD
9	<i>Ictinogomphus distinctus</i> Ram, 1985*#	R	DD
10	<i>Ictinogomphus angulosus</i> (Selys, 1854)*	R	LC
11	<i>Ictinogomphus rapax</i> (Rambur, 1842)	VC	LC
12	<i>Macrogomphus annulatus</i> (Selys, 1854)	FC	DD
13	<i>Microgomphus torquatus</i> Selys, 1854*	R	DD
14	<i>Paragomphus lineatus</i> (Selys, 1850)	C	LC
<b>Family: Libellulidae (32)</b>			
15	<i>Acisoma panorpoides</i> Rambur, 1842	C	LC
16	<i>Aethriamant abrevipennis</i> (Rambur, 1842)*	VR	LC
17	<i>Brachydiplax sobrina</i> (Rambur, 1842)	FC	LC
18	<i>Brachythemis contaminata</i> (Fabricius, 1793)	VC	LC
19	<i>Bradynopyga geminate</i> (Rambur, 1842)	VC	LC
20	<i>Crocorthemis servilia</i> (Drury, 1770)	VC	LC
21	<i>Diplacodes lefebvrei</i> (Rambur, 1842)*	R	LC
22	<i>Diplacodes nebulosa</i> (Fabricius, 1793)*	R	LC
23	<i>Diplacodes trivialis</i> (Rambur, 1842)	VC	LC
24	<i>Indothemis carnatica</i> (Fabricius, 1798)*	R	NT
25	<i>Neurothemis fulvia</i> (Drury, 1773)*	C	LC
26	<i>Neurothemis intermedia</i> (Rambur, 1842)	VC	LC
27	<i>Neurothemis tullia</i> (Drury, 1773)	C	LC
28	<i>Orthetrum Sabina</i> (Drury, 1773)	VC	LC
29	<i>Orthetrum chrysis</i> (Selys, 1891) *	FC	LC
30	<i>Orthetrum glaucum</i> (Brauer, 1865)	VC	LC
31	<i>Orthetrum luzonicum</i> (Brauer, 1868)	VC	LC
32	<i>Orthetrum pruinosum</i> (Burmeister, 1839)	VC	LC
33	<i>Orthetrum taeniolatum</i> (Schneider, 1845)	VC	LC
34	<i>Pantala flavescens</i> (Fabricius, 1798)	VC	LC
35	<i>Potamarcha congener</i> (Rambur, 1842)	VC	LC
36	<i>Rhodothemis rufa</i> (Rambur, 1842) *	R	LC
37	<i>Rhyothemis variegata</i> (Linnaeus, 1763)	VC	LC
38	<i>Rhyothemis triangularis</i> Kirby, 1889*#	R	LC
39	<i>Tholymis tillarga</i> (Fabricius, 1798)	C	LC

