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PRELIMINARY OBSERVATIONS ON THE TAXO-ECOLOGY OF AQUATIC HEMIPTERA AND COLEOPTERA (INSECTA) OF HIGH ALTITUDE KUMAON LAKES, INDIA WITH NEW RECORDS.

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INTRODUCTION

A great deal of taxonomical, biological and ecological work has been done on aquatic Hemiptera and Coleoptera in various parts of the world. The landmark contributions from abroad are by Hungerford (1948), Balfour Browne (1940, 1950), Clegg (1952), Mellanby (1963), Usinger (1968) and Hart and Fuller (1974).

Available literature on taxo-ecological aspects of aquatic Hemiptera and Coleoptera of the plains of India are mainly by Distant (1903, 1906, 1910), Annandale (1919), d 'Orchymont (1928), Ochs (1925, 1933), Hora (1927), Pruthi (1929), Hutchinson (1940), Hafiz and Mathai (1938), Hafiz and Pradhan (1947), Tonapi (1959), Tonapi and Ozarkar (1959), Julka (1977) and Vazirani (1977).

The Kumaon lakes are situated in lesser Himalayas, characterised by lower temperatures of water and air, lower atmospheric pressure and higher degree of rainfall, as compared to the plains of India. This has brought about considerable changes in aquatic entomofauna of this region.

Unfortunately our knowledge of aquatic Hemiptera and Coleopa of high altitude Kumaon lakes (1320-1938 m asl) is restricted only to a few taxonomic fragmentary records/ reports and is confined in the literature of Distant (1910), d'Orchymont (1928), Hafiz and Ribeiro (1939), Singh and Gupta (1956), Vazirani (1968, 1970). Recent literature on some aquatic Hemiptera and Coleoptera of Kumaon are dealt with in the taxo-ecological papers of Bisht (1979), Das and Bisht (1979), Bisht and Das (1979a, 1979b, 1979c, 1979d, 1979e, 1980a, 1980b, 1981).

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Lake Surveyed and Method of Collection

Five Kumaon lakes, Nainital, Bhimtal, Naukuchiatal, Sattal and Khurpatal were surveyed for aquatic Hemiptera and Coleoptera. The collections in the littoral region of the lakes were made with the help of a three metre wooden pole hand net of conventional design (30 cm in diameter), using organdie cloth of about 40 mesh. A container having a capacity of one litre was held in position at the end of the net for collection. Standard net sweeps of about 5 meters (to and fro) were made fortnightly by the net in five fixed stations in each lake. For surface dwelling, macrophytic and substratal insects the pole net was operated separately in respective supporting areas. During the sweeps the speed was kept reasonably constant. In case of saxicoline insect collections, the stones at the substratum were agitated with the help of net. In the laboratory the samples were thoroughly washed for qualitative studies.

For quantitative studies of insects yearly average value (in numbers) for each insect, in each lake was calculated. The general abundance of each insect species was then determined as abundant, common, few, rare and absent.

The collected insects were fixed and preserved in 70% alcohol. Majority of insects have been confirmed by the Commonwealth Institute of Entomology, London ; while a minor portion of the identifications have been confirmed by the authorities of Zoological Survey of India, Calcutta and Z. S. I. Jodhpur.

Results and Discussion

The list of aquatic Hemiptera and Coleoptera of Kumaon lakes, with their frequency of abundance is given in Table 1. A total of 70 species of aquatic Hemiptera and Coleoptera were collected from Kumaon lakes. 51 species marked with asterisk were new records over the past literature by Distant (1910), S. W. Kemp (1911, collection deposited in Z. S. I., Calcutta), Hafiz and Ribeiro (1939), Singh and Gupta (1956), Vazirani (1968, 1970). Out of these, four species of aquatic Coleoptera *viz.*, *Byrrhinus hirsutulus* Champion (Limnechidae) *Grouvellinus duplaris* Champion (Elmidae), *Cyllodes* sp. (Nitidulidae) and *Apion credulm* Fst. (Apionidae) observed to be the first records from the entire Indian region.

Qualitative studies on aquatic bugs and beetles of Kumaon lakes (Table 1) during the years 1977-1980 has revealed that eutrophication and pollution (as in lake Nainital) adversely affect the distribution of

TABLE 1 : Check-list of aquatic Hemiptera and Coleoptera and their relative abundance

