

FAUNISTIC COMPOSITION OF AQUATIC INSECTS OF
EASTERN BIHAR WITH NOTES ON THEIR SOME
ASPECTS OF ECOLOGY

By

S. P. ROY, H. S. PATHAK AND V. KUMAR
*Post-Graduate Department of Zoology,
Bhagalpur University, Bhagalpur-812007.*

INTRODUCTION

In the present studies about 71 species of aquatic insects belonging to orders Coleoptera, Hemiptera, Diptera, Odonata and Ephemeroptera have been encountered and enlisted from various freshwater bodies of eastern Bihar. In Coleoptera, the families Dytiscidae and Hydrophilidae and in Hemiptera, the families Corixidae, Nepidae, Notonectidae and Belostomatidae were found to be dominant by their adults and larvae/nymphs. In Diptera members of the family Chironomidae and in Ephemeroptera the members of the family Baetidae were found to be dominant in such aquatic systems. In Odonata the members belonging to families Gomphidae, Libellulidae, Cordulegastridae and Coenagriidae have been recorded. The abundance of these insects in the aquatic environment has been found to be correlated with the seasonal growth of floating and submerged vegetations.

Insects are the earth's most varied organisms and play an important role in biological or ecological regulation of the environment. About 50.8 per cent of the species of living beings and 72 percent of all animals are insects (Daly *et al.*, 1978). About 3% of the total insects or about 25,000 to 30,000 species of insects are aquatic or semiaquatic (Cheng, 1976). Of these only a fraction, perhaps several hundred species are marine or intertidal. These insects live in or on the surface of the still or running waters and are more or less specially adapted to the peculiarities of this mode of life. They are derived from the terrestrial insects and there is no demarcation line between terrestrial and aquatic insects. These insects are generally the most conspicuous forms of life in aquatic systems which in view of their extremely varied habits, wide distribution and countless adaptation, have occupied a dominant position in the freshwater communities.

The aquatic insects are taxonomically diverse and fascinating in structure and biology, and some of them such as mosquitoes and midges, are of great importance to public health. These insects constitute an integral part of the freshwater communities. They also

form natural fish foods in nurseries and rearing fish ponds. Certain aquatic insects are however, predators and parasitoids on fish fry populations and compete directly with them for food. The structural and functional analysis of the aquatic insect community will be helpful in the detection of pollution of inland waters and therefore, considered promising organisms for use in pollution monitoring because of their ease of collection and large number of species (Hilsenhoff, 1977). Their eggs and early larval stages are particularly sensitive to water quality (Roy and Sharma, 1983). These insects are also of concern to those involved in outdoor recreational activities since certain of its members are frequently pests of man and animals in water-based recreational environments. Thus, amongst the various components of freshwater ecosystem, the subsystem comprising aquatic insects play an important role in energy flow, detection and prevention of pollution, control of aquatic weeds and regulation of aquatic environment.

Since the publication of fauna of British India, Odonata (Vol. 1-3) by Fraser (1933, 1936) and Rhynchota (Vol. 3-5) by Distant (1906, 1910), a number of important treatises on Odonata and Rhynchota-Heteroptera have appeared. The taxonomy of larval odonates from Dehradun Valley has been studied in recent years by Kumar (1973a, b). Coleoptera as a whole has been received much attention from early taxonomists, morphologists and fishery biologists (Sharp, 1890 ; Wilson, 1923-24 and Balfour-Browne, 1950). However, field observations on this interesting group are few. Tonapi (1959) and Tonapi and Ozarkar (1969) have studied the taxonomy of Heteroptera and Coleoptera of Poona (Maharashtra). Vazirani (1967) in his series of papers has studied certain aspects of taxonomy of aquatic beetles specially of family Dytiscidae. The beetles of the families Dytiscidae, Haliplidae and Amphizoidae of the Indian Region has been intensively investigated in a series of papers (Guignot, 1954a, b). The Asian Hydrophilidae, Gyrinidae and beetles belonging to various other aquatic and semi-aquatic families and very poorly known. Alfred (1973) has studied the taxonomy of family Chironomidae at Madurai (South India).

