Odonata of Maharashtra, India with Notes on Species Distribution

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ABSTRACT. Odonata are freshwater insects spread world-wide. Tropical areas are high Odonata diversity areas. However, there has not been accumulation of extensive baseline data on species distribution of these insects from such places. Maharashtra, the third largest state of India, harbors a variety of land-use and occupies six biogeographic provinces. We carried out Odonata surveys in Maharashtra during 2006–2014. Compilation of all these studies along with other authenticated records resulted in a checklist of 134 species of Odonata belonging to 70 genera representing 11 families. The highest numbers of species were recorded from the Libellulidae (48 species) and Gomphidae (22 species) families. A previous study had reported 99 species of Odonata from the Maharashtra state considering records from early 1900’s to 2012. Our observations across the state add 33 species to this list. Maharashtra forms a unique source of Odonata diversity and our observations support the importance of this region in providing valuable habitats for Odonata. Here, we discuss several of the new records, how global surveys might help fill the local gap in species distributions, how secondary data deposited through crowd-sourcing can help and what it offers to conservation.

Key Words: checklist, conservation, crowd-sourcing, diversity, distributional gaps
(6) Deccan Peninsula-Deccan south (Rodgers et al. 2002). Maharashtra is divided into 35 administrative districts.

The region is flat undulating terrain, devoid of any major hill ranges. Large numbers of wetlands, such as ponds, lakes, and perennial streams, dot this landscape. The State has three well-defined seasons: monsoon (June to September), winter (October to January), and summer (February to June). The mean maximum temperature is 36.8°C, and the mean minimum temperature is 15.8°C (Hijmans et al. 2005a). Rainfall varies according to the topography of the region. Champion and Seth (1968) mention six forest types in Maharashtra: (1) tropical semi-evergreen, (2) tropical moist deciduous, (3) tropical dry deciduous, (4) tropical thorn, (5) subtropical broadleaf hill, and (6) littoral and swamp forests. Extensive tracts of evergreen and semi-evergreen forests, even though fragmented, are still present in the Western Ghats of Maharashtra. North-east Maharashtra supports few large moist deciduous and dry deciduous forest patches. A number of protected areas (PAs), reserved forests (RFs), wildlife sanctuaries (WLSS), and national parks (NPs) are spread across the state. Table 1 provides localities from which data were collected (Fig. 1).

**Data Collection**

Dragonflies and damselflies were collected, photographed, identified using standard taxonomic literature (Fraser 1933a, 1934, 1936; Mitra 2006) and field-guides (Subramanian 2005, Andrew et al. 2008, Nair 2011), and released during the surveys from 2006 to 2014. Secondary data were obtained from published literature (Laidlaw 1917, 1919; Fraser 1919, 1921, 1924, 1926, 1931, 1933a,b, 1934, 1936; Prasad 1996; Kulkarni et al. 2002; Kulkarni and Prasad 2002; Talmale and Kulkarni 2003, 2006; Kulkarni et al. 2004; Kulkarni and Prasad 2005; Kulkarni and Talmale 2005, 2008, 2009; Kulkarni et al. 2006a,b; Tiple et al. 2008; Babu et al. 2009; Babu and Nandy 2010; Sathe and Bhusnar 2010; Koparde et al. 2011; Aland et al. 2012; Manwar et al. 2012; Kulkarni et al. 2012; Tiple 2012a,b; Wankhede et al. 2012; Andrew 2013; Babu et al. 2013; Kulkarni and Subramanian 2013; Tijare and Patil 2012; Talmale and Tiple 2013; Tiple et al. 2013; Koparde et al. 2014, 2015; P. K., unpublished data) and authenticated records in public domain (DragonflyIndia 2014, IBP 2014). All scientific names follow Subramanian (2014). All the records up till Prasad (1996) were considered as old literature and records mentioned in literature after Prasad (1996) were considered as recent. Geographical coordinates of locations of published studies were extracted from literature (Table 1). In case of lack of data, geo-coordinates were assigned approximately near the study area. Surveyed localities were plotted on a map of Maharashtra (Fig. 1) and India land-use layer (Hijmans et al. 2005b). Land-use attributes of each locality were extracted using DIVA-GIS v7.5. Shapefiles of India, districts in India and wetland areas in India were accessed from DIVA spatial data portal (Hijmans et al. 2005b) and that of biogeographic provinces of India was obtained from India Biodiversity Portal (Rodgers et al. 2002, IBP 2014).

**Results**

The compilation of field studies and data from literature resulted in 134 species of Odonata, including 87 species of Anisoptera and 47 species of Zygoptera from Maharashtra. They belong to 70 genera representing 11 families (Table 2). Libellulidae was represented by the highest number of species (48), followed by Coenagrionidae (27) and Gomphidae (22). Both Euphaeidae and Cordulidae were represented by a single species. Twenty-two species were Data Deficient, and 11 were not listed in International Union of Conservation for Nature (IUCN) red-list of threatened species. Two species viz. Indothemis carnatica and Heliogomphus promelas were listed as Near Threatened. Around 50% of Data Deficient species in the list belong to Gomphidae (11 species), followed by Macromididae and Platycnemididae (three species each). Twenty five species of Anisoptera and 10 species of Zygoptera were added to the State checklist. The new Anisoptera species belong mainly to Gomphidae (nine species), Libellulidae (eight species), and Aeshnidae (four species). The 10 new species of Zygoptera, belong to Coenagrionidae (four species), Platycnemidae (four species), Euphaeidae (one species), and Lestidae (one species). In addition, 16 species have been recently recorded in single studies. Thirteen of them belong to Gomphidae (9) and Macromiididae (4). During the field-studies, two species recorded were not known from the State: Anaciaeschna jasipes and Anax imperator.

