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Diversity and abundance of Odonata larvae in a fresh water lentic system of Purba Medinipur District, West Bengal, India

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Abstract
In total 19 species of Odonata larva have been recorded from a weed infested manmade Freshwater large lentic system near Tamluk, West Bengal ($22^0 17' 52.56"$N, $87^0 55' 16.72"$E), India. Family Libellulidae was numerically the most abundant group comprising 66.04 % of the total Odonata larva followed by Family Coenagrionidae (31.92%) and Gomphidae (2.04%) respectively. Family Libellulidae represented by 12 species while Coenagrionidae represented by only 6 species and Gomphidae was represented by only one species. *Urothemis* and *Rhodothemis* were largest and lowest number of individuals recorded respectively. The water quality was fairly good during the 11 month study period of 2017-18. Various diversity indices were calculated in different seasons and the result shows maximum diversity and abundance during post-monsoon and minimum was in pre-monsoon. Diversity and evenness indices were fluctuated during study period due to seasonal changes of environmental conditions.

Keywords: Odonata larva, Coenagrionidae, Libellulidae, diversity

Introduction
The dragonflies and damselflies collectively known as order Odonata, are one of the most attractive, widely distributed group of insects. They are important members of ecosystem and efficient indicators of ecosystem health. The odonates have become most effective insect group in view to the ecological quality assessment. Immature Odonata occupy a great diversity of aquatic habitats but are generally most abundant in lowland streams, ponds, lakes and wetlands. The predatory nymphs are an important part of aquatic food webs and the aquatic stages of mosquitoes comprise a significant part of the diet of many immature odonates (Ward 1992, Westfall and Tennessen 1996).

Odonata are among the most ancient of winged insects, dating back well into the Permian. The order Odonata is divided into two suborders, the Zygoptera or damselflies and the Anisoptera or true dragonflies. Until recently a third suborder, Anisozygoptera, was recognized, with two species from Japan and the eastern Himalayas. Out of 6256 species known all over the world, Odonata fauna of India is known by 3 sub orders, 18 families, 152 genera and 487 species and 27 subspecies. (Subramanian K.A 2017). Many studies were carried out to access the adult dragonfly and damselfly diversity and distribution. But the study on larva is limited. There is a major gap in research on taxonomy and ecology of larval Odonata. Diversity and abundance is one of the major areas of ecological study and Hubbel opined that diversity would be maintained only by ecological stochastic city, in local and regional scales (Hubbel 2001) [17]. The Odonates have strong association with water because of their aquatic larvae. Dragonflies are key organisms of the food web as predators both as larvae and as imagoes. They usually have many variations in habitats according to its biological requirements. (Mendis P.T)

Materials and Methods
The present study was conducted in a man-made large lentic system at Tamluk ($22^0 17' 52.56"$N, $87^0 55' 16.72"$E), Purba Medinipur, West Bengal. The area of the water body is about 4.3 acre and average depth is about 3.7 meter. The pond is infested with many aquatic weeds like *Marsilea minuta* Lin, *Nelumbo nucifera* Gaertner, Nymphaea sp,

Eclipta alba Hassk, *Monochoria hastata* Solms, *Scirpus articulates* Lin, *Cyanotis axillaris* Roem and Sch, *Aeschynomene ampere* Lin, *Hygroryza aristata* Nees, *Hydrocotyle asiatica* Nees, *Hygrophila difformis* L.f, *Utricularia stellaris* L.f, *Jussiaea repens* Lin, *Nymphoides indica* Lin, *Eichhornia crassipes* (Mart.) Solms, *Hydrilla verticillata* Casp, *Chara sp*, *Nitella sp*, *Pistia stratiotes* L, *Lamna sp*, *Cyperus sp*, *Ipomea aquatic* Fors *k*, *Enhydra fluctuans* Lour, *Sphenoclea zeylanica* Gaertn, *Trapa sp*, *Jussia repens* L *Ceratophyllum demersum* L, *Polygonum sp*, *Alternanthera sp*, *Gomphrena sessilis.*

