

Article

Impact of a small artificial water source on the diversity of odonates (Insecta : Odonata) in an urban landscape

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Abstract

Rapid urbanisation is mainly responsible for the degradation and fragmentation of natural ecosystems in urban areas. Dragonflies and damselflies (Odonata) constitute an important part of urban biodiversity. The odonate larval stage is aquatic and being dependent on freshwater ecosystems, odonates are often used as ecological indicators for such ecosystems. Both larval and adult odonates are carnivorous and prey on other insects including mosquitoes. Hence, they perform an important role as predators in the ecosystems where they are found. In this study, the impact of a small artificial water source on the diversity of odonates in an urban landscape has been evaluated. The impact of the water source was found to be positive as its availability resulted in an increase in odonate diversity.

Keywords damselfly; dragonfly; Odonate; urban biodiversity.

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1 Introduction

The Odonata, that is dragonflies and damselflies are very familiar insects, as they are colourful, relatively larger than other insects, diurnal, and can be easily observed flying around freshwater bodies and nearby land areas (Thorpe and Rogers, 2011). Odonates have large eyes with many ommatidia, which is an adaptation for the detection of movement. Odonates use their keen eye sight to catch living prey (Tennessee, 2009).

Odonates are aquatic as larvae and terrestrial as adults, and hence can be used as bioindicators in both aquatic and terrestrial habitats (Oertli, 2008). Odonates are ideal for studying movement through the landscape, as their adult stage exhibits high dispersal ability and is very conspicuous (Conrad et al., 1999). Being exclusively carnivorous and mostly preying on other insects, odonates play an important role as predators in the natural food web. Odonate larvae are known to prey on mosquito larvae, and this is a good example of biological control in nature (Saha et al., 2012). When foraging, dragonflies can be categorized as “perchers” or “fliers.” Perchers spend much of their time stationary, making short flights from perches to capture prey and

then perching to consume it. In contrast, fliers are on the wing for a large part of their feeding activity, capturing their prey in the air and swallowing small prey while in flight (Tennesen, 2009).

Odonates are an integral part of urban biodiversity. However, urbanisation is associated with modification, degradation and fragmentation of natural ecosystems. Many studies show that species richness and evenness is reduced in highly urbanised regions, depending on the taxonomic group observed and the degree of urbanisation (McKinney, 2008). Odonates are closely associated with freshwater ecosystems and the degradation of such ecosystems is deleterious to them. The present study has been undertaken with the object to determine if a small and artificial water source can have a positive impact on odonate diversity in urban landscape.

2 Materials and Methods

2.1 Study area

The study was conducted in the grounds of S. M. Mohota College of Science, which is located in Nagpur City (c. 21.06°N 79.03°E) in Central India. The College is situated on land area measuring about 50 acres. Nagpur is a large city and its population is estimated to be approximately 2.4 million. Nagpur has a mean elevation of 310 m and the average annual rainfall is 1064 mm. The temperature ranges from a maximum of 46°C in the summer to a minimum of 10°C in the winter.

2.2 Observation and identification of odonates

During the period 2016-2017, odonate species visiting the College grounds were regularly identified through weekly observations. In December 2017, six cement tanks, each measuring five feet long, two and half feet wide, and two feet deep were constructed behind the College building. These tanks are used throughout the year for the cultivation of locally found aquatic plants such as *Hydrilla*, *Nymphaea*, *Lemna* and *Salvinia*. After the construction of these tanks, odonates found in their vicinity were observed weekly during the period 2018-2019 and identified with the help of field guides by Subramanian (2005) and Andrew et al. (2008). Odonate species were also photographed with a digital camera for helping in identification. After this, the data collected during the two study periods 2016-2017 and 2018-2019 was analyzed to check if the small man-made water source had any impact on the diversity of odonates found in the study area.

3 Results and Discussion

The odonate species that were observed during the course of the study are listed in Table 1 (Figs. 1-19). During the first period of study, that is 2016-2017, 10 species of odonates including seven dragonfly species and three damselfly species were observed in the study area. During the second period of study, that is 2018-2019, 18 odonate species including 12 dragonfly species and six damselfly species were recorded from the study area. Family Libellulidae dominates with 10 species and is followed by Family Coenagrionidae with five species. The three other families, namely Gomphidae, Aeshnidae, and Lestidae are represented by one species each. All the species that were identified are common in Nagpur (Andrew et al., 2008). Regarding their conservation status, all the recorded species are 'least concern' as per the IUCN (2020). Largest numbers of odonates were observed during the monsoon season from the months of July to September, whereas their numbers started decreasing in winter and least numbers of odonates were observed during the summer.

The results of the study show an increase of eight odonate species in the studied locality after the availability of the artificial water source. This is an increase of 80 percent compared to the period when artificial water source was not available. Hence, the impact of the small artificial water source on the diversity of odonates in the area studied was clearly positive.

Various studies have shown that different types of urban waterbodies are important habitats for odonates.