**Discussion**

Maharashtra supports high faunal diversity owing to its geographic position and the biogeographic zones it covers. Given the variety of macro- and micro-habitat types, it was expected that the State supports high number of Odonata species. From recent surveys and data mining, we have added 35 species to the previous list by Kulkarni et al. (2012) that included 99 species. Kulkarni et al. (2012) had counted some of the subspecies, such as Libellula lineate lineate and Libellula lineata indica or Aciagrion hisopa hisopa and Aciagrion hisopa krishna as different species in their species checklist. However, we confined our identification till species level. Recording subspecies on field is highly difficult. Hence, including subspecies in the checklist may introduce error. This difference of 35 species between previous (Kulkarni et al. 2012) and current checklist is mainly due to incomplete on-field sampling by previous researchers, which was scattered throughout the State. They undersampled various biogeographic provinces in Maharashtra. Moreover, difficulty in collection, unapproachable terrain in certain areas such as Western Ghats (mountains) or Central highlands, and limitations due to resources and expertise might have resulted in such a gap. Also Kulkarni et al. (2012) failed to incorporate records other than those published by the Zoological Survey of India. However, this work along with Prasad (1996) has been instrumental in providing the first exhaustive checklist of Odonata of Maharashtra State. Our sampling in addition to sampling done by previous researchers almost spanned the State. The sampling was not systematic and spread across seasons, because concentrated mainly in postmonsoon season when Odonata activity is at peak (Kulkarni and Subramanian 2013). The data collection was a collective effort, and sampling was highly limited due to resources and expertise. Therefore, although the current checklist significantly updates the previous ones by Prasad (1996) and Kulkarni et al. (2012), it may not be interpreted as a complete checklist of Odonata of Maharashtra.

Certain biogeographical areas such as the West coast or the Malabar plains of Western Ghats have been underrepresented in this and previous studies. The Deccan south region was not sampled at all. The Deccan peninsula-central plateau which represents the largest area of Maharashtra was fairly well-represented in all the studies, except central Maharashtra, dominated by scrub-forest and dry-deciduous forest, for which there is a serious lack of data. Similarly, the Western Ghats (mountains) have not been sampled exhaustively during the study period, despite the fact that they are also areas of high endemism (Myers et al. 2000; Subramanian 2007; Subramanian et al. 2011). This region which is rich in evergreen and semi-evergreen forest patches, even though fragmented, has been highly underrepresented in samples. Out of 74 localities from where data were compiled, only four localities represent evergreen forest areas (Table 1). The northern part of Western Ghats of Maharashtra has been also undersampled. This undersampling might be the root-cause of lack of data on species numbers and distributions (Koparde et al. 2014). It seems that most of the data on Odonata diversity from Maharashtra comes either from West Maharashtra or East and North-east Maharashtra (Fig. 1). From Central-north and North-east Maharashtra, Satpuda mountain ranges have been undersampled, even if biogeographically important areas (Hora 1949, 1953; Auden 1949; Daniels 2001; Karanth 2003). Species distribution data from these areas should be important in answering questions related to the biogeography of Indian peninsula and/or the Indian...
Table 1. Details of the study localities