Larvae were collected at monthly interval from July2017 to May 2018 between 8.00 a.m to 11 a.m. This study period was divided in to three seasons *viz*. pre-monsoon (Mar, Apr, May), monsoon (July, August, Sept, Oct) and post-monsoon (Nov, Dec, Janu, Feb). The collection were made by hauling of a dip net with a mesh size of 245 µm (Nylobolt PA, Deekay Nylobolt Industries (Pvt.) Ltd. Mumbai, India). The area of the circular net was 4208.0 cm^2. Samples were taken from eight sites at four sides of the pond and Insects thus collected were preserved in 70% ethyl alcohol in specimen bottles. For identification the larvae were placed under a binocular microscope (Magnus MS24) and upon observation of the characters and comparison with the larval identification keys. (Kumar 1970, 73, 80, 83 and Theischinger 2007) [20, 22, 33]. The identification of aquatic vegetation was done by following N.K Chakraborty, 2010 (Jalaja Gachpala).

For analysis of community, abundance, relative abundance, species diversity index and evenness index were determined. Dominance status of various species is described on the basis of relative abundance following Engelmann's scale (Engelmann, 1973) as mentioned under Table 1. Species diversity index (H) was estimated following Shannon and Wiener (1963) and Evenness index (e) was estimated following Pielou (1975).

The data analysis is done by PAST version 3.24 (2019) [Natural History Museum, University of Oslo.

Results and Discussion

In total 19 species were recorded during the present study (Table 1). The total number of collected Odonata larvae is 1283. These belong to 2 sub orders-Anisoptera and Zygoptera. Anisoptera and Zygoptera were represented by 68% and 32% respectively (Fig.1). There are 13 species of Anisoptera are distributed in only 2 families –Gomphidae and Libellulidae, where Gomphidae had only one species. Zygoptera represented only 6 species under only one family Coenargrionidae.

Family Libellulidae was the most common group quantitatively representing 66.04% of total collected Odonata larvae in this pond. Family Coenargrionidae and Gomphidae were represented by 31.92% and 2.04% of total Odonata respectively (Fig.2). Gomphidae were collected from only one site out of 8 collecting sites which was without vegetation and shaded by trees. Gomphidae larvae were only 2.04% because they generally burrower and prefers habitat without aquatic macrophytes. (A. Kumar) Out of 19 species *Urothemis signata* of Libellulidae and *Ceriagrion coromandelianum* of Coenagrionidae were dominant species. These species appear to be good exploiters of resources in weed infested aquatic system. There were 9 sub-dominant species one from Gomphidae, five from Libellulidae and four from Coenargrionidae *viz*. *Brachydiplax chalybea*, *Brachythemis contaminata*, *Crocothemis servilia*, *Diplacodes trivialis*, *Pantala flavescens*, *Agriocnemics sp*, *Ischnura aurora*, *Ischnura senegalensis*, *Pseudagrion sp.* The recedent species were 7 in number which includes 5 from Libellulidae and one from Gomphidae and Coenargrionidae each *viz*. *Ictinogomphus rapax*, *Neurothemis tullia*, *Orthetrum sabina*, *Potamarcha sp*, *Tramea basilaris*, *Zyxoma petiolatum*, *Ceriagrion sp.* There was only one subrecedent species named *Rhodothemis sp* of family Libellulidae.

Total number of larvae is highest in post-monsoon and lowest in pre-monsoon (Fig.3). Anisoptera and Zygoptera both the sub-order showed the almost similar trends in seasonal abundance *viz* lowest in pre-monsoon and highest in post-monsoon (Fig.4). Species diversity and Evenness were lowest in pre-monsoon and highest in post-monsoon. (Table. 2) In the present investigation, species diversity index was always higher than 1. Staub *et al*. (1970) [31] proposed that H value < 1 indicates heavy pollution of water. So H>1 indicates that the water quality was fairly good during study period. High species diversity indicates that such community has their resources more finely distributed among individuals of many species (Smith, 1977). Diversity index can also be used to measure environmental stress (Mason, 1981) [29]. Iwasaki (1999); however, opined that environmental stability rather than spatial heterogeneity has greater influence on H.

