Rec. zool. Surv. India, **91** (3-4) : 361-366, 1992

SURVEY OF SEASONALLY ICE-COVERED SURAJ TAL LAKE IN NORTHWEST HIMALAYA

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INTRODUCTION

The only information available on the seasonally snow covered high altitude lakes above 4,000 m. is that of Thomson (1852), Hutchinson (1933, 1937), Loffler (1969), James and Hubbick (1969), Singh and Sharma (1985) and Kumar *et al.* (1989). High altitude lakes have simple trophic structure and harbour few species predominated by arthropods. The present paper on Suraj Tal Lake gives a preliminary account of limnological and biological features on the high altitude lake of the Great Himalayan Range of which nothing is known.

AREA INVESTIGATED

Suraj Tal Lake is situated at an altitude of 4,800 m. AMSL (Lati : 32°45 'N ; Longi : 77°25 'E) on the Great Himalayan Range in the Lahaul-spiti valley of Himachal-pradesh. The lake (Fig. 1) is larger than the lakes present in the pir-panjal Range of

Table 1. Morphometric features of Suraj Tal Lake

Parameters	Values
Surface area (ha)	2.76
Max. lenght (Km)	0.29
Max. breath (Km)	0.14
Mean breath (Km)	96.80
Max. depth (m)	14.00
Mean depth (m)	4.50
Relative depth (%)	7.4
Volume (m^3)	125×10^3
Volume development*	0.97

*No unit, since a ratio.

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Northwest Himalaya, particularly in the Kullu valley and remains covered by snow and ice for about 9-10 months in a year. It is located slightly above the permanent snow-line and fed by melt water from the winter snow beds and glaciers all around the region. The shore is formed by stones and boulders. The southern shore of the lake is deterred with debris of frequent avalanches from the Great Himalayan Range, with snow-caped peaks arising over 20,000 ft. AMSL. The debris often causes the extension of littoral zone on the southern shore. The narrow western end of the lake is marked by a undergrground out-let through which the water drains into river Bhaga. The morphometry of the lake is given in Table 1.

Material and Methods

The Suraj Tal Lake was surveyed twice during June 1985 and 1986. During June 1985, it was partially covered with ice and ice foils floating on the surface of the water while in 1986 the lake water was clear without any snow or ice deposits.

Water samples were taken by dragging St John's water sampler on the surface. A battery operated portable digital electronic kit was used to record the data on water temperature, pH, conductivity and dissolved oxygen. All the other ionic solutes (Table 2) were determined in the laboratory following Mackereth (1963). The aquatic fauna was collected by using plankton nets with 50μ mesh size and chironomid adults with butterfly nets. The collection was sorted out groupwise and preserved in pample's fluid. Identification and counting of specimens were made under light microscope.

Results and Discussion

Physico-chemical features :

The air temperature fluctuates from 5.5-10.0°C. The lake water is slightly alkaline with pH 7.9 and high dissolved oxygen concentration (14.9 ppm), which is to be attributed to the low temperature rather than the photosynthetic activity of the phytoplankton (Welch 1952). Water analysis of the lake shows that the lake represents a simplified trophic structure, with low mineral content (Table 2). The conductivity value is low (128.0μ mhos) and hence lake can be classified as oligotrophic.

Table 2. Physico-Chemical features of the surface water of Suraj Tal Lake recorded in 1986.

Parameters	Mean Values
Water temperature (°C)	5.5 – 10.0
pH	7.9
Total alkalinity (mg/1 $Caco_3$)	–
Conductivity (μmhos cm^{-1})	128.0
Dissolved Oxygen (mg/1)	14.9
PO_4-P (mg/1)	0.53
NH_4-P (mg/1)	0.14
NO_2-N (mg/1)	0.02
NO_3-N (mg/1)	0.11
Cl– (meq/1)	0.78
Co_3^{--} (meq/1)	0.66
HCO_3^- (meq/1)	0.73
Ca^{++} (mg/1)	2.20
Mg^{++} (mg/1)	0.63
Na^+ (mg/1)	8.10
K^+ (mg/1)	0.85
Mn^{++} (mg/1)	0.14
Cu^{++} (mg/1)	0.03
Zn^{++} (mg/1)	0.51
Sio_3 (mg/1)	3.8
SO_4 (mg/1)	2.8