| Locality                        | Longitude | Latitude | ALT (m) | AMT (ºC) | PPT (mm) | LST |
|---------------------------------|-----------|----------|---------|----------|----------|-----|
| Devgad, Sindhudurg              | 73.3748   | 16.3727  | 14      | 27.2     | 2,529    | 4   |
| Verle, Sindhudurg               | 73.9300   | 15.98918 | 123     | 27       | 3,628    | 2   |
| Tamhini stream 1, Pune          | 73.4877   | 18.4762  | 723     | 24       | 3,026    | 2   |
| Tamhini stream 2, Pune          | 73.4288   | 18.4442  | 780     | 23       | 3,371    | 2   |
| Tamhini stream 3, Pune          | 73.4116   | 18.4416  | 408     | 25       | 3,745    | 2   |
| Tamhini stream 4, Pune          | 73.414    | 18.4606  | 379     | 25       | 3,825    | 2   |
| North Koyna WLS                | 73.7902   | 17.6813  | 1027    | 22.2     | 2,493    | 4   |
| North Chandoli NP              | 73.7186   | 17.2401  | 831     | 23.2     | 2,736    | 2   |
| Prakasha dam, Nandurbar        | 74.3524   | 21.5098  | 115     | 27.4     | 274      | 4   |
| Toranmal RF, Nandurbar         | 74.0675   | 21.8155  | 688     | 24.7     | 897      | 2   |
| Melghat tiger reserve, Amravati| 77.1074   | 21.446   | 495     | 25.9     | 1,301    | 2   |
| Amravati agriculture, Amravati | 77.7833   | 20.937   | 552     | 24.9     | 668      | 4   |
| Ghanewadi talav, Jalgaon       | 75.8578   | 19.9104  | 524     | 26.4     | 709      | 4   |
| Ghorpad lake, Nagpur           | 78.6761   | 21.2728  | 384     | 26       | 1,011    | 3   |
| Ghorpad lake, Nagpur           | 78.4585   | 21.2214  | 280     | 27       | 1,104    | 2   |
| Ghorpad lake, Nagpur           | 79.0385   | 21.1931  | 335     | 26.8     | 1,071    | 2   |
| Ghorpad lake, Nagpur           | 79.6059   | 20.8828  | 228     | 27.3     | 1,330    | 3   |
| Kazir lake, Nandurbar          | 74.2334   | 21.3851  | 220     | 26.8     | 679      | 4   |
| Ittadah lake, Brahmapuri, Chandapur | 80.1717 | 20.8104  | 343     | 26.6     | 1,494    | 2   |
| Kanha river, Nagpur            | 79.2271   | 21.2264  | 280     | 27       | 1,104    | 2   |
| Patraj hills, Pune             | 73.8712   | 18.4433  | 693     | 24       | 920      | 4   |
| Kawadi, Pune                   | 74.0014   | 18.5074  | 541     | 25.3     | 580      | 4   |
| Khadakwasla dam, Pune          | 73.7584   | 18.4283  | 605     | 25       | 1,128    | 4   |
| Khindis dam, Ramtek, Nagpur    | 79.3207   | 21.3979  | 308     | 26.8     | 1,134    | 4   |
| Koradi lake, Nagpur            | 79.0906   | 21.2565  | 293     | 27       | 1,045    | 5   |
| Linga lake, Nagpur             | 79.0956   | 21.2576  | 293     | 27       | 1,054    | 5   |
| Lonar lake, Buldhana           | 76.5083   | 19.9768  | 482     | 26.6     | 803      | 4   |
| Lower Wardha dam, Amravati     | 78.255    | 20.875   | 281     | 27.5     | 963      | 4   |
| Malkhed RF, Amravati           | 77.7702   | 20.8955  | 368     | 27.2     | 834      | 4   |
| Marunji, Pimpri-Chinchwad, Pune| 73.7144   | 18.6251  | 604     | 26.8     | 1,264    | 3   |
| Mehrun lake, Jalgaon           | 75.5655   | 20.981   | 244     | 27.1     | 788      | 4   |
| Mutha River, Pune              | 73.837    | 18.5057  | 560     | 25       | 768      | 5   |
| Nagpur city, Nagpur            | 79.0768   | 21.1494  | 319     | 26       | 1,090    | 5   |
| Navegaon Bandh dam, Gondia     | 80.133    | 20.923   | 290     | 26.9     | 1,495    | 2   |
| Pashan lake, Pune              | 73.7825   | 18.5317  | 595     | 24.8     | 997      | 5   |
| Pench tiger reserve, Nagpur    | 79.2279   | 21.7017  | 491     | 25       | 1,057    | 2   |
| Pimpalgaon lake, Ahmadnagar    | 74.7629   | 19.2103  | 690     | 25.1     | 559      | 4   |
| Potara river-Nagri-Warora      | 78.8666   | 20.425   | 212     | 27.6     | 1,162    | 3   |
| Purna river Andura Karanja     | 77.393    | 20.5873  | 342     | 27.3     | 838      | 4   |
| Sarangkheda dam, Sinnar, Nandurbar | 73.9582 | 18.8466  | 684     | 24.3     | 726      | 4   |
| Singhad valley, Pune           | 73.7759   | 18.3766  | 735     | 24       | 1,308    | 2   |
| Songirpada lake, Nadurbar      | 74.1879   | 21.3226  | 236     | 26.8     | 721      | 4   |
| Tadoba-Andhari tiger reserve, Chandrapur | 79.4009 | 20.1999  | 232     | 27       | 1,342    | 2   |
| Talaji hill, Pune              | 73.8407   | 18.4746  | 640     | 24.6     | 885      | 4   |
| Umari dam, Gadchiroli          | 79.9368   | 20.0144  | 197     | 27.3     | 1,448    | 4   |
| Urse, Pune                     | 73.6175   | 18.7132  | 872     | 23       | 2,200    | 4   |

(continued)
Table 1. Continued

| Locality                        | Longitude | Latitude | ALT (m) | AMT (°C) | PPT (mm) | LST |
|---------------------------------|-----------|----------|---------|----------|----------|-----|
| Vainganga Bhandara Bridge, Bhandara | 79.6669  | 21.1478  | 254     | 27.1     | 1,265    | 4   |
| Veer Sawarkar Udyan, Pimpri-Chinchwad, Pune | 73.791   | 18.6274  | 568     | 24.9     | 952      | 5   |
| Velhe, Pune                     | 73.7076   | 18.3673  | 697     | 24.1     | 1,596    | 4   |
| Vetal hill, Pune                | 73.81655  | 18.5284  | 606     | 24.8     | 892      | 5   |
| Wadali lake, Amravati           | 77.7943   | 20.9252  | 369     | 27.1     | 836      | 4   |
| Wardha river, Wardha            | 78.1442   | 20.979   | 287     | 27.4     | 932      | 4   |
| Zilpi lake, Nagpur              | 78.86812  | 21.06376 | 336     | 26.8     | 1,058    | 4   |

ALT—Altitude; AMT—Annual mean temperature; PPT—Annual precipitation; LST—Landscape type; 1—Evergreen broadleaved tree cover; 2—Closed Deciduous broadleaved tree cover; 3—Deciduous shrub cover closed-open; 4—Cultivated and managed areas; 5—Artificial surfaces and associated areas

Fig. 1. Map of the surveyed localities (Hijmans et al. 2005b).
### Table 2. Checklist of Odonata of Maharashtra state.

