



Effect Of Water Pollution On Assemblage And Community Structure Of Dragonfly At Three Ecosystems Of Pune (india)

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ABSTRACT:

The order Odonata deserves a special place in the study of ecology as it acts as a biological indicator. Dragonfly belongs to suborder Anisoptera. In this study our objectives were to explore and compare the diversity of dragonfly at three different habitats in Pune (2010-2011) Maharashtra, India and to study the habitat association in assemblage and community structure of species of dragonfly at these ecosystems. We selected three different types of ecosystems, studied the water quality of ecosystems and tried to correlate the assemblage of dragonfly species with habitat status of ecosystem. Three selected ecosystems are Pune University pond (seasonal and non-polluted), Mula-Mutha sangam (lotic, perenneal and polluted) and Pashan Lake (lentic, perenneal and polluted). Dragonfly at three different ecosystems were sampled and photographed.

In this study, by observing the diversity of Dragonfly, we have tried to evaluate and compare the status of three different ecosystems of Pune. In total we observed 15 species of dragonfly belonging to two families. In our observation Libellulidae is the most represented family. Pune University Pond is less polluted and has higher diversity of dragonfly than other two ecosystems. The high species diversity of dragonfly at University pond can be attributed to the undisturbed and non polluted ecosystem. This is the first report of the dragonfly fauna from Pune University pond.

KEYWORDS:

Water quality, habitat, ecosystem, Dragonfly, diversity, Pune University Pond. Mula-Mutha sangam, Pashan Lake. Pune

INTRODUCTION:

Order Odonata is classified in three suborders:- Zygoptera are more tiny and delicate creatures, Anisoptera with extra fatty shape, and the last one, a relict group, Anisozygoptera. Their eggs and larvae are aquatic while the adults are terrestrials [1]. These are carnivorous and some species are predators.

Please cite this Article as : Varsha Wankhade , Narendra Manwar and Azraj Dahihande , Effect Of Water Pollution On Assemblage And Community Structure Of Dragonfly At Three Ecosystems Of Pune (india) : Golden Research Thoughts (Sept ; 2012)



Dragonfly prefers to live in freshwater, non contaminated and well oxygenated habitats. Hence they can serve as a valuable bio-indicators for environmental contamination studies [2],[3],[4],[5]. The Odonata larvae use Anopheles larva in their diet, thus maintain the control over their population numbers, which is responsible for spreading of the epidemic illness like malaria[6]. Many species can use simple substrates and aquatic vegetation, but also certain species exhibit preferences for specific substrates, which may limit those species to habitats where the required substrate occurs [7].

The dragonflies and damselflies comprise relatively well-known insects that breed in a wide variety of aquatic habitats. Some species are specialists which use discrete habitats; others are generalists that are able to survive in a wide variety of environments. Dragonflies are noted for their striking colors. Many of them are stunningly beautiful, and hover in the air with elegance and acrobatic skill. Dragonflies and damselflies are amongst the prominent and colorful insects in tropical landscapes. Study of dragonfly diversity could give us valuable insights about ecosystem health, especially of wetland. Being very specific about breeding habitats, Odonates are sensitive indicators of the health of wetland and its landscape. Studies also show that dragonflies are sensitive not only to the quality of the wetland but also to the major landscape changes, especially changes in the riparian zone. Thus Odonates are also very good subjects in the study of behavior, ecology and biogeography.

Pune city (Maharashtra India) is located 560 m (1,840 ft) above sea level on the western margin of the Deccan plateau. It is situated on the leeward side of the Sahyandri mountain range, which form a barrier from the Arabian Sea. We selected three different water bodies from Pune. 1) Mula and Mutha sangam (confluence of the Mula and Mutha river) is a perennial and lotic water body, 2) Pune University pond is a seasonal and lentic water body and 3) Pashan Lake is a perennial and lentic water body.

The objectives of the present study was to explore and compare the diversity of dragonfly at three ecosystems of Pune and to evaluate the status of three ecosystems with special reference to dragonfly diversity and to study the habitat association in assemblage and community structure of dragonfly at these ecosystems.