	Scientific name	OS	TS
40	<i>Tramea basilaris</i> (Palisot de Beauvois, 1807)	C	LC
41	<i>Tramea limbata</i> (Desjardins, 1832) *	C	LC
42	<i>Trithemis aurora</i> (Burmeister, 1839)	VC	LC
43	<i>Trithemis festiva</i> (Rambur, 1842)	VC	LC
44	<i>Trithemis kirbyi</i> Selys, 1891	FC	LC
45	<i>Trithemis pallidinervis</i> (Kirby, 1889)	VC	LC
46	<i>Urothemis signata</i> Rambur, 1842*	FC	LC
<b>Family: Macromiidae (02)</b>			
47	<i>Epophthalmia vittata</i> Burmeister, 1839	C	LC
48	<i>Macromia cingulata</i> Rambur, 1842*	C	LC
<b>Suborder: Zygoptera (Damselflies)</b>			
<b>Family: Chlorocyphidae (01)</b>			
49	<i>Libellago lineate</i> (Burmeister, 1839)	C	LC
<b>Family: Coenagrionidae (17)</b>			
50	<i>Aciagrion pallidum</i> (Selys, 1891)	FC	LC
51	<i>Aciagrion occidentale</i> Laidlaw, 1919	C	LC
52	<i>Agriocnemis splendissima</i> Laidlaw	FC	NA
53	<i>Agriocnemis femina</i> (Brauer, 1868)	R	LC
54	<i>Agriocnemis pygmaea</i> (Rambur, 1842)	VC	LC
55	<i>Agriocnemis pieris</i> Laidlaw, 1919	VR	LC
56	<i>Paracercion calamorum</i> (Ris, 1916)	R	LC
57	<i>Ceriagrion coromandelianum</i> (Fabricius, 1798)	VC	LC
58	<i>Amphialagma parvum</i> (Selys, 1876)	R	LC
59	<i>Ischnura aurora</i> (Brauer, 1865)	VC	LC
60	<i>Ischnura senegalensis</i> (Rambur, 1842)	VC	LC
61	<i>Pseudagrion spencei</i> Fraser, 1922	FC	LC
62	<i>Pseudagrion decorum</i> (Rambur, 1842)	VC	LC
63	<i>Pseudagrion hypermelas</i> (Selys, 1876)*	R	LC
64	<i>Pseudagrion microcephalum</i> (Rambur, 1842)	C	LC
65	<i>Pseudagrion rubriceps</i> (Selys, 1876b)	VC	LC
66	<i>Ischnura nursei</i> (Morton, 1907)	FC	LC
<b>Family: Lestidae (03)</b>			
67	<i>Lestes elatus</i> Hagen in Selys, 1862	FC	LC
68	<i>Lestes concinnus</i> Hagen in Selys, 1862	VC	LC
69	<i>Lestes viridulus</i> Rambur, 1842	VC	LC
<b>Family: Platycnemididae (06)</b>			
70	<i>Copera marginipes</i> (Rambur, 1842)	VC	LC
71	<i>Caconeura ramburi</i> (Fraser, 1922) *	VR	DD
72	<i>Disparoneura quadrimaculata</i> (Rambur, 1842)	VC	LC
73	<i>Prodasineura verticalis</i> (Selys, 1860)	FC	LC
74	<i>Elattoneura nigerrima</i> (Laidlaw, 1917)*	R	DD
75	<i>Onychargia atrocyana</i> (Selys, 1865)*#	R	LC



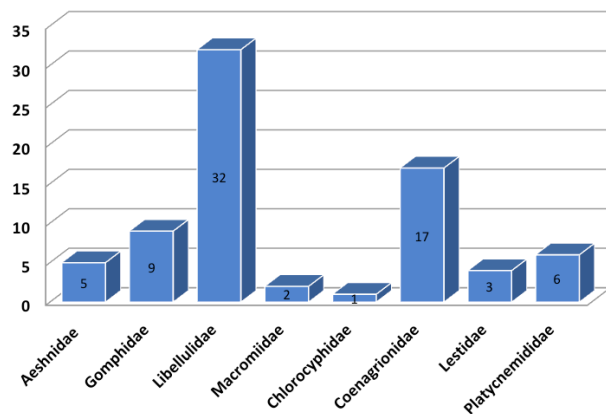


Figure 2. The number of odonate species encountered in different families in the Jabalpur city.

species; it was recorded only from forested areas of Western Ghats, Bengal, and northeastern states (Image 3). These species are recorded for the first time in central India. *A. indicus* is a widely distributed species in India. There are gaps in its known distribution but these are likely to be due to under sampling and misidentification as the closely related *A. guttatus*, with which it has been frequently confused (Image 2).

Among the 75 odonates recorded from Jabalpur city, 72 species are listed in the IUCN Red List of Threatened Species. Among them *Indothemis carnatica* is 'Near Threatened', 65 species are 'Least Concern', the six species are 'Data Deficient' (*Cyclogomphus wilkinsi*, *Ictinogomphus distinctus*, *Macrogomphus annulatus*, *Microgomphus torquatus*, *Caconeura ramburi*, and *Elatoneura nigerrima*), and three not listed. The family Gomphidae is also represented by the highest number of Data Deficient species (Table 1). The members of this family are fast moving insects and may have crepuscular habits. These insects are difficult to observe or collect. Many gomphids are already rare. Therefore, there are high chances of not detecting them during surveys (Tiple & Koparde 2015).

