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Temporal succession of planktonic crustaceans in a small eutrophic temperate lake (El Plateado, Valparaíso, Chile)

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Introduction

Knowledge about the structure of and processes in South American temperate lakes has increased in recent years. However, most of it involves annual cycles, and there are few studies which address how these lakes function. Thus, the validity of models developed in the northern hemisphere has only been tested against themselves and with ecosystems of the same type but with some physical and chemical dissimilarities (Kilham 1990).

During recent years, research on Lake El Plateado (33°04′30″ S, 71°39′12″ W), a warm eutrophic monomictic lake, has begun to provide information on the zooplankton and longer-term observations on the lake. Lake El Plateado can be classified (Ramos et al. in press) as having a plankton of predictable seasonality as postulated in the PEG model (Sommer et al. 1986). The research reported here examines the question: to what degree does the lake conform to general predictions? Additionally, the extent of inter-annual variation is examined.

Materials and methods

Sampling extended from January 1993 to December 1994. Samples were collected weekly by vertical hauls from 10 m to the surface with a HYDROBIOS net of mesh aperture 125 µm and diameter 25 cm. Samples were fixed with 5 % sugar formalin. For counting a WILD M5 stereomicroscope was used.

Microcrustaceans were identified to species, except cyclopoids. Data were expressed as individuals/L calculated from the estimated volume filtered. The diversity of the zooplankton was calculated using the formula of Shannon & Weaver.

Results and discussion

Most of the microcrustacean plankton comprised eight species: *Bosmina longirostris, Moina micrura, Diaphanosoma chilense, Daphnia ambigua, Ceriodaphnia dubia, Tumeodiaptomus diabolicus, Mesocyclops longisetus* and *Tropocyclops prasinus*. The latter two species were mainly represented by nauplii and copepodites, and so it was difficult to provide separate species counts. *Iliocryptus spinifer, Alona pulchella* and *Chydorus sphaericus* were not numerous and are not considered further.

The seasonal pattern shown by total microcrustaceans was not the same in the two years (Fig. 1). Among other features, there was a displacement of the peak of total abundance from

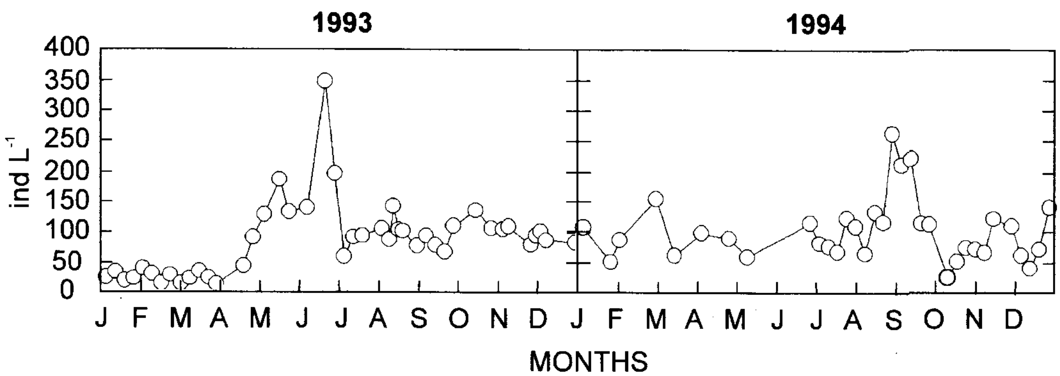

Fig. 1. Abundance of total crustacean plankton in Lake El Plateado.

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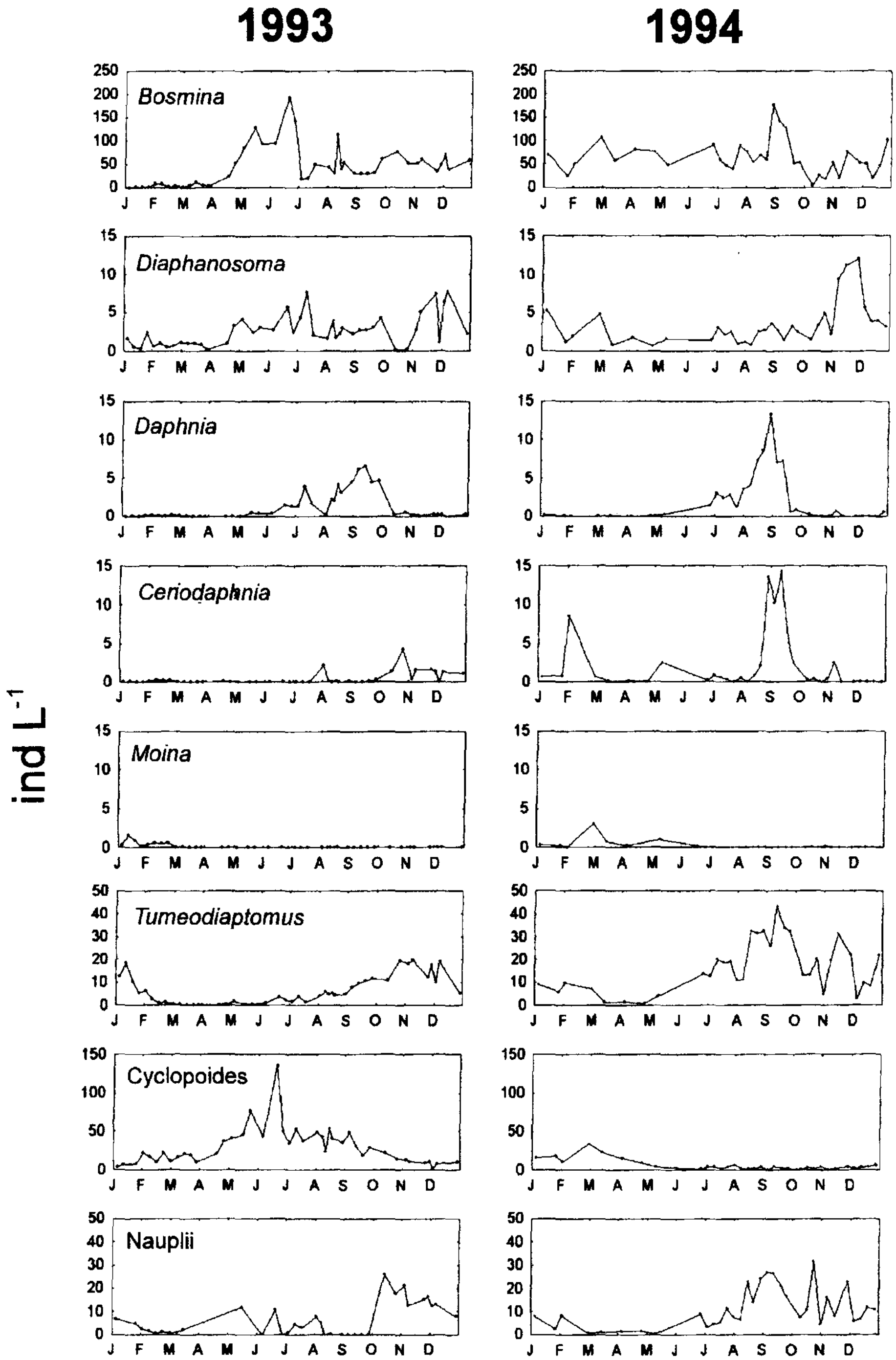