MATERIALS AND METHODS:

Study area :

The ecological habitats distinguished for sampling included Mula Mutha Sangam (confluence of Mula and Mutha river, approximate area 600 m²), Pune University campus (approximate area 200 m²), and Pashan Lake (area 570 m²). Mula Mutha Sangam is perennial and lotic water source. Pashan Lake is lentic and perennial water source. Pond of University of Pune is lentic and seasonal water source.

Sampling and photography:

Dragonflies were and photographed with careful notes of their locality, habitat and relative abundance. Sampling was performed along the transect of 50 m long and 5 m wide. Period of study was from July 2010- April 2011, during the day time 10.00 to 15.00. Photographs were taken by digital Camera Sony make model no. W-310

Species were listed to calculate and compare the composition, richness, including similarity indices among the three different habitats.

Identification:

For identification, a key field guide of Subramanian (2005) was used. Identification of each species covers information like: date, place and medium where they were photographed

Data Analyses:

Dragonfly species listed and the complete count of the number of species presented in each habitat were done for species composition and species structure indices. The results were used to indicate the dragonfly species structure at three different locations in Pune. Shannon- wiener function [8] was also used to calculate the species diversity indices of the dragonfly living around each type of habitats as follow:

$$H = -\sum_{i=1}^s (p_i) (\ln p_i)$$

Where H = species diversity index
 S = no. of species
 Pi = proportion of the total sample belonging to ith species

To measure the similarity between two community samples, the coefficient of Sorensen [9] was used as the following equation

$$QC = \frac{2a}{2a+b+c}$$

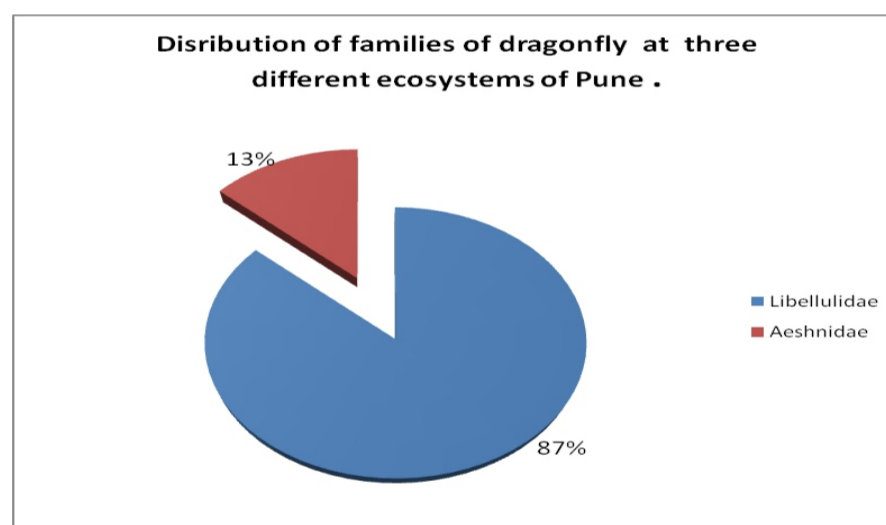
Where QC = Sorensen similarity coefficient
 a = no. of species in sample A and sample B (joint occurrences)
 b = no. of species in sample B
 c = no. of species in sample A

For the habitat study, water parameters like pH, conductivity, temperature, Total Dissolved Solids, Alkalinity and Hardness of Water were analysis by using water analysis kit (Make: Prerana)

RESULTS AND DISCUSSION:

The dragonflies observed from the study areas are represented in Table 1. Total fifteen species of dragonfly were observed in the study area of Pune. All the listed dragonflies belong to two families. Thus 15 species of dragonfly were identified upto the species level. The details are listed in observation Table 1.

Fig :1. Disribution of families of Dragonfly at three different ecosystems of Pune .



In total observed species 87% species belongs to family Libellulidae and 13% belongs to family Aeshnidae. During the present study, total of fifteen species representing two families namely Libellulidae and Aeshnidae are recorded. Out of these, Libellulidae is the most abundant may be because Libellulidae is one of the largest family of dragonfly, which has wide distributions and found in all zoographic regions and it breeds at variety of aquatic habitat.