| No. | Scientific name | OS | Reported by/distribution | D W T |
|-----|-----------------|----|--------------------------|------|
|     |                 |    |                          |      |
|     | **Suborder: Anisoptera**                               |    |                          |      |
| 1   | *Anaciaeschna jaspidea* (Burmeister, 1839)             | VR | Jalgaon*                 | 1    |
| 2   | *Anax guttatus* (Burmeister, 1839)                    | VC | Throughout Maharashtra*  | 1    |
| 3   | *Anax immaculifrons* (Rambur, 1842)                   | C  | Throughout Maharashtra*  | 1    |
| 4   | *Anax imperator* (Leach, 1815)                        | NK | Nashik*                  | 1    |
| 5   | *Anax indicus* (Liefenck, 1815)                       | R  | Zessin and Günther (2009) | 1    |
| 6   | *Anax parthenope* (Selys, 1891)                       | R  | Fraser (1936), Tiple et al. (2008), Tiple (2012a) | 1 |
| 7   | *Gynacantha bayadera* (Selys, 1891)                   | C  | Throughout Maharashtra*  | 1    |
| 8   | *Gynacantha dravida* (Liefenck, 1960)                 | FC | Throughout Maharashtra*  | 1    |
| 9   | *Gynacantha rotundata* (Navas, 1930)                  | VR | Navas (1930)             | 1    |
| 10  | *Hemianax ephippiger* (Burmeister, 1839)              | FC | Throughout Maharashtra*  | 1    |
|     | **Suborder: Zygoptera**                                |    |                          |      |
| 11  | *Anomogomphus heteropterus* (Selys, 1854)             | R  | Babu et al. (2009), Tiple et al. (2013) | 1 |
| 12  | *Burmagomphus pyramidalis* (Laidlaw, 1922)           | R  | Fraser (1934), Pradesh (1996) | 1 |
| 13  | *Asiagomphus nilgiricus* (Laidlaw, 1922)             | UN | Sathe and Bhusnra (2010), Aland et al. (2012) | 1 |
| 14  | *Burmagomphus laioidwai* (Fraser, 1924)              | UN | Sathe and Bhusnra (2010), Aland et al. (2012) | 1 |
| 15  | *Cyclogomphus vesiculosus* (Selys, 1873)             | R  | Fraser (1934), Prasad (1996) | 1 |
| 16  | *Cyclogomphus ypsilota* (Selys, 1854)                | R  | Fraser (1934), Pradesh (1996) | 1 |
| 17  | *Cyclogomphus wilkinsi* (Fraser, 1926)               | R  | Fraser (1919, 1924, 1926, 1931, 1934, 1943), Laidlaw (1922), Prasad (1996), Tiple et al. (2013) | 1 |
| 18  | *Cyclogomphus heterostylus* (Selys, 1854)            | R  | Fraser (1919, 1924, 1926, 1931, 1934, 1943), Laidlaw (1922), Prasad (1996), Tiple et al. (2013) | 1 |
| 19  | *Davidioides martini* (Fraser, 1924)                 | UN | Sathe and Bhusnra (2010), Aland et al. (2012) | 1 |
| 20  | *Cyclogomphus ypsilon* (Selys, 1873)                 | R  | Fraser (1919, 1924, 1926, 1931, 1934, 1943), Laidlaw (1922), Prasad (1996), Satara (DragonflyIndia 2014) | 1 |
| 21  | *Gomphidia t-nigrum* (Selys, 1854)                   | R  | Fraser (1919, 1924, 1926, 1931, 1934, 1943), Laidlaw (1922), Prasad (1996), Satara (DragonflyIndia 2014) | 1 |
| 22  | *Heliogomphus promelas* (Selys, 1873)                | R  | Fraser (1919, 1924, 1926, 1931, 1934, 1943), Laidlaw (1922), Prasad (1996), Satara (DragonflyIndia 2014) | 1 |
| 23  | *Ictinogomphus distinctus* (Ram, 1985)               | R  | Tiple (2012a), Tiple et al. (2013) | 1 |
| 24  | *Ictinogomphus angulosus* (Selys, 1854)              | R  | Tiple et al. (2014) | 1 |
| 25  | *Ictinogomphus rapax* (Rambur, 1842)                 | VC | Throughout Maharashtra*  | 1 |
| 26  | *Macrognomphus annulatus* (Selys, 1854)              | FC | Laidlaw (1922), Fraser (1934), Pradesh (1996), Tiple et al. (2008, 2013), Babu and Nandy 2010, Tiple (2012a), Kulkarni and Subramanian (2013) | 1 |
| 27  | *Macrognomphus wynaedicus* (Fraser, 1924)            | UN | Sathe and Bhusnra (2010), Aland et al. (2012) | 1 |
| 28  | *Micrognomphus torquatus* (Selys, 1854)              | R  | Fraser (1934), Pradesh (1996), Kulkarni and Pradesh (2002), Nagpur*, Chandrapur*, Pune*; Kulkarni and Subramanian (2013), Raigad (DragonflyIndia 2014) | 1 |
| 29  | *Micrognomphus verticalis* (Selys, 1873)             | UN | Fraser (1934), Pradesh (1996) | 1 |
| 30  | *Oncogomphus grammicus* (Rambur, 1842)               | UN | Fraser (1934), Babu et al. (2009), Babu and Nandy (2010) | 1 |
| 31  | *Oncogomphus nigriennis* (Fraser, 1922)              | VR | Koparde et al. (2014) | 1 |
| 32  | *Paragomphus lineatus* (Selys, 1850)                 | C  | Throughout Maharashtra*  | 1 |
|     | **Family: Libellulidae**                               |    |                          |      |
| 33  | *Acsicosa panorpoides* (Rambur, 1842)                 | R  | Fraser (1934), Pradesh (1996), Tiple et al. (2008, 2013), Babu and Nandy 2010, Tiple (2012a), Kulkarni and Subramanian (2013), Raigad*, Ratnagiri* and Sindhudurg* | 1 |
| 34  | *Aethriamanta brevipennis* (Rambur, 1842)            | VC | Throughout Maharashtra*  | 1 |
| 35  | *Brachydiplax sobrina* (Rambur, 1842)                | FC | Pradesh and Ghosh (1988), Pradesh (1996), Tiple et al. (2008), Tiple (2012a), Andrew (2013) | 1 |
| 36  | *Brachythemis contaminata* (Fabricius, 1793)         | VC | Throughout Maharashtra*  | 1 |
| 37  | *Bradinopyga geminata* (Rambur, 1842)                | FC | Fraser (1936), Pradesh (1996), Kulkarni and Talmale (2008), Tiple et al. (2008), Koparde et al. (2014, 2015), Raigad*, Ratnagiri* and Sindhudurg* | 1 |
| 38  | *Cratilla lineata* (Brauer, 1878)                    | VC | Throughout Maharashtra*  | 1 |
| 39  | *Crocothemis servilia* (Drury, 1770)                 | VC | Throughout Maharashtra*  | 1 |
| 40  | *Diplacodes lefebervii* (Rambur, 1842)               | R  | Pradesh (1996), Tiple et al. (2008, 2013), Tiple (2012a), Pune* | 1 |
| 41  | *Diplacodes nebulosa* (Fabricius, 1793)              | R  | Fraser (1936), Kulkarni et al. (2006a), Tiple et al. (2008), Tiple (2012a), Andrew (2013) | 1 |
| 42  | *Indothemis limbata* (Selys, 1891)                   | UN | Babu et al. (2009) | 1 |
| 43  | *Indothemis carnatica* (Fabricius, 1793)             | R  | Tiple et al. (2008), Tiple (2012a), Mumbai (DragonflyIndia 2014), Koparde et al. (2014, 2015), Kolhapur* and Pune* | 1 |
| 44  | *Lathrecista asiatica* (Fabricius, 1793)             | C  | Throughout Maharashtra*  | 1 |
| 45  | *Neurothemis fulvia* (Drury, 1773)                   | C  | Throughout Maharashtra*  | 1 |
| 46  | *Neurothemis intermedia* (Rambur, 1842)              | VC | Throughout Maharashtra*  | 1 |