HEMIPTERA	Locality and abundance				
Insect	NT	BT	NAT	ST	KT
	1	2	3	4	5
HEMIPTERA					
1. CORIXIDAE					
(1) *Micronecta merope* Dist*	—	++++	++++	++++	—
(2) *M. wui* Lundblad*	+++	+++	++	—	+++
(3) *M. siva* Krik*.	+	++	+	+	+
(4) *M. fulva* Paiva*	—	+++	+++	+++	—
(5) *Corixa hieroglyphica* Duf.*	++	+++	++	++	+
(6) *C. Kempi* Hutchinson*	+	++	—	—	+
(7) *Corixa* sp.	+	+	+	—	—
2. NOTONECTIDAE					
(8) *Anisops batillifrons* Lundblad*	++	+++	+++	+++	—
(9) *A. sardea* Herrich-Shaffer*	++	+++	++	++	++
3. PLEIDAE					
(10) *Plea pelopea* Dist.	+	+++	+++	+++	+
(11) *Plea* sp.	—	+	++	++	—
4. NEPIDAE					
(12) *Laccotrephes griseus* (Guer)*	+	+++	+++	++	+
(13) *L. ruber* Linn.	—	+++	+++	++	++
(14) *Laccotrephes* sp.	—	+	++	+	—
(15) *Ranatra filiformis* Fabr.	+	+++	+++	++	+
(16) *R. varipes* Stal.*	+	+++	+++	++	—
(17) *R. elongata* Fabr.*	—	+	+	+	—
5. NAUCORIDAE					
(18) *Heleocoris vicinus* Montand*	—	++++	++++	+++	—
6. GERRIDAE					
(19) *Gerris spinolae* Leth & Sever	—	++++	+++	+++	—
(20) *Gerris nepalensis* Dist.	+	+	+	+	++
(21) *Metrocoris strangulator* Bredd*	—	+++	+++	+++	—
(22) *Chimarrhometra orientalis* (Distant)*	+	++	++	++	+++
7. VELIIDAE					
(23) *Microvelia* sp.	—	++	+++	++	+
8. BELOSTOMATIDAE					
(24) *Lithocerus indicum* (Lep. & Serv.)*	—	+	+	+	—

HEMIPTERA	Locality and abundance				
Insect	NT	BT	NAT	ST	KT
	1	2	3	4	5
COLEOPTERA					
1. DYTISCIDAE					
(1) *Laccophilus inefficiens* Walk.	—	++	++	++	++
(2) *Hyphydrus renardi* Severin	—	++	+++	++	—
(3) *Hyphoporus aper* Sharp.*	++++	+	—	—	+
(4) *H. elevatus* Sharp*	—	++	+	—	—
(5) *Rhantus taprobenicus* Sharp*	++	+++	+	+	++
(6) *R. punjabensis* Vazirani*	++	+++	++	+	—
(7) *R. sexualis* Reg.*	+	+	—	—	—
(8) *Agabus nitidus* (Fabr.)*	++	+	—	—	++
(9) *A. sinuaticollis* Reg.*	+	++++	+++	++	+
(10) *Eretes sticticus* (Linn.)	+	—	—	—	—
(11) *Hydaticus vittatus* (Fabr.)	+	++	++	+++	+
(12) *Uvarus genitilis* (Sharp)*	++	+++	+++	++	+++
(13) *Potamonectes balli* Vazirani*	+	++	—	—	—
(14) *P. manii* Vazirani	—	+	+	—	++
(15) *Potamonectes* sp.	+	—	—	—	—
(16) *Platynectes kashmiransis* Balfour Browne	+	++	+++	+++	+
(17) *Cybister limbatus* Fabr.*	—	+	+	++	—
(18) *C. tripunctatus asiaticus* Sharp.	+	++	+	+	+
(19) *C. convexus* Sharp*	—	+	++	+	—
2. HALIPLIDAE					
(20) *Haliplus kupuri* Vazirani*	—	++	++	++	+
(21) *H. manipurensis* Vazirani*	—	++	+	++	—
3. GYRINIDAE					
(22) *Orectochilus* sp. (Patrus)*	—	+	—	—	+
(23) *Dinutes unidentatus* Aube*	+	++	++	+++	++
4. HYDROPHILIDAE					
(24) *Coelostoma stultum* (Walk.)*	—	++	+	++	+
(25) *Pachysternum nigrovittatus* Motschulsky*	—	+	+	+	—
(26) *Sphaeridium quinquemaculatum* Fabr.*	—	+	++	—	—
(27) *Laccobius simullans* d'Orchymont	+	++	+++	+++	++
(28) *Helochares crenatus* Reg.*	++	++++	+++	+++	++
(29) *Enochrus vulgatus* Regimbart*	+	++	+++	++	—
(30) *Paracymus vulgatus* Wooldridge*	+	+++	+++	+	++

HEMIPTERA Insect		Locality and abundance NT 1	BT 2	NAT 3	ST 4	KT 5
(31) *Paracymus* sp.	++	++++	+++	+++		++
(32) *Hydrocassis regosus* Knisch*	+	+	+	—		—
(33) *Berosus pulchellus* Macleay*	—	+	+	+		—
(34) *B. nigriceps* F.*	+	+	—	+		—
(35) *B. indicus* Motschulsky*	+	++	+	—		—
(36) *Regimbartia attenuata* Fabr.*	+	+	++	++		+
(37) *Sternolophus rufipes* Fabr.*	—	++++	+++	+++		—
(38) *Hydrophilus cashmirensis* Redtenbacher*	—	+	+	+		—
(39) *H. senegalensis* Percheron*	—	++	+	+		—
5. HYDRAENIDAE						
(40) *Hydraena fontana* d'Orchymont*	—	+	+	+		—
(41) *Ochthebius* sp.	—	+	+	—		—
6. LIMNECHIDAE						
(42) *Byrrhinus hirsutulus* Champion*	—	+	—	—		—
7. CURCULIONIDAE						
(43) *Bagous* sp.*	—	+++	++	++		+
8. ELMIDAE						
(44) *Grouvellinus duplaris* Champ.*	—	++	+	—		+
9. NITIDULIDAE						
(45) *Cyllodes* sp.*	—	+	—	—		—
10. APIONIDAE						
(46) *Apion credulum* Fst.*	—	+	—	—		—