We could observe six species of dragonfly at the Mula Mutha Sangam and at Pashan Lake and nine species at Pune University Campus. The details of species are listed in Table 1. The species diversity indices among the three locations are slightly different. The species diversity index is found to be highest for University of Pune followed by Mula Mutha Sangam and Pashan .The dominance indices are similar for Pashan and Mulla & Mutha Sangam .

We assayed the physicochemical parameters of water of the three ecosystems to understand their pollution status. We analyzed Turbidity, Conductivity, Dissolved, Total alkality, Total hardness and Total

dissolved solids of water of above mentioned ecosystems. Effect of water quality on assemblage and community structure of Dragonfly at three ecosystems in Pune is shown in Table 1.

Table 1 : Effect of water quality on assemblage and community structure of Dragonfly at three ecosystems in Pune .

S . N .	Properties of water (units)	Ecosystem		
		M ula Mutha sangam	Pashan Lake	University pond
1	Turbidity (NTU)	16 ±0.02	15± 0.012	10 ±0.01
2	Conductivity (mS/cm)	0.30±0.01	0.28±0.02	0.40 ±0.01
3	Dissolved O2 (mg/L)	4.5±0.95	5.1±0.91	6.1 ±1.23
4	Total alkality (mg/L)	250±5.3	270±3.3	210 ±2.2
5	Total hardness (mg/L)	300±4.9	290±3.9	230 ±1.9
6	T. D. S. (gm/L)	0.60±0.01	0.55±0.01	0.25±0.009
7	Species assemblage of dragonfly	6 species	6 species	9 species
8	Community structure of dragonfly	<i>Brachythemis contaminata</i> (L) <i>Crocothemis servilia</i> (L) <i>Pantala flavescens</i> (L) <i>Orthetrum sabina</i> (L) <i>Tholymis tillarga</i> (L) <i>Orthetrum glaucaum</i> (L)	<i>Brachythemis contaminata</i> , <i>Crocothemis servilia</i> <i>Pantala flavescens</i> <i>Orthetrum sabina</i> <i>Anax guttatus</i> (A) <i>Anax immaculifrom</i> (A)	<i>Orthetrum pruinosum</i> (L) <i>Tramea limbata</i> , (L) <i>Orthetrum caledonicum</i> (L) <i>Trithemis festiva</i> (L) <i>Bradinopyga geminata</i> (L) <i>Orthetrum sabina</i> (L) <i>Orthetrum glaucaum</i> (L) <i>Trithemis aurora</i> (L) <i>Diplocodes trivialis</i> (L)

Values of water analysis are expressed as mean values with ± SE
In parenthesis Family of the species is stated L= Family Libellulidae ,A= Family Aeshnidae

From the above Table 1, it is obvious that the water quality of Mula Mutha Sangam and Pashan Lake is polluted as compared to Pune University pond. Pune University pond exhibits different species structure of dragonfly than other two ecosystems.