(continued)
| No. | Scientific name                  | OS | Reported by/distribution                                                                 | D | W | T |
|-----|---------------------------------|----|-----------------------------------------------------------------------------------------|---|---|---|
| 48  | Neurothemis tullia (Drury, 1773) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 49  | Onychothemis testacea (Laidlaw, 1902) | R  | Fraser (1936), Koparde et al. (2015), Sindhudurg*                                         | 1 | 1 | LC|
| 50  | Orthetrum aniceps (Schneider, 1845) | UN | Prasad (1996)                                                                            | 1 | NA|    |
| 51  | Orthetrum sabina (Drury, 1773)    | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 52  | Orthetrum japonicum (Uhler, 1858) | VR | Babu et al. (2009)                                                                       | 1 | 1 | LC|
| 53  | Orthetrum chrys (Selys, 1891)     | FC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 54  | Orthetrum glaucum (Brauer, 1865)  | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 55  | Orthetrum luzonicum (Brauer, 1868) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 56  | Orthetrum praunuscinum (Burmester, 1839) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 57  | Orthetrum testaceum (Burmester, 1839) | UN | Babu et al. (2009)                                                                       | 1 | 1 | NA|
| 58  | Orthetrum taeniolatum (Schneider, 1845) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 59  | Orthetrum triangulare (Selys, 1878) | R  | Aland et al. (2012), Koparde et al. (2015)                                               | 1 | 1 | LC|
| 60  | Pseudopodagra sexmaculata (Fabricius, 1798) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 61  | Potamarcha congener (Rambur, 1842) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 62  | Rhodothemis rufa (Rambur, 1842)   | R  | Fraser (1936), Tiple et al. (2008), Andrew (2013), Koparde et al. (2015), Nagpur*         | 1 | 1 | LC|
| 63  | Rhyothemis variata (Linnæus, 1763) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 64  | Sympetrum fonscolombei (Selys, 1840) | UN | Kulkarni and Subramanian (2013)                                                          | 1 | 1 | LC|
| 65  | Sympternum hypomelas (Selys, 1844) | FC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 66  | Tetrathemis platyepera (Selys, 1878) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 67  | Tramea virginia (Rambur, 1842)    | FC | Kulkarni et al. (2004), Tiple et al. (2008)                                              | 1 | 1 | LC|
| 68  | Tramea limbatis (Desjardins, 1832) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 69  | Trithemis aurora (Burmester, 1839) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 70  | Trithemis festiva (Rambur, 1842)   | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 71  | Trithemis kirbyi (Selys, 1891)     | FC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 72  | Trithemis pollinivora (Kirby, 1889) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 73  | Urothemis signata (Rambur, 1842)   | FC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 74  | Zygonyx iris (Kirby, 1869)         | R  | Sindhudurg (DragonflyIndia 2014); Koparde et al. (2014, 2015); Ratnagiri*                 | 1 | 1 | LC|
| 75  | Zyxomma petiolatum (Rambur, 1842) | VR | Koparde et al. (2014), Nagpur*                                                            | 1 | 1 | DD|
| 76  | Hylaeothemis indica (Fraser, 1946) | R  | Fraser (1936), Prasad (1996), Tiple et al. (2008), Tiple et al. (2013)                    | 1 | 1 | NA|
| 77  | Epophthalmia frontalis (Selys, 1871) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 78  | Epophthalmia vittata (Burmester, 1839) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 79  | Macromia flavicincta (Selys, 1874) | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 80  | Macromia flavovittata (Fraser, 1935) | UN | Sathe and Bhusnar (2010), Aland et al. (2012)                                             | 1 | 1 | DD|
| 81  | Macromia cingulata (Rambur, 1842)  | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 82  | Macromia indica (Fraser, 1894)     | VR | Fraser (1936), Sathe and Bhusnar (2010), Aland et al. (2012), Mumbai (DragonflyIndia 2014)| 1 | 1 | DD|
| 83  | Libellago lineata (Selys, 1878)    | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 84  | Aciagrion pallidum (Selys, 1891)   | FC | Fraser (1933a, b), Prasad (1996), Tiple et al. (2008), Manwar et al. (2012), Tiple et al. (2013), Koparde et al. (2014, 2015), Pune (DragonflyIndia 2014), Ratnagiri* | 1 | 1 | LC|
| 85  | Aciagrion hisopae (Selys, 1876)    | R  | Fraser (1933a, b), Prasad (1996), Tiple (2012b), Koparde et al. (2014, 2015), Sindhudurg* and Satara* | 1 | 1 | LC|
| 86  | Aciagrion occidentale (Laidlaw, 1919) | R  | Prasad (1996), Kulkarni and Prasad (2002), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015) | 1 | 1 | LC|
| 87  | Agriocnemis lacteola (Selys, 1840) | VR | Fraser (1936), Tiple et al. (2008), Andrew (2013), Koparde et al. (2015), Nagpur*         | 1 | 1 | LC|
| 88  | Heliothis aurora (Burmester, 1839) | R  | Fraser (1936), Prasad, Varshney (1995), Prasad (1996), Sathe and Bhusnar (2010), Nagpur* | 1 | 1 | LC|
| 89  | Heliothis signata (Rambur, 1842)   | VC | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 90  | Agriocnemis lacteola (Selys, 1853) | C  | Throughout Maharashtra*                                                                   | 1 | 1 | LC|
| 91  | Aciagrion pallidum (Selys, 1891)   | FC | Fraser (1933a, b), Prasad (1996), Tiple et al. (2008), Manwar et al. (2012), Tiple et al. (2013), Koparde et al. (2014, 2015), Pune (DragonflyIndia 2014), Ratnagiri* | 1 | 1 | LC|
| 92  | Aciagrion occidentale (Laidlaw, 1919) | R  | Fraser (1933a, b), Prasad (1996), Tiple (2012b), Koparde et al. (2014, 2015), Sindhudurg* and Satara* | 1 | 1 | LC|
| 93  | Agriocnemis lacteola (Selys, 1877) | R  | Tiple (2012a), Koparde et al. (2015), Kulkarni et al. (2012)                              | 1 | 1 | LC|
| 94  | Agriocnemis lacteola (Laidlaw, 1919) | FC | Fraser (1933a, b), Prasad (1996), Nagpur* and Sindhudurg*                                | 1 | 1 | LC|