Practically no information is available regarding the aquatic insect fauna and their systematic position inhabiting the freshwaters of this north-eastern region of India. In the present studies an attempt has been made to enumerate the aquatic insects inhabiting the freshwaters of eastern Bihar.

MATERIALS AND METHODS

The aquatic insects were collected from the lentic (ponds) as well lotic (Ganges) systems covering areas from Barauni to Farakka from

littoral, limnetic and benthic zones of these water bodies. These insects were collected at fortnightly intervals by an insect collecting net made of nylon cloth (mesh size 40 to 80/cm²). The D-frame aquatic net is made according to Merritt and Cummins (1978) and the samples were taken by the method used by Allan (1975). The samples were brought to the laboratory and preserved in 70% alcohol after sorting. Identification of insects were made in the laboratory and it is further confirmed by sending the specimens to the Zoological Survey of India, Calcutta. After identification the number of species in each hauling were counted and their relative abundance was determined. If more than fifty specimens were recorded during five haulings, the species were considered to be abundant, if twentyfive specimens were recorded, the species has been regarded as common and if only a specimen or two were collected at a time of hauling and it was not found again than it has been regarded as rare. All the collected specimens has been deposited in the museum of Post-Graduate Department of Zoology, Bhagalpur University, Bhagalpur-812007.

RESULTS AND DISCUSSION

The aquatic insect fauna surveyed during the present study belong to five orders. They are : (i) Coleoptera, (ii) Hemiptera, (iii) Diptera, (iv) Odonata, and (v) Ephemeroptera. In case of Coleoptera both larvae/nymphs and adults were present in the samples whereas in the case of Diptera, Odonata and Ephemeroptera only larvae/nymphs were collected and adults being the aerial or amphibious in habit. The relative abundances and faunal composition of these insects are shown in the Table I.

TABLE—I

Genera/Species	Relative Abundance		
	Abundant	Common	Rare
1	2	3	4
A. Order—Coleoptera			
Family—Dytiscidae			
<i>Cybister confusus</i> Sharp	—	—	+
<i>Cybister regulosus</i> Redt.	—	—	+
<i>Cybister limbatus</i> Fabr.	—	—	+
<i>Cybister tripunctatus asiaticus</i> Sharp	—	—	+
<i>Laccophilus chinensis inefficiens</i> Boh.	—	—	+
<i>L. parvulus</i> Aube	+	—	—
<i>L. anticatus</i> Sharp	+	—	—
<i>Hyphoporous</i> sp.	—	—	+

TABLE—I (Continued)

1	2	3	4
<i>Hyphydrus indicus</i> Sharp	—	—	+
<i>Hydrocoptus subvittatus</i> Mot	—	+	—
<i>Canthydrus laetabilis</i> Walk	+	—	—
<i>Canthydrus</i> sp.	+	—	—
<i>Eretes sticticus</i> L.	—	+	—
<i>Sandracottus festivus</i> Illinger	—	—	+
<i>Guignotus pradhani</i> Vazirani	—	+	—
<i>Hydaticus vittatus</i>	—	+	—
Family—Hydrophilidae			
<i>Sternolophus rufipes</i> Fabr.	+	—	—
<i>Amphiops</i> sp.	+	—	—
<i>Helochaeres anchoralis</i> Sharp.	—	+	—
<i>Berosus pulchellus</i> M'Leay	—	+	—
<i>B. indicus</i> Mots	—	+	—
<i>Regimbartia attenuata</i> Fabr.	+	—	—
<i>Hydrophilus olivaceous</i> Fabr.	+	—	—
<i>H. indicus</i> Bedel.	+	—	—
<i>Enochrus</i> sp.	—	+	—
<i>Hydraena</i> sp.	—	+	—
<i>Laccobius</i> sp.	—	—	+
Family—Gyrinidae			
<i>Orectocheilus gangeticus</i> Wied.	+	—	—
<i>Dineutes spinosus</i> Fabr.	—	+	—
Family—Haliplidae			
<i>Haliplus pulchellus</i> Fabr.	+	—	—
<i>Haliplus</i>	—	+	—
B. Order—Hemiptera			
Family—Corixidae			
<i>Corixa hieroglyphica</i> Duf	—	+	—
<i>C. promontoria</i> Dist.	+	—	—
<i>Micronecta merope</i> Dist.	+	—	—
<i>M. proba</i> Dist.	—	+	—
<i>M. scutellaris</i> Stal.	+	—	—
<i>M. striata</i> Dist.	—	+	—
Family—Notonectidae			
<i>Anisops sardea</i> Herr-Schaff	+	—	—
<i>A. breddini</i> Kirk.	—	+	—
<i>Enithares</i> sp.	—	—	+
Family—Pleidae			
<i>Plea frontalis</i> Fieb.	+	—	—
<i>P.</i> sp.	+	—	—
Family—Gerridae			
<i>Gerris fossarum</i> Fabr.	+	—	—
<i>G. spinole</i> Leth. et. Sevn.	+	—	—

