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Notes on Freshwater Zooplankton Found in Central Province, Papua New Guinea, 1981-2

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ABSTRACT. The study reported on was carried out on three water bodies in Central Province of Papua New Guinea between 1981 and 1982. They were Lake Surinumu, a hydroelectric reservoir on the Sogeri Plateau, which was ascertained to be warm polymictic and oligotrophic, Waigani Swamp in Port Moresby, and the artificial pond at Varirata National Park. The following zooplankton are discussed in terms of their local ecology and zoogeography: the Rotifers *Brachionus falcatus*, *Asplachna brightwelli*, *Trochosphaera aequitorialis*, and *Filinia opoliensis*; the Crustaceans *Diaphanosoma sarsi*, *Diaphanosoma excisum*, *Ceriodaphnia cornuta*, *Eodiaptomus lumholtzi*, *Thermocyclops crassus*, *Mesocyclops leuckarti* and the genus *Phyllognathopus*; and the Dipteran planktonic larva *Chaoborus*.

INTRODUCTION

Prior to 1980 very few species lists for the Papua New Guinea limnetic fauna had been put together. Between 1980 and 1982 I collected zooplankton samples from three water bodies in Central Province and also some physicochemical data. With the exception of one rotifer all species were identified by Professor C.H. Fernando of Waterloo University, Canada, and Dr. N.N. Smirnov of the Academy of Sciences, USSR.

The water bodies sampled were:

(i) Lake Surinumu, a hydroelectric reservoir on the Sogeri Plateau, an impoundment of the Laloki River at an altitude of 538 m.a.s.l. The lake is shallow (I recorded a maximum depth of 14 m) with a complex perimeter. Petr (1976) reported a fall in nutrient ion concentration between 1970 and 1975 and commented on the lake's very low calcium concentration, in the range of 0.075 - 0.090 $m.eq.l^{-1}$, having been raised to its present level in 1971.

(ii) Waigani Swamp, a shallow tropical body at sea level in Port Moresby, which has been a site of sewage effluent disposal since 1975.

(iii) The artificial pond at Varirata National Park, altitude approx. 750 m.a.s.l. It was no deeper than 2.25m at any time when I sampled it.

METHODS

A standard silk-bolt net was used for all zooplankton sampling. Lake Surinumu was sampled regularly between October 1981 and December 1982 at various points throughout the lake. Littoral samples were taken at Waigani Swamp on three occasions in 1982 in response to a request from Dr. R. Hamond of Melbourne University while a surface tow was taken in December 1982. The pond at Varirata was visited twice in 1982.

Physicochemical parameters were measured at Lake Surinumu only. Water levels and surface temperatures were recorded throughout 1982 while surface water samples were submitted to the University of Papua New Guinea in June 1982 for nutrient and photosynthetic pigment analyses.

RESULTS

(i) Lake Surinumu - Physicochemical: The lake's water level was observed to peak at 13.5m as measured at the dam wall in March following the wet season influx, while the lowest watercolumn at the same site was 6.5m in December. At the same time surface temperatures generally rose from 27°C to 31.5°C. Nutrient concentrations in March were found to be consistently low throughout the lake, featuring Soluble Reactive Phosphorus concentrations of 3 $\mu g.L^{-1}$ while NH_4-Nitrogen readings ranged from 120 - 215 $\mu g.L^{-1}$. Nutrient levels in the May and June surface water samples were much lower (maximum NO_3-Nitrogen recorded was 25 $\mu g.L^{-1}$) although there was an increase in S.R.P. concentrations to a maximum of 8 $\mu g.L^{-1}$.

(ii) Lake Surinumu - Productivity: Only the March samples were analysed. The maximum chlorophyll-a pigment concentration measured was 7.14 $\mu g.L^{-1}$ while the maximum carotenoid concentration was 7.00 m.s.p.u.

(iii) Lake Surinumu - Colonial Cyanophytes: Two genera were regularly found in samples, namely *Microcystis* and *Oscillatoria*. *Microcystis* was found to be most abundant from July to December 1982 while *Oscillatoria* was very abundant from March to July 1982.

(iv) Zooplankton Found: (at Lake Surinumu only unless specified)

Rotifers:

Brachionus falcatus, perenially present in low abundances.