(continued)
Table 2. Continued

| No. | Scientific name | OS | Reported by/distribution | D | W | T |
|-----|-----------------|----|--------------------------|---|---|---|
| 95  | Agriocnemis splendidissima (Laidlaw, 1919) | FC | Fraser (1933a,b), Prasad (1996), Koparde et al. (2014, 2015), Nagpur*, Pune*, Satara*, and Ratnagiri* | 1 | NA | NA |
| 96  | Agriocnemis pygmaea | VC | Throughout Maharashtra* | 1 | L | C |
| 98  | Cercion dyeri (Fraser, 1920) | R | Fraser (1933a,b), Kulkarni and Subramanian (2013), Pune* | 1 | NA |
| 99  | Paracercion calamorum | R | Fraser (1933a,b), Prasad and Varshney (1995), Prasad (1996), Tiple et al. (2013) | 1 | NA |
| 100 | Paracercion malayanum (Selys, 1876) | R | Fraser (1933a,b), Prasad and Varshney (1995), Prasad (1996), Tiple et al. (2013) | 1 | NA |
| 101 | Ceriagrion cerinorubellum (Brauer, 1865) | R | Fraser (1933a,b), Prasad (1996), Tiple et al. (2013) | 1 | L | C |
| 102 | Ceriagrion coromandelianum (Fabricius, 1798) | VC | Throughout Maharashtra* | 1 | L | C |
| 103 | Ceriagrion olivaceum (Laidlaw, 1914) | FC | Kulkarni and Subramanian (2013), Koparde et al. (2014, 2015), Raigad*, Sindhudurg*, Pune* and Ratnagiri* | 1 | L | C |
| 104 | Ceriagrion rubiae (Laidlaw, 1916) | FC | Fraser (1933a,b), Sindhudurg* | 1 | NA |
| 105 | Enallagma parvum (Selys, 1876) | R | Prasad (1996), Kulkarni and Prasad (2005), Tiple et al. (2008, 2013) | 1 | L | C |
| 106 | Enallagma parvum (Selys, 1876) | VC | Throughout Maharashtra* | 1 | L | C |
| 107 | Enallagma parvum (Selys, 1876) | VC | Throughout Maharashtra* | 1 | L | C |
| 108 | Mortonagrion varralli (Fraser, 1920) | VR | Fraser (1933a,b), Tiple et al. (2008), Manwar et al. (2012); Sindhudurg* | 1 | DD |
| 109 | Pseudagrion spencei (Fraser, 1922) | FC | Tiple (2012a), Tiple et al. (2013) | 1 | L | C |
| 110 | Pseudagrion decorum (Rambur, 1842) | VC | Throughout Maharashtra* | 1 | L | C |
| 111 | Pseudagrion decorum (Rambur, 1842) | VC | Throughout Maharashtra* | 1 | L | C |
| 112 | Pseudagrion microcephalum | Kulkarni and Subramanian (2013), Raigad (DragonflyIndia 2014), Koparde et al. (2014, 2015), Nagpur*, Satara* and Sangli* | 1 | L | C |
| 113 | Pseudagrion malabaricum (Fraser, 1924) | R | Tiple et al. (2013) | 1 | L | C |
| 114 | Ischnura nursei (Morton, 1907) | FC | Kulkarni et al. (2004), Tiple et al. (2008, 2013), Manwar et al. (2012), Tiple (2012a), Tijare and Patil (2012), Thane (DragonflyIndia 2014), Pune* and Raigad* | 1 | L | C |
| 115 | Euphaea fraseri (Laidlaw, 1920) | VR | Babu et al. (2013), Koparde et al. (2014, 2015) | 1 | L | C |
| 116 | Lestes elatus | Family: Lestidae (04) | Hagen in (Selys, 1862) | FC | Prasad (1996), Tiple et al. (2008), Tiple (2012a), Kulkarni and Subramanian (2013), Koparde et al. (2011, 2012), Andrew (2013), Koparde et al. (2014, 2015), Nashik*, Pune* and Ratnagiri* | 1 | L | C |
| 117 | Lestes umbrinus | Family: Lestidae (04) | FC | Prasad (1996), Tiple (2012a), Kulkarni et al. (2004, 2006a,b), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015), Thane (DragonflyIndia 2014), Pune* and Raigad* | 1 | L | C |
| 118 | Lestes thoracicus | Family: Lestidae (04) | FC | Prasad (1996), Tiple (2012a), Kulkarni et al. (2004, 2006a,b), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015), Thane (DragonflyIndia 2014), Pune* and Raigad* | 1 | L | C |
| 119 | Lestes viridulus | Family: Lestidae (04) | FC | Prasad (1996), Tiple (2012a), Kulkarni et al. (2004, 2006a,b), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015), Thane (DragonflyIndia 2014), Pune* and Raigad* | 1 | L | C |
| 120 | Copera ciliata | Family: Coperaeidae (01) | VR | Kulkarni et al. (2004), Tiple (2012a), Tiple (2012b) | 1 | L | C |
| 121 | Copera vittata | Family: Coperaeidae (01) | C | Prasad (1996), Kulkarni et al. (2004, 2006a,b), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015) | 1 | 1 | L | C |
| 122 | Caconeura ramburi (Fraser, 1922) | VR | Tiple (2012a), Babu et al. (2013), Tiple et al. (2013), Koparde et al. (2014, 2015) | 1 | 1 | DD |