TABLE—I (Concluded)

1	2	3	4
Family—Mesovellidae			
<i>Mesovelia</i> sp.	—	—	+
Family—Hydrometridae			
<i>Hydrometra vittata</i> Stal	—	+	—
Family—Nepidae			
<i>Ranatra fliformis</i> Fabr.	+	—	—
<i>R. elongata</i> Fabr.	+	—	—
<i>Laccotrephes griseus</i> Guer.	+	—	—
<i>L. ruber</i> Linn.	—	+	—
Family—Belostomatidae			
<i>Diplonychnus annulatum</i> Fabr.	+	—	—
<i>Sphaerodema rusticum</i> Fabr.	—	+	—
<i>Belostoma indicum</i> Lep. et. Serv.	—	—	+
C. Order—Odonata			
Suborder—Anisoptera			
Family—Gomphidae			
<i>Mesogomphus lineatus</i> Selys	+	—	—
Family—Libellulidae			
<i>Potomarcha obscura</i> Rambur	+	—	—
<i>Zyxomma petiolatum</i> Rambur	—	+	—
Family—Cordulegasteridae			
<i>Cordulegaeter</i> sp.	—	+	—
Suborder—Zygoptera			
Family—Coenagriidae			
<i>Ischnura delicata</i> Hagen	+	—	—
<i>I. senegalensis</i> Rambur	+	—	—
<i>Rhodischnura nursei</i> Morton	—	+	—
<i>Agrioonemis</i> sp.	—	—	+
D. Order—Diptera			
Family—Chironomidae			
<i>Chironomus</i> sp.	+	—	—
<i>Monopelopia</i> sp.	+	—	—
<i>Conchapelopia</i> sp.	—	+	—
<i>Clinotanypus</i> sp.	+	—	—
Family—Culicidae			
<i>Anopheles</i> sp.	+	—	—
<i>Culex</i> sp.	+	—	—
E. Order—Ephemeroptera			
Family—Baetidae			
<i>Baetis</i> sp.	+	—	—
<i>Cloeon</i> sp.	+	—	—
<i>Ephemerella</i> sp.	+	—	—

Thus, in the present survey 31 species of Coleoptera, 23 species of Hemiptera, 8 species of Odonata, 6 species of Diptera and 3 species of Ephemeroptera have been recorded. It appears from this study that aquatic insect fauna are well represented by their larvae/nymphs and adults in various water bodies. It was found that appreciable seasonal faunal composition of aquatic insects have been correlated with the appearance and disappearance of macro-vegetations of these water bodies. The emergent portions of the plants afford shelter to the adult stages of insects. The floating vegetation constitutes a biotope with so many ecological niches that almost all the aquatic insect groups are represented in this vegetation type, which may be considered the most species-rich biotope of the fresh-water ecosystems. The submerged, above ground parts of plants forms the habitat for sedentary insects. Macrophytes are also frequently colonized by mining (*Chironomus* larvae) and are periodically used by various free-swimming species of insects (Pieczynska and Ozimek, 1976).

