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Short Communication

Some biological features of a freshwater fairy shrimp, *Branchinecta schantzi*, Mackin, 1952 in the Northwestern Himalayas, India

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Abstract

This communication describes the occurrence and several biological features of *Branchinecta schantzi* in two habitats in the northwestern Himalayas. In both the populations, the hatching of overwintering eggs began when the sediments thawed, i.e. in April in low-laying paddy fields, and in August in high altitude seasonal ponds, thus corresponding with an increase in water temperature and nutrient level. Egg production of females in both environments was synchronous (throughout the population). Size and egg production at high elevation was comparatively small and low, respectively, when compared to the lowland population.

Keywords: *Branchinecta schantzi*, biological behaviour, habitat ecology, and highland ecosystems.

1. Introduction

Biology of many aquatic organisms of temperate waters in Indian Himalayan ecosystems is virtually unknown. The taxonomy and seasonal distribution of zooplankton and benthic invertebrates from both lacustrine and riverine ecosystems have been somewhat studied [1, 2], but not the freshwater fairy shrimp from Himalayan ecosystems. Yet, an anostracan, *Branchinecta schantzi* [3] is well-represented seasonally in waterbodies of Kashmir valley, particularly paddy fields. The Kashmir valley is situated at 34°5′–34°10′N and 74°8′–79°9′E and is considered as an oval 'dun' in the northwestern Himalayas. It is formed by rocks of various geological ages, from Carboniferous to Eocene, and is situated above 1585 m asl. Rice is the only annual crop of the region, and it is cultivated in terraced fields, which contain biologically most fertile waters, supporting high populations of aquatic organisms on a luxuriant growth of aquatic plants, due to intensive fertilization (both organic and inorganic). The fields receive a significant inflow of snowmelt waters in spring, and in autumn they dry out the paddy harvest. Related species of anostraca from European and American waters have been thoroughly investigated [4–8]. Dexter [4] has recorded *Bran-*

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chinecta schantzi from Alpine waters. Consequently, the present report presents the first study of *Branchinecta schantzi* from the northwestern Himalayas. The present data is compared with information on this species and allied ones from different geographic locations. Apart from the biology of the species, some features of its habitat are also summarized.

2. Material and methods

For the examination of life cycles, *Branchinecta schantzi* were collected with standard quality bolting–silt plankton net, fixed and stored in 7.0% Formalin. The organism was collected regularly from Kashmir valley, from paddy fields during spring and high altitude ponds in summer. The biological characteristics of males and females were studied after Brown and Carpelan [8], Daborn [6] and Geddes [9]. Live specimens for biological studies in the laboratory were also collected by the same method. Germination trials on the eggs of *B. schantzi* and other biological investigations (observations on size increment, maturity and longevity) were conducted in the laboratory, using water and feed from their natural habitats, in small glass containers (5 l cap.). Water in the each container was changed daily and water quality was monitored for temperature, pH, total alkalinity, specific conductivity, etc. using standard methods [10].

3. Results and discussion

3.1. *Distribution*

A thorough survey of seasonal and perennial freshwaters at lowland and high altitude regions revealed only one species, i.e., *Branchinecta schantzi*. In the valley, this species is recorded only in seasonal paddy fields. The animals are local and are sporadic in occurrence. One paddy field may have an abundant population, whereas nearby fields may not contain any specimen. Eggs remain at the bottom mud during the winter period. During summer, the paddy fields have an average depth of 30 cm (water temperature range 25–30°C) and support a rich assemblage of crustaceans like *Macrothrix rosea* (Jurine 1820), *Ceriodaphnia reticulata* (Jurine 1820), *Cyclops agilis* (Muller 1776), *Cyclops scutifer* Sars 1863 and *Cypris* spp., chironomid larvae and *Branchinecta schantzi*. In contrast, rain pools and temporary ponds, formed by local precipitation and meting of ice and snow, constitute the habitat of *Branchinecta schantzi* in regions above 3000 m asl. These areas normally have subzero temperatures for more than 8 months a year. They offer good pastures for shepherds, who bring their flocks from the lowlands to the high ranges for the four summer months. The ephemeral habitats are typically oligotrophic, but in summer heavy local precipitation and cattle dung, wash nutrients into them, making them productive. They then support an abundant growth of algae, zooplankton, and freshwater shrimp. *Branchinecta schantzi* is found here in association with Calanoids, *Arctodiaptomus parvispineus* Kiefer 1939, *Acanthodiaptomus denticornis* (Wierzejski 1888), and *Limnocalanus* spp., the rotifers, *Keratella hiemalis* Carlin 1943, *Asplanchna brightwelli* Gosse, 1850, and *Notholeca* spp., the cladocerns, *Daphnia pulex*, Leydig 1860 and the ostracod, *Cyclocypris laevis* (Muller 1776). These species were all recorded from temporary pools, located in the vicinity of the oligotrophic lakes Vishansar and Krishansar, situated NE of Srinagar in the altitude of 3000–4000 m asl. Among the zooplankton, *Arctodiaptomus parvispineus*, *Acanthodiaptomus denticornis* and *Limnocalanus* spp. are mainly restricted to high altitude lakes (> 3000 m asl*)* developing

Table I
Some biological features of *Branchinecta schantzi*, Mackin 1852 recorded from two different habitats in the northwestern Himalaya

Habitat	Maximum length (mm)	Size at distinguishable sex (mm)	Maximum life span (weeks)	Egg size (mm)	Number of eggs (Size range of females)
Paddy field (1600 m asl)	Females 17.6–18.0	3.0–3.5	5.0–6.0	0.2–0.34	55–147 (7.5–16.5 mm)
	Males 16.0–18.0	3.0–3.2	5.0–6.0		
High altitude ponds (>3500 m asl)	Females 15.0–20.0	4.5–5.0	5.0–6.0	0.27–0.40	35–97 (6.5–13.5 mm)
	Males 15.0–17.0	3.5–4.0	5.0–6.0		

a bright reddish pigmentation here. Climatically the area is temperate with summer temperature varying between 10 and 20°C. These species are also recorded from high altitude lakes in the Ladakh region (Tso Morari) but are absent from the valley lakes.

