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# WATER QUALITY AND AQUATIC INSECT FAUNA IN TWO PONDS OF MANSA DISTRICT, PUNJAB

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## ABSTRACT

**Present study evaluates the diversity and abundance of aquatic insects and relate these with the physicochemical parameters of water in the two selected ponds of Mansa district, Punjab. Collections made during December, 2017 to November, 2018 revealed 16 species of aquatic Coleoptera and Hemiptera. Maximum fauna was observed during summer followed by post-monsoon, monsoon and winter seasons. Physicochemical water parameters viz., temperature, pH, free carbon dioxide, dissolved oxygen, nitrate and phosphates were correlated with the diversity attributes.**

**Key words:** Aquatic insects, abundance, diversity, ponds, seasonal variations, water quality, temperature, pH, carbon dioxide, oxygen, nitrate, phosphate



Ponds have high potential among wetland sources with regard to the biodiversity components, productivity and utilization, as comparable to tropical terrestrial rain forests (Ramachandra et al., 2005). There are about 45,000 species of insects known to inhabit diverse freshwater ecosystems (Balaram, 2005). Aquatic insects are frequently employed to measure the aquatic environment, and hence termed as environmental indicators (McGeoch, 1998). Aquatic Coleoptera and Hemiptera act as good indicator of water quality (Balaram, 2005). They are essential component of food webs and regulate functioning of aquatic ecosystem. The water beetles show high diversity in colour, form, size and life patterns (Vazirani, 1977). Study of aquatic Hemiptera indicate that the quality of aquatic environment is partially dependent on aquatic bugs population dynamics (Thirumalai and Raghunathan, 1988; Ramakrishna, 2000). As they are keystone predators, their abundance is essential to the existence of animal communities in an aquatic habitat (Murdoch et al., 1984). Hence, the present study to understand the condition of aquatic insect diversity in relation to physicochemical water parameters.

## MATERIAL AND METHODS

District Mansa is in south Punjab (N 29°32'-30°12', L 75°10'-75°46'). which is at the edge of the Thar desert. The study was carried during winter (Dec-Feb.), summer (Mar-May), monsoon (Jun-Aug.), and post-monsoon (Sept-Nov.) during December 2017 to November 2018 in two selected ponds from Bhikhi and Nagal village in Mansa district which are designated as A and B, respectively. These ponds are permanent and used for drainage of sewage and runoff from the surrounding areas. Collection of aquatic insects was done during morning and evening (7 to 9am and 4 to 6 pm), by enclosing 1 $m^2$ area square-mesh cloth. The bottom stones, gravel and sand were upturned to dislodge the aquatic life. Samples were washed separately with sieved mesh size of 0.5 mm to eliminate the excess debris and sediments. These were sorted, brush-picked and preserved in 5% formaldehyde (APHA, 2012), and identified using relevant literature (Needhamand Needham, 1957; Ward and Whipple, 1991; Pennak, 1978; Thirumalai, 2002; 2004). The water samples were collected in 1 l plastic bottles, and parameters such as water temperature (WT), pH, free carbon dioxide ($FCO_2$) dissolved oxygen (DO), nitrate and phosphate studied. Physicochemical parameters like free carbon dioxide, nitrate and phosphate were estimated (APHA, 2012; Trivedy and Goel, 1984). Dissolved oxygen of water was fixed on the spot and brought to laboratory for further titrations. Water temperature and pH were determined by respective field meters.

## RESULTS AND DISCUSSION

The results revealed 16 species of aquatic Coleoptera and Hemiptera, of which 8 were Coleoptera (Dytiscidae, Hydrophilidae and Noteridae); Dytiscidae include 60%- *Hydroglyphusflammulatus* (Sharp), *H. pradhani* (Vazirani)*, Laccophilussharpi* Regim bartand *Eretes* sp.; Hydrophilidae of 32%- *Sternolophusrupifus* (F.), *Berosus* sp. and *Enohurus* sp.*;* and Noterdiae of 8% -with only *Canthydruspolitus* (Sharp). Dytiscidae includes predaceous beetles and mostly prefer the submerged vegetation in clean freshwater (Maumadar et al., 2013). These dominate over the Hydrophilidae and Noterdiaein species richness. Dytiscids and hydrophilids generally occur in shallow water bodies or banks of rivers and marshes and occupy the zone of emergent vegetation, mats of plant debris or flooded terrestrial vegetation along the shore line (Jach and Margalit, 1987). Noterids are frequent among roots of floating plants (Saleh et al., 1991; Zalat et al., 2000).