In the present survey it was noticed that in big rivers like Ganges, and other factors like wave action, wind velocity and scarcity of macro-vegetations probably discourage the colonization of aquatic insects in such water bodies. In water bodies having abundance of macrophytic vegetations such as *Eichhornia crassipes* ; *Potamogeton crispus* ; *Hydrilla verticillata* ; *Ceratophyllum demersum* and *Vallisnaria* sp. etc. provide necessary shelter, shade and suitable substrate for the colonization of these aquatic insects. Thus, plants form an important element of the aquatic environment manufacturing and providing food and shelter for these insects. A diverse flora is responsible for the establishment of stable insect communities. A complex flora allows for a greater diversity of faunal components and more complex food webs (Boyd, 1971).

In Coleoptera the members of the family Hydrophilidae are poor swimmers, consequently they live on vegetations of very shallow waters. The members of the family Dytiscidae, however, are efficient swimmers and are found in deep waters also. The gyrids actively found swimming on open water surface column. They actively whirl and gyrate on the surface of the water, therefore, they are also called as "whirligig and waltzing beetles" and also "scuttle bug". The haliplids are commonly called as the "crawling beetles" and are fairly good swimmers. The aquatic and semi-aquatic Hemiptera in general, are predators at intermediate stages in the food-chains of the ecosystem. The corixids are found on the bottom of the water bodies and are responsible for the conversion of the decomposed plant materials into

animal food, thus, helpful in the prevention of pollution of inland waters. The corixids and hydrophilids are all detritivores and scavengers feeding on detritus and decomposed organic matters and are responsible for the natural filter of the aquatic environment. The nymphal odonates are predaceous and spend their entire nymphal period in the inland waters. These insects are carnivorous, feeding on various zooplankton, aquatic insects, fish-fry and fingerlings and are secondary and tertiary consumers (Roy, 1980). Aquatic Diptera specially of chironomids form high proportion of zoobenthos and are very important link in energy transfer in aquatic ecosystems. Their significance as an important component of fish food is widely known. They also take part in organic matter degradation. Mayfly nymphs are often called as "cattle" or "rabbit" of the aquatic environment as they are subsisting on algae and other plant materials for food (Roy and Sharma, 1982). In the littoral fauna mayfly nymphs and chironomid larvae serve as primary converters of plant materials into animal protoplasm. Thus, such basic herbivores serve as the "key industries" in the ecosystem because they are smaller in size but large in numbers and are responsible for the transfer of energy to higher food-chain (Roy and Sharma, 1983).

Thus, the aquatic insects are the dominant members of the littoral as well as benthic fauna of the freshwater ecosystems. The benthic insects are considered promising organisms for use in "biological indicator" of pollution, because of their ease of collection, large number of species and sensitivity to water quality. The structural and functional analysis of these insect community will be helpful in the detection of pollution of inland waters and therefore, they can be helpful in the monitoring of the system.

SUMMARY

Thus, aquatic insects do not comprise a systematic group but are scattered through a large number of orders. These insects are species that are more or less closely associated with water at least for any one phase of their life cycle. They fall into two major groups: (i) Insects having aquatic larval and pupal stages and (ii) those spending their entire life cycle in or near the free water areas. The former group includes the Ephemeroptera, Odonata and Diptera. The second group includes aquatic Hemiptera and Coleoptera, whose entire life cycle is passed in water. Their seasonality and periodicity depend upon the seasonal appearance and disappearance of macro-vegetations

of the aquatic systems. These insects have undergone certain morpho-anatomical, behavioural and phenological adaptations for aquatic mode of life.

ACKNOWLEDGEMENTS

The authors are grateful to Professor J. S. Datta Munshi F.N.A., F.N.A.Sc., for his valuable guidance and helpful suggestions. We are thankful to the Director, Zoological Survey of India, Calcutta for identification of the aquatic insects. This work was financed by CSIR, New Delhi, Research Scheme No. 38 (422) 181-EMR-II.