| 123 | Disparoneura quadrimaculata | Family: Euphaeidae (01) | R | Fraser (1933a,b), Prasad (1996), Tiple et al. (2013), Koparde et al. (2014, 2015), Kolhapur*, Pune* and Ratnagiri* | 1 | 1 | DD |
| 124 | Prodasineura verticalis (Selys, 1860) | FC | Fraser (1921), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015), Kolhapur*, Pune* and Ratnagiri* | 1 | 1 | LC |
| 125 | Elattoneura nigerrima (Laidlaw, 1917) | R | Laidlaw (1917), Fraser (1924, 1933b, 1934), Prasad (1996), Koparde et al. (2015), Nagpur*, Pune, Rathnagiri, Satara and Sangli (Koparde et al., unpublished data) | 1 | 1 | DD |
| 126 | Elattoneura tetrica | Family: Calopterygidae (03) | R | Fraser (1921), Tiple (2012a), Tiple et al. (2013), Koparde et al. (2014, 2015), Kolhapur*, Pune* and Satara* | 1 | L | C |
| 127 | Protosticta hearseyi | Family: Calopterygidae (03) | VR | Koparde et al. (2014, 2015) | 1 | D | D |
| 128 | Protosticta gravelyi (Laidlaw, 1915) | R | Fraser (1933a,b), Prasad and Varshney (1995), Prasad (1996), Mumbai (DragonflyIndia 2014) | 1 | L | C |
| 129 | Neurobasis chinensis (Linnaeus, 1758) | R | Fraser (1934), Prasad (1996), Sindhudurg (DragonflyIndia 2014) | 1 | L | C |
| 130 | Vestalis apicalis | Family: Vestallidae (02) | VR | Koparde et al. (2014, 2015) | 1 | L | C |
| 131 | Vestalis gracilis (Rambur, 1842) | VC | Prasad et al. (2006a,b), Tiple et al. (2013), Koparde et al. (2014, 2015), Mumbai, Pune, Ratnagiri, and Nagpur (Koparde et al., unpublished data) | 1 | L | C |

OS: Occurrence status; D: Deccan Peninsula; W: Western Maharashtra (includes Western Ghats and West Coast); T: Threat status as assigned from IUCN, 2010 (NA: Not available; LC: Least concern; DD: Data deficient; VU: Vulnerable; NT: Near threatened.). Numbers in brackets are thenumbers of species in a given family; 1: presence; *: data from present field studies.
subcontinent. Such studies have been carried out using Odonata as model systems (Dijkstra 2007, Shah et al. 2012), underscoring the importance of spatial data from these regions.

Sathe and Bhusnar (2010) have listed many species, especially Gomphidae family members, which are not included in the previous literature by Fraser (1933, 1934, 1936), Prasad (1996) and Kulkarni et al. (2012) (Table 3). Recent studies by Tiple (2012a,b), Tiple et al. (2013), Kulkarni and Subramanian (2013), Koparde et al. (2014, 2015) from Maharashtra or even those from Western Ghats of Goa (Rangnekar et al. 2010, Subramanian et al. 2013, Rangnekar and Naik 2014), which is a neighbouring State, failed to record these species. Sathe and Bhusnar (2010) have listed Microgomphus longistigma (Table 3) which is most probably Merogomphus longistigma. Similarly, Orthetrum caledonicum recorded by Wankhede et al. (2012) in Pune district is not a valid species. Recent studies by Kulkarni and Subramanian (2013) and Koparde (P. K., unpublished data) in the same district did not record this species. The species list of Amba RF, that lies in Western Ghats of Maharashtra, by Sathe and Bhusnar (2010) also includes four species which have not been recorded by earlier researchers or during recent studies (Table 3). This might be because these areas were not surveyed earlier. However, authors in these articles do not mention anything specific about these species, i.e., new records to Maharashtra State, unusual sightings or taxonomic uncertainties. Koparde et al. (2014, 2015) had done a short-survey in areas around Kolhapur and Amba RF, however, they did not record species mentioned by Sathe and Bhusnar (2010) and Koparde et al. (2012, 2014, 2015) studies were short-termed, specifically in postmonsoon season, which might be a reason that they could not detect many Gomphidae. However, this study was more extensive than other studies in the same region. We failed to retrieve these species even from public data. Although it is difficult to assess their authenticity, while compiling the state checklist we have retained the species which have been recorded by Sathe and Bhusnar (2010) and Koparde et al. (2012), considering that they had been probably undersampled by other researchers.