Asplachna brightwelli, perenially present in low abundances, peaking in November 1981, with a relatively high abundance recorded in March 1982 in a shallow basin in which many ephippial and juvenile cladocerans were also present.

Trochosphaera aequitorialis, found at all times except June to September 1982, very abundant October to December 1982 (maximum relative abundance 0.64 in November, 1982.

Filinia opoliensis, present in very low abundances between June and December 1982. Owing to the species' similarity in appearance to *B. falcatus* and to the fact that sample analysis could not begin until October 1982, by which time earlier samples had been stored in formalin for several months, it is quite possible that specimens in those samples were not recognized.

Crustaceans:

Diaphanosoma sarsi and *Diaphanosoma excisum*, at Lake Surinumu and Waigani Swamp. The two species can be distinguished from one another only by the shape of the fold on the exoskeletal margin and this was not possible for most samples due to preservation damage. The diaphanosomids in the December 1982 Waigani Swamp sample were however described as *D. excisum* by Professor Fernando in the apparent absence of its congener, while my own observations of identifiable specimens indicated that *D. sarsi* is the more abundant in Lake Surinumu. The density of diaphanosomids at Lake Surinumu peaked at 2.6 organisms per litre in January 1982 with secondary peaks in May and July 1982 approaching $2.5L^{-1}$, with troughs of about 1 organism per litre from February to May 1982 and fewer than $0.1\ L^{-1}$ from September to December 1982. Fertility in terms of percentage ephippial females featured a single peak in March 1982 of nearly 40%.

Ceriodaphnia cornuta, at all three sites. At Lake Surinumu the species was perennially present, featuring relative abundance peaks of 0.55 - 0.6 from December 1981 to March 1982 with a secondary peak of 0.48 in October 1982, the lowest abundance recorded being 0.1 in July 1982. Ephippial females were perennially present peaking at 38% in March 1982.

Eodiaptomus lumholtzi, at Lake Surinumu and Varirata. At Lake Surinumu this species is normally dominant, a peak relative abundance of 0.82 being recorded in August 1982, though the animal fell to below 0.1 in October 1981 and November to December 1982.

Thermocyclops crassus, at Lake Surinumu and Waigani Swamp, perennially present in the former, and very abundant in the December 1982 Waigani Swamp sample.

Mesocyclops leuckarti, perennially present in low abundances.

Phyllognathopus, a single specimen of which was found in littoral samples at Waigani Swamp.

Insect Larva:

Chaoborus, present in low abundances in all samples except those taken from June to October 1982.

DISCUSSION

Lake Surinumu would appear to be of the warm polymictic type by Hutchinson and Loffler's thermal classification of lakes (1956). Neither thermal stratification nor tropholytic oxygen depletion tend to occur in such lakes (Bayly and Williams, 1973; Finlayson, Farrell and Griffiths, 1980). Both Petr's (1976) and my own nutrient analyses indicate that the Lake is oligotrophic by Finlayson and Gillies (1982) trophic classification for artificial lakes.

B. falcatus is characteristic of tropical lakes in general, and occurs in subtropical and temperate regions (Ruttner-Kolisko, 1974). Specific references to it include the Lower Murray River (Shiel, Walker and Williams, 1982), the Queensland University Pond (Timms, 1967), the Lake Kainji Reservoir and the potamoplankton of the Niger and Swashi Rivers (Clarke, 1978a), and the Eilengele Reservoir in Nigeria (Imevbore, 1967), where it is reported to display an optimal temperature range of 17 - 29°C.

A. brightwelli features a very wide tropical and subtropical distribution, both limnetic and lotic (Fernando et al, 1982). References to it include the Lower Murray River (Shiel, Walker and Williams, 1982), the Queensland University Pond (Timms, 1967c), Eilengele Reservoir (Imevbore, 1967), and the Blue Nile River (el-Moghraby, 1977). A predaceous carnivore, its diet includes *B. falcatus* and juvenile cladocerans (Green and Oey, 1974), consistent with my observations of its high abundance in the basin featuring a high abundance of ephippial cladocerans in March 1982.

The global distribution of *T. aequitorialis* has been poorly mapped (Fernando, 1980). It occurs commonly in the Danube Delta (Ruttner-Kolisko, 1974) and is common in Sri Lankan lakes (Fernando, 1980).