For example, urban stormwater ponds can be attractive habitats for dragonflies and damselflies. Implementation of the design elements of urban stormwater ponds and their plant community composition can be used to enhance biodiversity and ecosystem services (Perron and Pick, 2019). Findings from a 10-year study that intensively monitored odonate fauna in the Upper Silesian industrial coal region having many secondary habitats characterized by very frequent disturbances due to soil instability suggest that secondary habitats with a great diversity of succession stages arising directly as a consequence of environmental instability may be considered as partial alternatives to natural habitats in cultural landscapes (Harabiš and Dolný, 2012). Results from yet another study suggest that a natural design of well-vegetated ponds as well as a high diversity of different pond types and particularly a more natural redesign of city park ponds can help in promoting urban odonate biodiversity (Goertzen and Suhling, 2013). A great deal of biodiversity persists in urban environments where synanthropic communities are supplemented by species that thrive in disturbed environments, while aquatic urban biodiversity appears to persist despite anthropogenic stressors (Hassall, 2014).

Man-made water bodies could be suitable habitats for diverse odonate species provided that they are characterized by adequate environmental conditions (Vilenica et al., 2020). As odonates spend their larval stage in freshwater bodies, availability of man-made water sources in urban areas can definitely help in increasing diversity of odonates found in urban landscapes. For breeding, odonates are known to use the available water sources in urban areas including small tanks used for storing water in buildings. Restoration of freshwater habitats in urban landscape and the construction of small tanks or ponds in parks and home gardens can provide a larger number of breeding habitats to urban odonate fauna. This can help in increasing species diversity and species richness of the Odonata in urban landscapes.

Table 1 List of Odonata observed during the study (Y: Yes, C: Common, LC: Least Concern).

S. No.	Common Name	Zoological Name	Species Observed during 2016-2017	Species Observed during 2018-2019	Local Status	IUCN Status
Suborder Anisoptera (Dragonflies)						
Family Gomphidae (Clubtails)						
1.	Common Clubtail	<i>Ictinogomphus rapax</i> (Rambur, 1842)	Y	Y	C	LC
Family Aeshnidae (Darners)						
2.	Blue-tailed Green Darner	<i>Anax guttatus</i> (Selys, 1839)	-	Y	C	LC
Family Libellulidae (Skimmers)						
3.	Ditch Jewel	<i>Brachythemis contaminata</i> (Fabricius, 1793)	Y	Y	C	LC
4.	Granite Ghost	<i>Bradinopyga geminata</i> (Rambur, 1842)	Y	Y	C	LC
5.	Ruddy Marsh Skimmer	<i>Crocothemis servilia</i> (Drury, 1770)	-	Y	C	LC
6.	Ground Skimmer	<i>Diplacodes trivialis</i> (Rambur, 1842)	Y	Y	C	LC
7.	Green Marsh Hawk	<i>Orthetrum sabina</i> (Drury, 1770)	Y	Y	C	LC

		1770)				
8.	Wandering Glider	<i>Pantala flavescens</i> (Fabricius, 1798)	Y	Y	C	LC
9.	Yellow Tailed Ashy Skimmer	<i>Potamarcha congener</i> (Rambur, 1842)	-	Y	C	LC
10.	Common Picture Wing	<i>Rhyothemis variegata</i> (Linnaeus, 1763)	-	Y	C	LC
11.	Coral-Tailed Cloud Wing	<i>Tholymis tillarga</i> (Fabricius, 1798)	-	Y	C	LC
12.	Red Marsh Trotter	<i>Tramea basilaris</i> (Kirby, 1889)	Y	Y	C	LC
Suborder Zygoptera (Damselflies)						
Family Coenagrionidae (Dartlets)						
13.	Pigmy Dartlet	<i>Agriocnemis pygmaea</i> (Rambur, 1842)	Y	Y	C	LC
14.	Coromandel Marsh Dart	<i>Ceriagrion coromandelianum</i> (Fabricius, 1798)	Y	Y	C	LC
15.	Golden Dartlet	<i>Ischnura aurora</i> (Brauer, 1865)	Y	Y	C	LC
16.	Senegal Golden Dartlet	<i>Ischnura senegalensis</i> (Rambur, 1842)	-	Y	C	LC
17.	Pixie Dartlet	<i>Rhodischnura nursei</i> (Morton, 1907)	-	Y	C	LC
Family Lestidae (Spreadwings)						
18.	Brown Spreadwing	<i>Lestes umbrinus</i> Selys, 1891	-	Y	C	LC



Figs. 1-4 1. *Ictinogomphus rapax* 2. *Anax guttatus* 3. *Brachythemis contaminata* 4. *Bradinopyga geminata*



Figs. 5-19 5. *Crocothemis servilia* 6. *Diplacodes trivialis* 7. *Orthetrum sabina* 8. *Pantala flavescens* 9. *Potamarcha congener* 10. *Rhyothemis variegata* 11. *Tholymis tillarga* 12. *Tramea basilaris* 13. *Agriocnemis pygmaea* 14. *Ceriagrion coromandelianum* 15. *Ischnura aurora* 16. *Ischnura senegalensis* 17. *Rhodischnura nursei* 18. *Lestes umbrinus* 19. A tank containing aquatic plants.

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