The maximum number of individuals of Odonata in post-monsoon and minimum number of individuals in pre-monsoon might be due to relatively longer of development process due to low temperature in post-monsoon and relatively faster development process due to high temperature in pre-monsoon. Increased predation and competition for space and lack of the availability of food during summer may also be the reason for numerical scarcity during pre-monsoon. Different species, however, increase in number in different season for example the dominant species *Urothemis signata* was 102 in post-monsoon and only 38 in pre-monsoon. This indicates some sort of temporal niche separation. Different rich aquatic vegetation in this pond provides spatial heterogeneity which helps making habitat of different species without severe competition in the form of ecological guild.

Charts and Tables

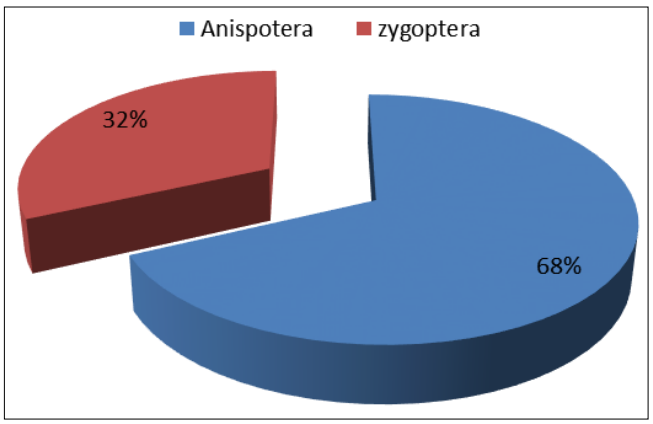

Fig 1: Relative abundance of sub-order Anisoptera and Zygoptera in a lentic system in Purba Medinipur.

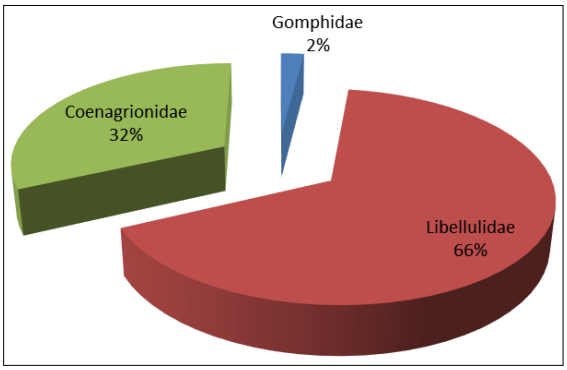

Fig 2: Relative abundance of families of order Odonata in a Lentic system in Purba Medinipur

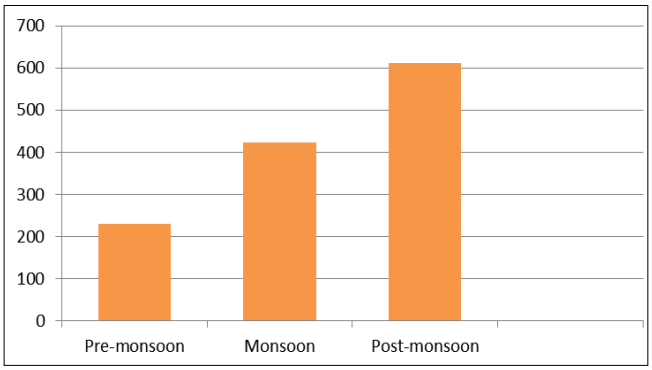

Fig 3: Seasonal variation in abundance of total Odonata larva in a lentic system in Purba Medinipur