Eight species of aquatic Hemiptera were collected belonging to eight families viz*.,* Notonectidae (24%), Belostomatiae (20%), Corixidae (18%), Veliidae (16%), Gerridae (8%), Mesoveliidae (7%), Nepidae (5%), and Pleidae (2%); with each family represented by a lone species each- *Anisopssardea* Herrich-Schaeffer, *Diplonychusmolestus* (Dufour), *Micronecta* spp*.,* *Microveliadouglesi* Scott, *Limnogonusfossarum* (F.), *Mesovelia* sp., *Laccotrephes maculatus* (F.) and *Paraplea* sp.

Seven species of Coleoptera and six species of Hemiptera were present in the pond at Bhikhi (with more macrophytes andorganic matter) and in the pond at Nagalonly four species of Coleoptera and five species of Hemiptera; maximum number were observed during the summer season and minimum during the winter. This fact is attributed to high temperature, as temperature play important role in physicochemical and biological activities (Dwivedi and Pandey, 2002). Large population of zooplankton due to high temperature provides food to insects (Sharma et al., 2010). Number of aquatic insects decreased during winter due to low temperature and less predation due to low metabolic rate (Sundar and Vass, 1988). Hence aquatic insect diversity with hydrophytes related to several factors like anchorage, natural hiding places, breeding sites, to provide more oxygen and food spectrum and to afford suitable spawning niches (Bisht and Das, 1979; Pandit et al., 1985)(Table 1).

The water temperature ranges between 12°C-33°C and 15°C-31°, and low temperature during winter is due to low atmospheric pressure and high during summer season due to increased day length and photoperiod (Sharma, 2002). pH value 8-8.5 or 8.8-9.4; less pH was in the winter season because of the decreased rate of photosynthetic activity reducing the use of carbon dioxide and bicarbonates and leads to increase in pH (Manjare et al., 2010). pH value of pond water was maximum during the monsoon season, due to increased carbonate content in water and absence of free carbon dioxide (Zafar, 1964).

Free carbon dioxide range between 7-10 or 8-12 mg/l, less during winter and maximum during the summer. Decline in free carbon dioxide during winter is due to decline in decomposition activity due to low temperature. During summer high temperature and high metabolic activity result in addition of $CO_2$ (Jindal and Sharma, 2011). Dissolved oxygen ranges between 4.6-9 and 4.3-8.2 mg/l, it was minimum during the summer and maximum during winter. In summer dissolved oxygen was maximum due to high respiratory rate, high temperature and decomposition rate using more DO in water bodies (Rao, 1955). Nitrate content ranges from 0.50- 0.240 and 0.56- 0.278 mg/l, with decline in nitrate during winter due to low temperature, reduced rate of decomposition and active uptake and utilization of nitrates by macrophytes (Lee et al., 1975; Nawange, 1993; Ganai et al., 2010). Maximum nitrates were recorded during monsoon, and it might be due to runoff of water, due to influx of dead decaying organic and faecal matter (Asuquo, 1989). Phosphates range between 0.181-1.160 and 0.270-1.325 mg/l, which is less during winter, due to its utilization by macrophytes and algae (Khan and Siddiqui, 1974). Peak value of phosphates was during summer season, attributed to increased decomposition rate at high temperature; and with increase in nutrient value, evaporation increased and decrease in water level leading to increase the value of biochemical mobilization of phosphates from particulate stores to dissolved phosphates (Stumm and Morgan, 1995). The selected ponds fall under hypereutrophic on the basis of total phosphate content (oligotrophic < 0.005mg/l, mesotrophic 0.005 to 0.01 mg/l, mesoeutriophic 0.01 to 0.03 mg/l, eutrophic 0.03 to 0.1 mg/l, and hypereutrophic > 0.1 mg/l) (Wetzel, 1975).