REFERENCES

- ALFRED, J. R. B. (1973). A guide to the study of freshwater organisms (Diptera : Tendipedidae-Chironomidae). *J. Madurai Univ. Supplement* 1, March, pp. 1-185.
- ALLAN, J. D. (1975). The distributional ecology and diversity of benthic insects in Cement Creek, Colorado. *Ecology*, 56 (5) : 1040-1053.
- BALFOUR-BROWNE, F. (1950). British water beetle. Vol. II. *Royal Society London*. I-II : 1-394.
- BOYD, C. E. (1971). The limnological role of aquatic macrophytes and their relationship to reservoir management. *Reser. Fish. Limn. Spl. Puc.* No. 8, pp. 155-166.
- CHENG, LANNA (ed.) (1976). Insects in marine environment. *Marine Insects. North-Holland Publishing Co., Amsterdam*. pp. 1-581.
- DALY, H. V. DOYEN, J. T. AND EHRLICH, P. R. (1976). An Introduction to insect Biology and Diversity. *McGraw Hill Book Co.* New York, pp. 1-564.
- DISTANT, W. L. (1906). The fauna of British India. Vol. IV. Rhynchota-Heteroptera, London, *Taylor and Francis Ltd.*
- DISTANT, W. L. (1910). The fauna of British India. Vol. V. Heteroptera, London, *Taylor and Francis Ltd.*
- FRASER, F. C. (1933). The fauna of British India. Odonata I. London, *Taylor and Francis Ltd.*
- FRASER, F. C. (1936). Fauna of British India. Odonata 3. London. *Taylor and Francis Ltd.*
- GUIGNOT, F. (1954a). Dytiscidae recoltés par la yale North Indian Expedition en Kashmir et en Penjab. *Upusc. ent. Lund*, 19 : 221-224.

- GUIGNOT, F. (1954b). Entomological results from the expedition to Burma and British India. Coleoptera : Haliplidae et Dytiscidae recuilles par Rena Malaise. *Ark. Zool.* **6** : 563-567.
- HILSENHOFF, W. L. (1977). Use of Arthropods to Evaluate water Quality of Streams. *Tech Bull. No. 100. Dept. Nat. Res. Madison, Wisconsin*, pp. 1-15.
- KUMAR, A. (1973). Descriptions of the last instar larvae of Odonata from the Dehradun Valley (India), with notes on biology. 1. (Suborder Zygoptera), *Oriental Insects*, **7** (1) : 83-118.
- KUMAR, A. (1973b). Descriptions of the last instar larvae of Odonata from the Dehradun Valley (India), with notes on biology. II. Suborder—Anisoptera. *Oriental Insects*, **7** (2) : 291-331.
- MERRITT, R. W. AND CUMMINS, K. W. (1978). An Introduction to the aquatic insects of North America. *Kendall/Hunt Publishing Co. Iowa*, pp. 1-427.
- PIECZYNSKA, E. AND OZIMEK, T. (1976). Ecological significance of Lake macrophytes. *Int. J. Environ. Sci.* 115-128.
- ROY, S. P. (1980). Studies on some aspects of ecology of the aquatic insects of Bhagalpur. Ph. D. thesis, *Bhagalpur Univ.* pp. 1-156.
- ROY, S. P. AND SHARMA, U. P. (1982). Studies on the food and feeding biology of mayfly nymphs (Insecta : Ephemeroptera) and their role in aquatic ecosystem. *Entomon.* **7** (2) ; 145-150.
- ROY, S. P. AND SHARMA, U. P. (1983) Studies on the role of insects in freshwater ecosystem. *Proc. Symp. Ins. Ecol. & Resource Manage.*, Muzaffarnagar, pp. 18 -191.
- TONAPI, G. T. AND OZARKAR, V. A. (1969). A study of aquatic Coleoptera of Poona (Maharashtra). *J. Bombay Nat. Hist. Soc.* **66** (2) : 310-316 and **66** (3) : 107-112.
- TONAPI, G. T. (1959). Studies on the aquatic insect fauna of Poona (Aquatic Heteroptera). *Proc. Nat. Int. Sci. India*, **25** : 321-332.
- SHARP, D. (1890). On some aquatic Coleoptera from Ceylon. *Sci. Trans. Ent. Soc. London.* **10** : 339-348.
- VAZIRANI, T. G. (1967). Contributions to the study of aquatic beetles (Coleoptera). A collection of Dytiscidae from Western ghat with description of new species. *Oriental Insects.* **1** (1 and 2) : 99-112.
- WILSON, C. B. (1923-24). Water beetles in relation to pond fish culture with the life histories of those found in fish ponds at Fairport, Iowa. *From Bulletin of Bureau of Fisheries.* **39** : 221-345.