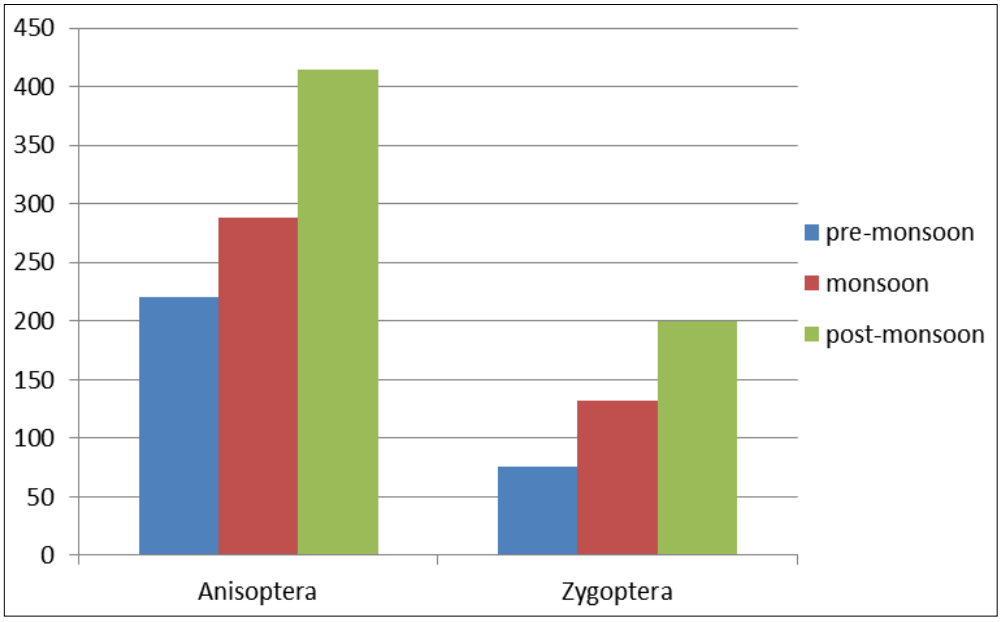

Fig 4: Seasonal abundance of Anisoptera and Zygoptera larvae in a lentic system of Purba Medinipur

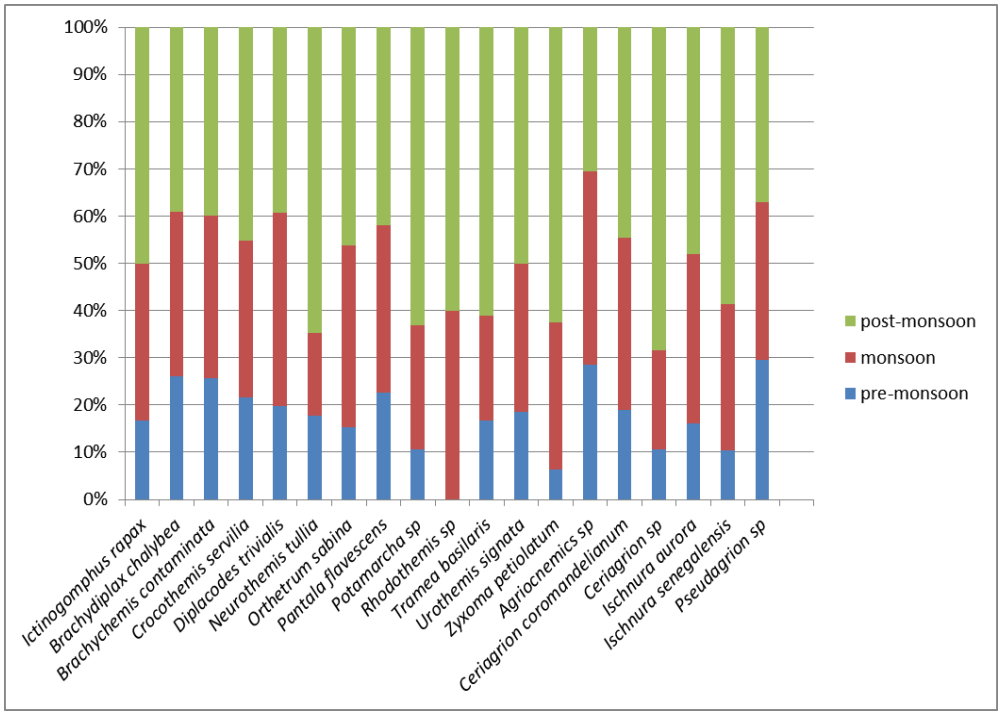

Fig 5: Seasonal abundance of various species Odonata larva in a lentic system in Purba Medinipur