Thus the results reveal that the physicochemical characteristics of pond ecosystem had important role in trophic dynamics. Pond A (Bhikhi) dominated with high DO, less pH, low $FCO_2$ as compared to the pond B (Nagal). These represent the eutrophication value of water bodies which directly or indirectly affect the distribution of aquatic insects. Species vary in their degree of number and tolerance due to effect of water pollution. Maximum distribution of aquatic Coleoptera and Hemiptera exhibited during the summer and decrease during winter was due to low temperature and metabolic rate. Results show that presence of aquatic

Table1. List of species collected from ponds (Mansa, Punjab, 2017-18)

| | Species | POND A | | POND B | |
|---|---|---|---|---|---|
| | | RA (%) | DS | RA (%) | DS |
| Coleoptera Dytiscidae | | | | | |
| | *Hydroglyphusflammulatus* (Sharp, 1882) | 34.48 | EU | 31.0 | D |
| | *Hydroglyphuspradhani* (Vazirani,1969) | 25.86 | D | 23.25 | D |
| | *Laccophilussharpi* Regimbart, 1889 | 3.66 | SUB | - | |
| | *Eretes* sp. | 4.31 | SUB | - | |
| Hydrophilidae | | | | | |
| | *Sternolophusrupifus* (Fabricius, 1792) | - | - | 7.75 | SUB |
| | *Berosus* sp. | 21.55 | D | 34.8 | EU |
| | *Enochurus* sp. | 2.58 | R | - | - |
| Noteridae | | | | | |
| | *Canthydruspolitus* (Sharp, 1873) | 2.15 | R | - | - |
| Hemiptera Notonectidae | | | | | |
| | *Anisopssardea* Herrich-Schaeffer, 1849 | 30.58 | D | 33.14 | EU |
| Belostomatiae | | | | | |
| | *Diplonychusmolestus* (Dufour, 1863) | 27.52 | D | 27.62 | D |
| Corixidae | | | | | |
| | *Micronecta* sp. | - | - | 3.59 | SUB |
| Veliidae | | | | | |
| | *Microveliadouglesi* Scott, 1874 | 15.29 | D | 22.09 | D |
| Gerridae | | | | | |
| | *Limnogonusfossarum* (Fabricius, 1775) | 2.29 | R | - | - |
| Mesoveliidae | | | | | |
| | *Mesovelia* sp. | - | - | 13.53 | D |
| Nepidae | | | | | |
| | *Laccotrephes maculatus* (Fabricius, 1775) | 7.64 | SUB | - | - |
| Pleidae | | | | | |
| | *Paraplea* sp. | 1.52 | R | - | - |

RA (Relative Abundance), DS (Dominance status), EU (eudominant), D (dominant), SUB (subdominant). SR (Subrecedent), R (Recedent). RA <1 = Subrecedent; 1.1-3.1 = Recedent; 3.2-10% Subdominant; 10.1-31.6 = Dominant and >31.7% = Eudominant (Engelmann, 1973).

macrophytes play important role for the growth of aquatic insect fauna.

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## REFERENCES

APHA. 2012. Standard methods for the examination of water and waste water. 21st Edition. APHA, Washington.

Balaram P. 2005. Insect of tropical streams. Current Science 89: 914 pp.

Bisht R S, Das S M. 1979. Studied on the ecology of aquatic entomofauna of Kumaon lakes. Proceedings. Workshop on high altitude entomology and wild life ecology. Zoological Survey of India, Solan.

Dalal A, Gupta S. 2014. Aquatic insect diversity in two temple ponds of Silchar Assam North-East India and their conservation values. Knowledge and Management of Aquatic Ecosystem 415 (9): 1-14.

Dwivedi B K, Pandey G C. 2002. Physico-chemical factors and algal diversity of two ponds in Faizabad India. Pollution Research 21(3): 361-370.

Engelmann H.D. 1973. Under such angenzur Erfassung Pedozoogener component in difinictenoko system, Forschungober, Staatliche Museum Naturkunde, Gorlitz. Journal of Acta Hydrobiology23: 349-361.

Jach M, Margalit J. 1987. Distribution of dytiscids in springs of the western Dead Sea area (Coleoptera: Dytiscidae). The Coleopterists Bulletin41(4): 327-334.