NT=Nainital ; BT=Bhimtal ; NaT=Naucuchiatal ; ST=Sattal ; KT=Khurpatal
++++=abundant ; +++=common ; ++=few ; +=rare ; —=Absent

entomofauna ; since there are a large number of species which are completely absent in polluted lake Nainital but present in oligotrophic lakes of Kumaon (Table 1). Bisht and Das (1080b) have shown that the quality of water (polluted and unpolluted), quality and quantity of aquatic vegetation, nature of lake bottom, play an important role in determining the qualitative and quantitative distribution of insect communities. Thus there is a marked fall in the number of families, genera and species and their relative abundance as well. On the contrary the oligotrophic waters (Bhimtal, Naukuchiatal, Sattal) show comparatively more diversification of species and thereby more number

of families, genera and species and the abundance of aquatic bugs and beetles (except the biological indicators of pollution (Bisht and Das, 1980b) in these lakes. The present observations support the statement of Tonapi and Khole (1975) that there may be a total disappearance of several beneficial freshwater organisms by pollution contaminants.

One of the most important ecological factors that appears responsible for the differences in habitat and abundance of aquatic bugs and beetles between Kumaon lakes and the Indian plains waters is mainly the altitudinal difference between the two regions, with concommittant differences in climate, temperature of water and air, moisture, food and reproductive seasons. Contrary to the altitudinal difference between extreme high altitude (at or above timber line) and the plains of India, the Kumaon lakes may be considered to be intermediate in altitude. When compared to the alpine zone waters, the Kumaon lakes in general contain incursion of entomofauna from the plains as well as from the alpine zone, which has resulted in an appreciable number of species of aquatic Hemiptera (24 species) and Coleoptera (46 species). But so far as their numerical abundance is concerned most of the genera and species are either common, few or rare ; while only a few occur in abundant numbers. However at extreme high altitudes in North-West Himalaya (about 3,600 m), only a single species of Gerridae (Hemiptera) and eight species of Coleoptera have been recorded (Mani and Singh, 1961). According to these authors aquatic communities inhabiting lakes and ponds and streams etc. of biotic province above timber line, are comparatively smaller in size and in distribution, and are characterised by general absence of surface haunting species of higher orders like Heteroptera and Coleoptera.

Moreover, comparing the species composition of aquatic Hemiptera and Coleoptera of high altitude Kumaon lakes and the plains of India, it appears that there are far more diversified families, genera and species in the plains waters. Tonapi (1959) recorded 11 families, including 41 species of aquatic Hemiptera from Indian plains in Poona when compared to only 8 families and 24 species in the present investigation in Kumaon lakes.

Observations on the qualitative estimations of aquatic bugs and beetles of Kumaon lakes have revealed that many of the families genera and species are completely absent in eutrophic and polluted lake Nainital, but are present in most of the oligotrophic Kumaon lakes. Thus the oligotrophic Bhimtalfamilies are : Naucoridae, Vellidae, Belostomatidae (Hemiptera) ; Haliplidae, Hydraenidae, Limnechidae, Curculionidae,

Elmidae, Nitidulidae and Apionidae (Coleoptera). Their complete absence in lake Nainital appears to be mainly due to pollution and eutrophication of the lake, as evidenced by the physico-chemical characters of its water (Das and Bisht, 1979) followed by higher altitude, as secondary ecological factors.

It may be concluded that the distribution of aquatic bugs and beetles is not only affected by the physico-chemical features of water but also due to the altitudinal differences of a water body.

SUMMARY

1. The present work incorporates the results of investigations on the qualitative and quantitative studies of aquatic Hemiptera and Coleoptera in five high altitude (1220-1938 masl) Kuamon lakes.

2. A list containing 70 species, of which 24 species belonging to Hemiptera and 46 to Coleoptera are given in the paper. 51 species of have been found to be new records from this region ; of these four species of Coleoptera are being recorded for the first time from entire Indian region.

3. A comparision of species of aquatic Hemiptera and Coleoptera collected, has been dealt with reference to the extreme high altitudes (3600 masl) and the plains of India. It has been shown that there is a marked fall in number of these insect families genera and species with the increase of altitude.

4. Certain other ecological factors such as eutrophication and pollution ; tuxture of lake substratum (Bisht and Das, 1980b) ; and the physico-chemical features of water (Das and Bisht, 1979) has been shown to effect the distribution and the relative abundance of aquatic bugs and beetles in coldwater Kumaon lakes.

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