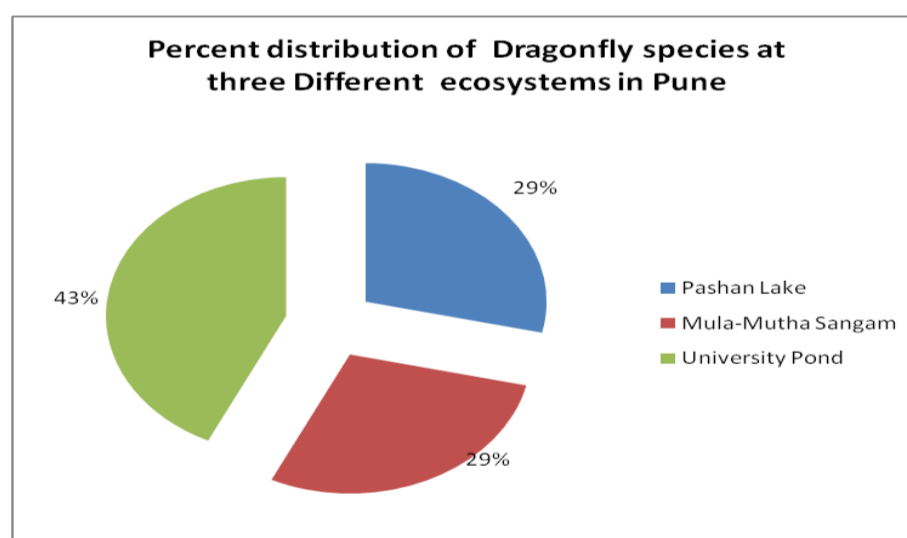


Fig2. Percent distribution of Dragonfly species at three Different ecosystems in Pune .

Pond of Pune University though it is small ecosystem as compared to other two ecosystems, holds high number of species. 43 % of total species of total were inhabitants of Pond of University of Pune while Mula Mutha Sangam and Pashan Lake hold 29% species. Mula Mutha Sangam and Pashan Lake are bigger ecosystem than Pond of University of Pune.

We calculated similarity index and diversity index of the species. We found that Pond of University of Pune is relatively successful ecosystem. Diversity index of Pond of University of Pune with reference to dragonfly is the highest. The highest similarity index is in between Mula Mutha Sangam and Pashan Lake and the least similarity between University campus and Pashan Lake. The details of the dragonfly species indices is shown in Table 2.

Table 2: Ecological indices of Dragonfly species structure in the three different ecosystems : Mula Mutha Sangam (M) , Pashan Lake (P) and University of Pune (PU) in the study area in Pune city, State Maharashtra.

Ecological Indices of Species Structure	Mula (M)	Pashan (P)	University
	Mutha Sangam	Lake	Pond (PU)
Species Diversity Index	0.84	0.84	0.90

- Similarity Index between M and P = 0.4
- Similarity Index between M and PU = 0.21
- Similarity Index between P and PU = 0.11

The study of species structure indices compared among the three types of locations such as Mula Mutha Sangam, Pashan Lake and Pune University Campus indicates that the difference in structure of habitat influence the kinds of dragonfly species inhabiting at these places. The similarity indices, tools for comparing the similarity between two community samples, vary from 40% to 60% among those habitats sites. By the similarity measurement, Mula Mutha Sangam, Pashan Lake show the most similar dragonfly species structure. This might be because the water quality of Mula Mutha Sangam and Pashan Lake is somewhat similar. While the university campus shows totally different species structure. It might be because the University campus (pond) is least polluted and with least or negligible human interference.

The University of Pune shows high index of species dominance. This might be because the Pune university pond is away from the human interference and so it is least polluted. We also surveyed the area of Pune University other than the pond and we found the *Bradinopyga geminata* (granite ghost) near the department of Zoology University of Pune, Pune. This species is used to control the dengue fever because it feeds on *Aedes aegypti*.

The genus *Brachythemis contaminata* (species which inhabit the in polluted water) is dominant at the Mula Mutha Sangam and Pashan Lake. Thus we can have idea of pollution of Mula Mutha Sangam and Pashan Lake. Water analysis of Mula Mutha Sangam and Pashan Lake also confers that these water bodies are polluted. *Brachythemis contaminata* is not seen at university campus.

CONCLUSION:

Present study yields valuable information of dragonfly availability at three mentioned ecosystems of Pune. This study shows that Mula Mutha Sangam and Pashan Lake are the polluted ecosystems and shows

less assemblage of dragonfly species and different community structure than non-polluted water body (University Pond). Thus we propose that efforts should be made to conserve the Dragonfly habitat and existence of dragonfly by maintaining the ecosystem non-polluted for the growth of flora and fauna. Introduction of drainage and other pollutants in these water bodies should be checked and ecosystems should be kept pollution free so as to nurture the diversity of various insects and other organism and flora.

ACKNOWLEDGEMENT:

First author acknowledges BCUD University of Pune, ISRO-UoP Cell, DST-PURSE and CAS for partial financial support for the above study.

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