Ganapati S V. 1956. Hydrobiological investigation of the Hope reservoir and of Tham Baraparni River at Papanasam Tirunalveli Dt. Madras state. Indian Geographical Journal 31:1-2.

Jindal R, Sharma C. 2011. Studies on water quality of Sutlej River around Ludhiana with reference to physico-chemical parameters. Environmental Monitoring and Assessment 174: 417-425.

Lee G F, Bentley E, Amundson R. 1975. Effects of marshes on water quality. Coupling of land and water systems. Hasler AD (ed.). Springer Verlag Berlin Beiddberg, New York.105-126 pp.

Manjare S A, Vhanalakar S A, Muley D V. 2010. Analysis of water quality using physico-chemical parameters in Tamdalge Tank in

Kohlapur district Maharashtra. International Journal of Advanced Biotechnology and Research 1 (2): 115-119.

McGeoch M A. 1998. The selection, testing and application of terrestrial insects as bioindicators. Biological Reviews of the Cambridge Philosophical Society 73: 181-201.

Murdoch W W, Scott M A, Ebsworth P. 1984. Effects of general predators, Notonecta (Hemiptera) upon a fresh water community. Journal of Animal Ecology 53: 791-808.

Nawange S. 1993. Limnological studies on new mean Surwari Reservoir (Sagar district) and old Upper Lake of Bhopal with special reference to macrophytic vegetation. Ph.D. thesis, Barkatullah University, Bhopal.

Needham J G. 1957. A guide to the study of fresh water biology with special reference to aquatic insects and other invertebrate animals and phytoplankton. Comstock Publishing Association, New York.

Pandit A K, Pandit S N, Kaul V. 1985. Ecological relations between invertebrates and submerged macrophytes in two Himalayan Lakes. Pollution Research 4(2): 53-58.

Pennak R W. 1978. Freshwater invertebrates of United States, 2nd Ed. John Wiley and Sons Inc., New York. 803 pp

Ramachandra T V, Ahalya N, Rajashekara Murthy C. 2005. Aquatic Ecosystems: Conservation, Restoration and Management, Capital Publishing Company, New Delhi. 31 pp.

Rao C B. 1955. On the distribution of algae in a group of six small ponds. Journal of Ecology 43: 291-308.

Saleh Ahmed R S. 1991. Study of aquatic insects in Suez Canal region, M.Sc thesis. Zoology Dept. Faculty of Science, Science, Suez Canal University. 255 pp.

Sharma A, Rnga M M, Sharma P C. 2010. Water quality status of historical Gundolav lake at Kishangarh as a primary data for suitable management. South Asian Journal of Tourism and Heritage 3(2): 149-158.

Sharma S P. 2002. Impact of anthropogenic influences on Gharana Wetland Reserve. Ph.D Thesis. University of Jammu, Jammu.

Sundar S, Vass K K. 1988. Seasonal dynamics of benthos in some Kashmir lakes. Proceedings of the National Academy of Science India 58(B): 193-203.

Thirumalai G, Raghunathan M B. 1988. Population fluctuations of three families of aquatic Heteroptera in perennial pond. Records of Zoological Survey of India 85(3): 381-389.

Thirumalai G. 2002. A checklist of Gerromorpha (Hemiptera) from India. Records of Zoological Survey of India100(1-2): 55-97.

Thirumalai G. 2004. A checklist of aquatic and semi- aquatic Hemiptera (Insecta) of Karnataka. Records of Zoological Survey of India 102(1-2): 57-72.

Trivedy R K, Goel P K. 1984. Chemical and biological methods for water pollution studies. Environmental Publications, Karad. 215 pp.

Vazirani T G. 1977. Catalogue of Oriental Dytiscidae. Records of the Zoological Survey of India. Miscellaneous Publications Occasional papers 6, 111 pp.

Zafar A R. 1964. On the ecology of algae in certain fish ponds of Hyderabad-India. Hydrobiologia 23: 179-195.

Zalat S, Saleh R, Angus R, Kaschef A. 2000. Diving beetles (Coleoptera: Dytiscidae and Noteridae) of Egypt. Egyptian Journal of Natural History 2:107 pp.

Ward H B, Whipple G C. 1991. Fresh Water Biology. New York, Wiley. 49 pp.

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