3.2. *Reproductive behaviour*

Branchinecta schantzi starts egg production at 13 mm length and continue producing broods as it continues to grow. The egg production in the population is of 'synchronized' type. There are fewer males than females, in the ratio of 1 : 5. The fertilized eggs release directly into the water or remain in the sac till the death of the female, if favouable conditions do not exist. The cycle from oogenesis to release the eggs from the egg sac takes about 15–21 days at 19–26°C. A positive correlation between egg size and age of the animals was recorded in some habitats. Characteristics of the species in two different habitats are summarized in Table I.

For an estimation of fecundity, only developed eggs that were still in the ovisac were taken into account. For this purpose, 45 mature female specimen of this species were used. Egg sac has a spherical shape with a diameter of 3.0 mm (0.21–0.34 mm) and is dark brown in colour. A clutch consists of 55–147 eggs (average 97 eggs per female), which has a size range of 7. 5–16.5 mm. Studies conducted under laboratory conditions revealed that *Branchinecta schantzi* releases shelled eggs within a period 3–4 weeks at 14–20°C, with only one clutch in a lifetime.

3.3. *Hatching*

Eggs of *Branchinecta schantzi*, collected from the natural habitat, were hatched in petri discs under laboratory conditions. They hatched almost simultaneously after 3–5 days at 15–20°C into nauplii of 0.5–0.6 mm in length, approximately twice the diameter of the egg.

4. Life history and development

Normally, only one brood is produced in a year in natural condition (paddy field). Hatching starts 10–15 days following warming of the pond bottom in late April (specific conductivity below 150 micro-mhos at 25°C, because of fresh snow-fed water). After 15–20 days (where

Table II
Distribution and biological characteristics of a few freshwater fairy shrimps

Species	Habitat/location	Max. length (mm)	Size of 1st nauplius (mm)	Size of sex distinguishable (mm)	Size at egg production (mm)	Reference
Branchinecta gigas, Lynch 1937	Shallow astatic lakes in semiarid regions (turbid/ alkaline habitat) Alberta, Canada	60–70 males 80–90 females	0.9–1.1	6–7	45–50 (4–5 weeks)	Daborn, 1974, 1975
Branchinecta mackini, Dexter 1956	Shallow and moderately saline lakes	28–30 (5–7 weeks)	0.5	12.5–3.5	18–20 (3–4 weeks)	Brown & Carpelan, 1971
Eubranchipus bundyi, Forbes 1876	Temporary vernal ponds Alberta	12–13 (3–4 weeks)		2.0–2.5	8.0–9.0	Broch, 1965
Branchinecta schantzi, Mackin 1952	Seasonal (turbid paddy fields & high altitude ponds) Indian Himalayas	16.0–18.0 males 17.6–18.0 females (5–6 weeks)	0.4	3.5–5.0	9.0–11.0 (3–4 weeks)	Present study

fields are organically fertilized, specific conductivity increases to a level above 700 micromhos at 25°C), nauplii are collected abundantly. Active feeding starts when the nauplii are about 2.35 mm long. They feed on small suspended particulate or colloidal organic matter from the bottom of the water. Sexes were first distinguished at a size range of 3–4 mm, when the ovisac and the anlage of the penes appear on the ventral surface of the first abdominal segment. During the present study, the largest males and females collected from the paddy fields measured 16–18 and 17–18 mm, respectively. The animals matured at a size of about 9–11 mm in both the sexes. The total life span of *B. schantzi* under these climatic conditions ranged between 35 and 42 days (45 days). Distribution and biological characteristics of a few other species of Anostraca recorded in varied geographical locations are mentioned in Table II. On a few occasions, it was noted that if a pond dries up temporarily and is refilled again, there was no second hatching, indicating that under the ambient climatic conditions the eggs require a resting period and do not hatch for some time, even though they are socked in the water.

The record of *Branchinecta schantzi* above the tree line area (>3000 m asl) is an exceptional one and is quite striking too. The occurrence of this species in high attitude ponds and ditches presumably is a case of dispersal through migratory waterfowl as carriers. In winter, the Siberian water birds like Mallard, Teal, Pintail, etc. migrate to wetlands in the valley and on their way back in summer a few halt at the high altitude lakes, thus acting as carrier for this shrimp. *B. schantzi*, however, is not colonized in any of the lakes situated at these elevations, but populations have developed in some low-lying ponds only. This may be because the small systems are not connected to the main lakes, which have populations of the brown trout (*Salmo trutta fario*, Linnaeus). Hutchinson [11] and Daborn [7] report

that fairy shrimp generally do not survive when fish are present: they readily become a prey to the fish, and this may well be the reason that *B. schantzi* has not been able to colonize large high mountain lakes of the northwestern Himalayas with a trout population. However, further detailed investigations of this species, both at high and low altitudes, are needed to fully understand the ecological variability of this organism, which forms a characteristic element in Himalayan biota.

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