Biological features :

Suraj Tal Lake supports considerable amount of phytoplankton and rich aquatic fauna. Phytoplankton is largely represented by Chlorophyceae, Myxophyceae and Bacillariophyceae. The aquatic fauna predominantly consists of the insect population representing 90.3% of the total catch, followed by crustaceans 9.7%. The insect community is represented by Collembola, Trichoptera, Plecoptera and Diptera (Table 3). The Diptera is represented by the family Chironomidae and constitutes the preponderant element. Collembola, Trichoptera and Plecoptera constitute the minor groups of insects (Fig. 3). The benthos is also rich in chironomid larvae and pupae as characteristic of high altitude lakes (Hutchinson 1933, Kaisila 1952, oliver 1964, James & Hubbick 1969 and Kumar et al 1989). The significant feature of the benthic fauna of Suraj Tal Lake is the predominance of chironomid larvae and the absence of other

groups especially Amphipoda. The paucity of amphipods is also reported by oliver (1964) in the large Nettilling lake. However in large oligotrophic lakes amphipods occur in larger numbers, often outnumbering the chironomid larvae (Rawson 1953, 1960, Oliver 1960 and Kumar *et al*, 1989). The characteristic swarming behaviour of the chironomid adults was however not observed. The adults keep themselves close to the water surface to escape the hazards of wind. Taxonomically the Chironomidae is represented by the genera *Himatendipes.*, *Corynoneura*, *Pseudodiamesa*, *Diamesa*, *Metriocnemus* and *Protanypus.*

Table 3. Faunal composition of Suraj Tal Lake during 1986.

Arthropod fauna	No. of specimens
Insecta	
Diptera (Chironomidae)	
Imagines	267
Immature stages*	680
Collembola	220
Trichoptera	70
Plecoptera	63
Crustacea*	
Cladocera	
Chydoridae	32
Copepoda	
Diaptomidae	86
Ostracoda	
Cyridae	21

*No. of specimens calculated as individuals/litre.

Crustacea, Rotifera and very few protozoa constitute the zooplankton population of the lake. The Crustacea is represented by the orders Cladocera, Copepoda and Ostracoda (Table 3)· The cladocerans are represented by the species *Chydorus sphaericus* Muller and *Daphnia pulex* Leydig (Chydoridae). The Copepoda is largely represented by two undescribed species of genus *Allodiaptomus* (Diaptomidae). The Ostracoda is represented by the genus *Eucypris* Hartmen (Cypridae). The Crustacea of Suraj Tal exhibits phenomenon of diurnal migration. During the hours of bright sunshine the Crustacea were found either inside the bottom silt or under the shelter of submerged stones and boulders. Just before sunrise and in the evening, the density of the Crustacea in the upper layers of water was greatly enhanced. With the increase in intensity of sunlight, they retreat into the deeper layers of the lake water, exhibiting the phenomenon of "photophobia".

The arthropodfauna of Suraj Tal Lake is characterized by pronounced body pigmentation and reduction in body size as also reported by Mani & Singh (1961). The melanism of high altitude insects is also known in Alps in Europe and North American mountains (Erhard 1929, Petersen 1956). Animal life in the lake undergoes hibernation to tide over the prolonged snow-covered icy winters for 9-10 months a year. All their life activities are completed within the short and fleeting summer. Summarily, the lake can be termed as oligotrophic with a very simple trophic structure of the extreme environment conditioned by short growing period, low temperature and abundance of benthic chironomid larvae. This large freshwater lake supports a remarkable variety of animals and needs detailed investigation for the preservation of endangered freshwater germplasm.

SUMMARY

Suraj Tal is a freshwater high altitude lake with a simplified trophic structure and low mineral content. The aquatic fauna is mainly represented by insects and crustaceans. Significant fearture of the lake is the predominance of chironomid larvae and the absence of amphipods. The arthropods hibernate to tide over the long icy-winters.

ACKNOWLEDGEMENTS

The author is thankful to Dr. Santokh Singh for providing facilities at high altitude lab, School of Entomology, Manali, Himachal Pradesh and guidance. I am also thankfull to U. G. C. New Delhi India for financial assistance.

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