During monsoon and post-monsoon seasons, *Pantala flavescens* is very abundant, as a result of mass emergence and migration. However, species like *Aethriamanta brevipennis*, *Agriocnemis pieris*, *Caconeura ramburi*, *Onychargia atrocyana*, *Elatoneura nigerrima*, *Ictinogomphus angulosus*, and *Rhyothemis triangularis* were rarely encountered. Abundance of *Brachythemis contaminata*, *Orthetrum Sabina*, and *Diplacodes trivialis* was high in contaminated water bodies. Species of Gomphidae, Macromiidae, Chlorocyphidae, and Platynemididae were not found in contaminated water but found to occur in unpolluted



Image 1. *Ictinogomphus distinctus*



Image 2. *Onychargia atrocyana*



Image 3. *Anax indicus*



Image 4. *Rhyothemis triangularis*

wetlands.

Odonates are an indicator group and conservation activities must be acknowledged, especially for tropical odonates (Samways & Steytler 1996; Suhling et al. 2004). Zones in and around urban regions which consist of rivers, lakes, dams, rainwater puddles, marshes, urban parks, and gardens are excellent and rich sites of Odonata, and thus should be conserved and kept pollution free. Emerging urbanization affects odonate populations because of destruction and contamination of their natural habitats. Regions like the Narmada River and Bargi dam, which are home to large numbers of migratory birds, should be monitored and kept pollution free. Thorough analyses of their population in these habitats may act as role model for the evaluation of environmental health and quality. Observations from the present investigation may end up being significant as a reference for biodiversity managers in assessing changes in environmental conditions in the study area.

To conserve the suitable habitats of these ecologically important insects, public awareness is required. Anthropogenic activities (cutting logs, expansion of agricultural fields in lake surroundings), siltation, and eutrophication are among the major causes for increasing deterioration rate of the suitable habitats of odonates. However, presence of forest streams, waterfalls, rivers, lakes, and temporary & permanent flowing or still water bodies with dense shrubs & tree vegetations are most likely the major attractions for the Odonata. The observations recorded in the present study may prove valuable as a reference for assessing the changes due to the environmental conditions in the locality in the future.

The suborder Anisoptera was abundant in comparison to Zygoptera, and found in all the water bodies that were sampled. This corroborates the findings of earlier reports (Williams 1997; Lawler 2001; Suhling et al. 2004). Our findings agree with Keize & Kalkman (2009), who concluded that Coenagrionidae and Libellulidae are the dominant Odonata fauna in standing water worldwide. Tiple (2008) studied the Odonata fauna of Nagpur city and observed that the Libellulidae dominated with 30 species followed by Coenagrionidae (16 species). In central India too, odonate fauna is mostly dominated by the Libellulidae and Coenagrionidae (Tiple & Chandra 2013). Andrew (2013) observed similar findings with the Odonata of Chatri Lake in Amravati and Zilpi Lake in Nagpur, respectively. Tiple et al. (2013) gave a detailed compilation of odonates of Vidarbha region of Maharashtra with 82 species under 47 genera and nine families, and revealed that the Libellulidae is

the dominant one (38 species). The present study also corroborates this as Libellulidae (32 species), the most dominant, followed by Coenagrionidae.

Tiple & Chandra (2013) reported 106 species of Odonata from Madhya Pradesh and Chhattisgarh States. The present study on the Odonata of Jabalpur city revealed the presence of 75 species which account 71% of total species reported in Madhya Pradesh and Chhattisgarh States. The Jabalpur city and surrounding area seems to be having rich Odonate diversity of 75 varieties of species in small city area. Probably due to the presence of rivers (Narmada, Hiran, Gour, Ken, and Sone), lakes, and temporary & permanent flowing or still water bodies with dense shrub & tree vegetation a major attraction to the odonate species. The observations recorded in the present study supports the value of the Jabalpur city area in providing valuable resources for Odonata and it may prove as a reference for assessing the changes due to the environmental conditions in the locality in the future.

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