F. opoliensis is a pantropical species (Ruttner-Kolisko, 1974). It is common in India (Koste and Shiel, 1980) and in the Blue Nile (el-Moghraby, 1977).

The distributions of the diaphanosomids are complicated by the fact that a degree of uncertainty exists about 'species' identifications in many reports prior to 1980. Krovchinsky (1981) noted that specimens from New Guinea and Celebes classified as *D. paucispinosum* by Brehms in 1939 were almost certainly *D. excisum* while reports of *D. sarsi* from Sars in 1901 were probably *D. spinulosum*, and suggested that all reports from Africa were particularly suspect. Fernando et al (1982) reported that *D. excisum* is an exclusively tropical species. The species appears to be common in Queensland and New South Wales (Krovchinsky, 1981) and it was reported as being present in Lakes Dakataua and Wisdom in Papua New Guinea's West New Britain Province (Ball and Glucksman, 1982). Krovchinsky (1981) reported *D. sarsi* as definitely occurring in North Queesland and Sumatra. Both species occur in Sri Lanka, *D. excisum* being more common in reservoirs while *D. sarsi* is more common in rivers and ponds (Rajapatska and Fernando, 1982). The genus appears to display a marked preference for calm waters in the temperature range of 27 - 28.5°C in Lake Surinumu, especially in terms of its univoltine reproductive cycle.

Ceriodaphnia cornuta is a pantropical species which extends into subtropical regions (Fernando et al, 1982), being common in tropical Asia, Africa, America and Australia (Rajapatska and Fernando, 1982). It featrues a high abundance in the White Nile Gebel Aulia Dam (Clarke, 1978), Lake Kainji and the Blue Nile (el-Moghraby, 1977). It is a common limnetic species in Australia and normally peaks in spring or summer, though in Tasmania it does so in winter (Bayly and Williams, 1973), and was reported from Lake Dakataua by Ball and Glucksman (1982). It was recorded as being multivoltine in Lake Surinumu, but fertility peaks appeared to correlate inversely with density, suggesting that lowering population densities acted as a parthenogenetic stimulus.

Eodiaptomus lumholtzi is one of two species of a genus present in Australia, inhabiting the open waters of lakes, large ponds and deep pools (Willisms, 1968). Bayley (1966) reported its distribution as being from the north-east of West Australia, across mid-Northern Territory to a southerly latitude of 23°S. This distribution appears to be due to mutually exclusive competitive relationship with *Boeckella triarticulata* (Bayly, 1965). Bayly (1965) claimed a similar relationship exists between *E. lumholtzi* and *Calamoecia* species, but Bayly and Williams (1973) stated that where the two coexist, competition for food is avoided by the two species growing to different average sizes. With the exception of samples in which both *E. lumholtzi* and *C. cornuta* were at a low abundance, the Correlation Coefficient between the relative abundances of the two species as measured at the dam wall in Lake Surinumu was found to be -0.88, indicating intense interspecific competition, *C. cornuta* being relatively the more abundant until June 1982, with *E. lumholtzi* more so from June on. It is possible that temperature is responsible for this change in competitive status, higher temperatures favouring the latter.

T. crassus is a globally widespread species (Fernando et al, 1982).

M. leuckarti is a cosmopolitan species exhibiting considerable ecological diversity though it is seldom dominant (Gophen, 1978b). It is omnivorous but will not eat *Microcystis* (Clarke, 1978b). It preys on both *Ceriodaphnia* and *Diaphanosoma* species. It is common in the Blue Nile (el-Moghraby, 1977), Lake George in Uganda (Burgis, 1974), Lake Kainji and the Swashi and Niger Rivers (Clarke, 1978a), Lake Kinneret in Israel (Gophen, 1978a), and Lake Tjeukemeer in the Netherlands (Vijverberg, 1977), as well as in New South Wales lakes and reservoirs (Bayly and Williams, 1973) and in Victorian waste stabilization ponds (Mitchell and Williams, 1982).

Phyllognathopus occurs in Europe, North America, Northern Africa, the Malay Archipelago, Brazil, Patagonia and New Zealand (Barclay, 1969).

Chaoborus is a pantropical dipteran genus extending into subtropical regions (Fernando et al, 1982) which preys on diaphanosomids, copepodites, and adult cladocerans, cyclopoids and calanoids (Lewis, 1977, 1979).

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