Table 1: Dominance status of different species of Odonata larvae

Scientific name	Number	Relative abundance(RA)%	Dominance status
Family-Gomphidae			
Ictinogomphus rapax	26	2.04	Recedent
Family-Libellulidae			
Brachydiplax chalybea	46	3.6	Subdominant
Brachythemis contaminata	71	5.48	Subdominant
Crocothemis servilia	102	8	Subdominant
Diplacodes trivialis	122	9.56	Subdominant
Neurothemis tullia	34	2.67	Recedent
Orthetrum sabina	26	2.04	Recedent
Pantala flavescens	124	9.7	Subdominant
Potamarcha sp	38	2.98	Recedent
Rhodothemis sp	10	0.07	Subrecedent
Tramea basilaris	36	2.8	Recedent
Urothemis signata	204	16	Dominant
Zyxoma petiolatum	32	2.5	Recedent
Family-Coenagrionidae			
Agriocnemics sp	64	5	Subdominant
Ceriagrion coromandelianum	148	11.6	Dominant
Ceriagrion sp	38	2.98	Recedent
Ischnura aurora	50	3.6	Subdominant
Ischnura senegalensis	58	4.5	Subdominant
Pseudagrion sp	54	4.23	Subdominant

RA, 1=Subrecedent, 1.1-3.1=Recedent, 3.2-10=Subdominant, 10.1-31.6=Dominant and. 31.7% =Eudominant

Table 2: Seasonal variation in number, species diversity and evenness indices in a lentic system in Purba Medinipur

Parameters	Pre-monsoon	Monsoon	Post-monsoon
No of individuals	244	424	622
No of species	18	19	19
Shannon H	2.59	2.66	2.75
Evennes index(e)	0.75	0.76	0.77

References

1. Andrew RJ, Subramanian KA, Tiple AD. A Hand book on Common Odonates of Central India. South Asian Council of Odonatology, 2009, 65.
2. Tiple AD, Paunikar S, Talmale SS. Dragonflies and Damselflies (Odonata: Insecta) of Tropical Forest Research Institute, Jabalpur, Madhya Pradesh, Central India. Journal of Threatened Taxa, 2012, 2529-2533.
3. Campbell Grant EH, Lowe WH, Fagan WF. Living in the branches: population dynamics and ecological processes in dendritic networks. Ecol Lett. 2007; 10(2):165-175.
4. Gilpin ME. Interference competition and niche theory. Proc Nat Acad Sci. 1974; 71(8):3073-3077.
5. Chave J. Neutral theory and community ecology. Ecol Lett. 2004; 7:241-253.
6. Chesson PL, Warner RR. Environmental variability promotes coexistence in lottery competitive systems. Amer Nat. 1981; 117:923-943.
7. Chovanec A, Waringer J. Ecological integrity of river - floodplain systems - assessment by dragonfly surveys (Insecta: Odonata). Regul River. 2001; 17(4-5):493-507.
8. Conrad KF, Wilson KH, Harvey IV, Thomas CJ, Sherratt TN. Dispersal characteristics of seven odonate species in an agricultural landscape. Ecography. 1999; 22:524-531.
9. Conrad KF, Wilson KH, Whitfield K, Harvey IF, Thomas CJ Sherrat TN. Characteristics of dispersing Ischnura elegans and Coenagrion puella (Odonata): age, sex, size, morph and ectoparasitism. Ecography. 2002; 25(4):439-445.
10. Cordoba-Aguilar A. Dragonflies and Damselflies. Model organisms for ecological and evolutionary research. Oxford University Press, Oxford, UK, 2008, 290.
11. Costa JM, Souza Loi DE, Oldrini BB. Chave para identificação para as famílias e gêneros das Larvas conhecidas para o Brasil: Comentários e registros bibliográficos (Insecta; Odonata). Publicações Avulsas do Museu Nacional, Rio de Janeiro. 2004; 99:1-44.
12. Corbet PS, Hoess R. Sex ratio of odonata at emergence. International Journal of Odonatology. 1998; 1(2):99-118.
13. Reibel ME, Merckx T, Riordan P, Macdonald WD, Thompson JD. The dragonfly delution: why it is essential to sample exuviae to avoid biased surveys. Journal of insect conservation. 2010; 14(5):523-533.
14. Foster SE, Soluk DA. Evaluating exuvia collection as a management tool for the federally endangered Hines's emerald dragonfly, *Somatochlora hineana* Williamson (Odonata: Cordulidae). Biological Conservation. 2004; 118(1):15-20.
15. Graham Reels Dragonfly emergence at a small newly-created pond in Hong Kong. Hong Kong Entomological Bulletin. 2009; 1(2):32-37.
16. Harvey IF, Corbet PS. Territorial behaviour of larvae enhances mating success of male dragonflies. Anim Behav. 1985; 33:561-565.
17. Hubbell SP. A Unified Neutral Theory of Biodiversity and Biogeography. Princeton University Press, Princeton, NJ, 2001, 390p.
18. Hughes TP, Baird AH, Dinsdale EA, Mollschaniwskyj NA. Pratchett Odonate assemblage structure in relation to basin and aquatic hábitat structure in Pantanal wetlands. Hydrobiol. 579:125-134.
19. Jacob S, Thomas AP, Manju EK. Odonata (Dragonflies and Demselflies) as bio indicators of water quality. IJIRST. 2017; 6:9.