Most of our additions belong to the family Gomphidae. This family is also represented by the highest number of Data Deficient species as well as species for which information is not available in the IUCN red-list of threatened 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 Gomphidae are already rare. Therefore, there are high chances of not detecting them during surveys. Microgomphus verticalis and Cyclogomphus vesiculosus are the only two species of Gomphidae that have not been recorded recently; whereas 10 species have been recorded only recently (Table 2). This explains the huge gap in knowledge on the distribution of Gomphidae. Although the spatial distribution may vary in time, addition of only 10 species over almost 17 yr indicates slow rate of data acquisition on Gomphidae. Lack of recent records and systematic information on population occurrences has been discussed as a major fall out in assigning conservation status to Gomphidae by many IUCN red-list assessors (Dow 2009a,b,c; Sharma 2010; Kakkasery 2011a,b; Subramanian et al. 2013, Rangnekar and Naik 2014), which is a neighbouring State, failed to record these species. Sathe and Bhusnar (2010) have listed Microgomphus longistigma (Table 3) which is most probably Merogomphus longistigma. Similarly, Orthetrum caledonicum recorded by Wankhede et al. (2012) in Pune district is not a valid species. Recent studies by Kulkarni and Subramanian (2013) and Koparde (P. K., unpublished data) in the same district did not record this species. The species list of Amba RF, that lies in Western Ghats of Maharashtra, by Aland et al. (2012) also includes four species which have not been recorded by earlier researchers or during recent studies (Table 3). This might be because these areas were not surveyed earlier. However, authors in these articles do not mention anything specific about these species, i.e., new records to Maharashtra State, unusual sightings or taxonomic uncertainties. Koparde et al. (2014, 2015) had done a short-survey in areas around Kolhapur and Amba RF, however, they did not record species mentioned by Sathe and Bhusnar (2010) and Aland et al. (2012) studies were short-termed, specifically in postmonsoon season, which might be a reason that they could not detect many Gomphidae. However, this study was more extensive than other studies in the same region. We failed to retrieve these species even from public data. Although it is difficult to assess their authenticity, while compiling the state checklist we have retained the species which have been recorded by Sathe and Bhusnar (2010) and Aland et al. (2012), considering that they had been probably undersampled by other researchers.

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| Scientific name | Reported by | Reported from | TS  |
|----------------|-------------|---------------|-----|
| Gomphus nigricornis/Asiagomphus nilgiricus (Laidlaw, 1922) | Aland et al. (2012) | Amba RF, Kolhapur | DD  |
| Macromia ellisoni (Fraser, 1924) | Aland et al. (2012) | Amba RF, Kolhapur | LC  |
| Macromia ida (Fraser, 1924) | Aland et al. (2012) | Amba RF, Kolhapur | LC  |
| Macromia irata (Fraser, 1924) | Aland et al. (2012) | Amba RF, Kolhapur | LC  |
| Lamelligomphus malabaricus/Onychogomphus malabarensis (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | NA  |
| Lamelligomphus nilgiricus/Onychogomphus nilgirienis (Fraser, 1922) | Sathe and Bhusnar (2010) | Kolhapur | NA  |
| Megalagomphus superbus (Fraser, 1931) | Sathe and Bhusnar (2010) | Kolhapur | DD  |
| Merogomphus longistigma (Fraser, 1922) | Sathe and Bhusnar (2010) | Kolhapur | DD  |
| Onychogomphus striatus (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | DD  |
| Microgomphus longiseta (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | NA  |
| Chlorogomphus xanthoptera (Fraser, 1919) | Sathe and Bhusnar (2010) | Kolhapur | VU  |
| Chlorogomphus campioni (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | LC  |
| Chlorogomphus yunnanensis (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | LC  |
| Chlorogomphus yunnanensis (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | LC  |
| Chlorogomphus yunnanensis (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | NA  |
| Chlorogomphus yunnanensis (Fraser, 1924) | Sathe and Bhusnar (2010) | Kolhapur | NT  |
| Chlorogomphus yunnanensis (Fraser, 1924) | Wankhede et al. (2012) | Pune | NA  |

TS: Threat status as assigned from IUCN (2010). NA: Not available; LC: Least concern; DD: Data deficient; VU: Vulnerable; NT: Near threatened.
after Prasad (1996) study. We retrieved many other spatial records of this species across Maharashtra from public domain. It seems that this underrecorded species is widespread, but patchily distributed in Maharashtra (Kopardare et al. 2015; Kopardare et al., unpublished data). This probably explains artifact of sampling and usefulness of crowd-sourcing in data collection.

Advent of field-guides and public forums has driven to the next level. Continuous data sharing among researchers through social networks has led to free flow of information and site and/or species-specific studies. However, such public forums often suffer from deposition of non-authenticated records and false presence data. If checklists of regions made by experts are referred along with records in public domain, they may result into usable species data. Field data collected by experts is of primary importance to understand changing species distributions and the causes of this change. Additional systematic field-studies across Maharashtra State covering all possible microhabitats, will provide insights into species richness and threats to them. Establishing the current checklist of Odonata needs an effort to gather species presence data across an extensive landscape. This checklist is highly likely to get modified as more data flow in across the State.

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