20. Kumar A, Sangal SK. Studies on the taxonomy of larvae of Doon Valley Odonata II. J nat Hist. 1970; 4:306-313.
21. Kumar A. Studies on the life history of Trithemis festiva (Rambur) (Odonata: Libellulidae). Odonatologica. 1972; 1(2):103-111.
22. Kumar A. Description of the last instar larvae of Odonata from the Dehra Dun Valley (India), with notes on Biology: II (Suborder Anisoptera). Oriental Insect. 1973; 7(2):291-331.
23. Kumar A. Studies on the life history of Indian dragonflies, Pantala flavescens (Fab.) (Libellulidae: Odonata). Ann Entomol. 1984; 2(1):43-50.
24. Kumar A. Studies on the life history of Indian dragonflies, Anax immaculifrons (Rambur) (Aeshnidae: Odonata). Entomon. 1984; 9(2):127-133.
25. Leibold MA, Holyoak M, Mouquet N, Amarasekare P, Chase JM, Hoopes MF, Gonzalez A. The Meta community concept: a framework for multi-scale community ecology. Ecol Lett. 2004; 77:601-613.
26. May ML. Thermoregulation in adaptation to temperature in dragonflies (Odonata: Anisoptera). Ecological Monographs. 1976; 46(1):1-32.
27. May ML. Thermal adaptations of dragonflies, revisited. Advances in Odonatology. 1991; 5:71-88.
28. Mccauley SJ, Davis CJ, Relyea RA, Yurewicz KL, Skelly DK, Taniguchi H, *et al*. Effects of habitat complexity on benthic assemblages in a variable environment. Freshwater Biol. 2004; 49(9):1164-1178.
29. Mason CF. Biology of freshwater pollution. Longman Scientific and Technical, 1981, 250.
30. Srivastava VD, Sinha C. Insecta: Odonata. In: State fauna Series 3: Fauna of West Bengal, Part 4, Zoological Survey of India, Calcutta, 1995, 163-224.
31. Staub R, Applinq W, Hofstetter AM, Ham JJ. The effect of industrial waste of mephis and Shelby country on primary plankton producers. Bioscience. 1970; 20:905-912.
32. Subramanin KA, Babu R. Checklist of Odonata (Insecta) of India, 2017. Version 3.0. www.zsi.govt.in
33. Theischinger G. Identification Guide to Australian Odonata, Department of Enviornment, Climate Change and Water NSW, 2009.
34. Thomaz SM, Dibble E, Evangelista LR, Higuti J, Bini LM. Influence of aquatic macrophyte habitat complexity on invertebrate abundance and richness in tropical lagoons. Freshwater Biol. 2008; 53(2):358-367.
35. Thompson DJ. Regulation of damselfly populations: The effects of weed density on larval mortality due to predation. Freshwater Biology. 1987; 17:367-371.
36. Townsend CR, Hildrew AG, Schofield K. Persistence of Stream Invertebrate Communities in Relation to Environmental Variability. J Anim Ecol. 1987; 56(2):597-613.