Fig. 2. Seasonal shifts in population densities of crustaceans in Lake El Plateado during 1993 (left column) and 1994 (right column).

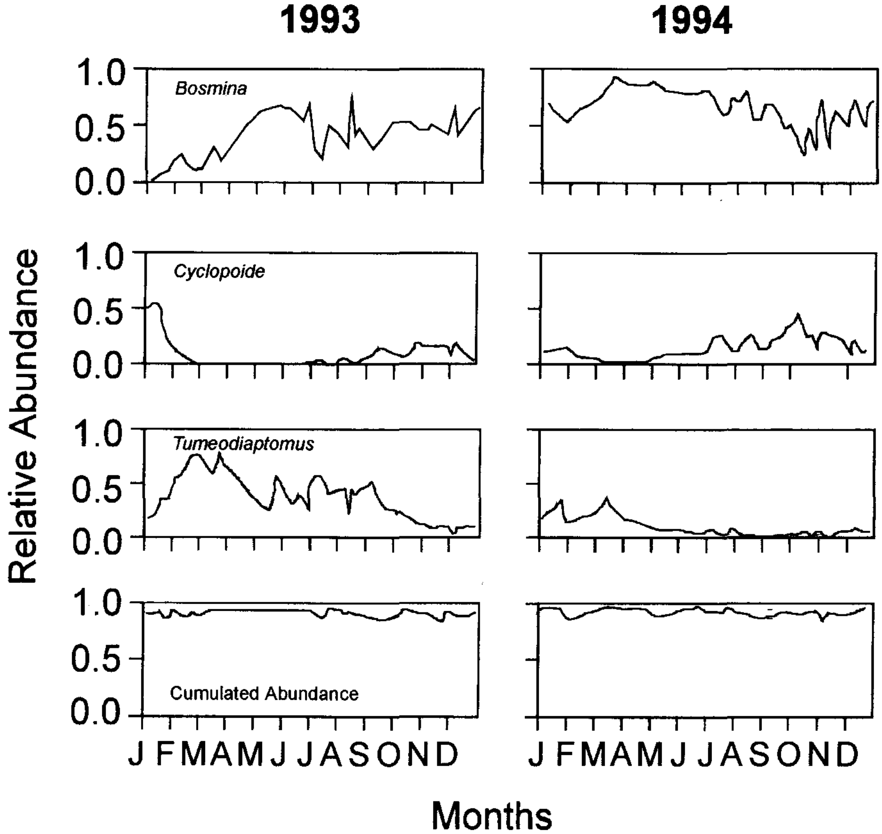

Fig. 3. Relative abundance shifts of dominant species in Lake El Plateado during 1993 (left column) and 1994 (right column).

early winter in 1993 to early spring in 1994. However, the numerical dominance remained the same: *B. longirostris*, *T. diabolicus*, and the cyclopoids (Fig. 2). The first two species, exclusively herbivores, showed apparently opposing seasonal dynamics (Fig. 3), as indicated by relative abundance. It is also remarkable that the cladocerans, except for *Bosmina*, are less important in the lake at all times. This suggests that the general characterization of the lake on the basis of the *Daphnia-Diaptomus* ratio (Muck & Lampert 1984) could be replaced for lakes such as El Plateado by a *Bosmina-Diaptomus* ratio. This also occurs in the nearby lake, Lake Penuelas (Schmid-Araya & Zúñiga 1992), in this same region.

The pattern of seasonal dynamics of the microcrustaceans in Lake El Plateado are not in good accord with the most significant points of the PEG model. Thus, there was not a clear peak in spring, a decrease as a by-product of clear waters, or an autumnal maximum. The dynamics appear dominated by *B. longirostris*, the dominant species present all year. On the other hand, there was not a clear seasonality between species of different body size. This is an important difference with the PEG model, since it predicts a succession from small to large and then again to small-sized species because of the combined effects of size-dependent growth rates and size-dependent vulnerability to predation by fish.

The most significant differences detected between the two years of study for these zooplanktonic species were:

(i) In the summer of 1992–1993, *B. longirostris* was present in very low densities compared to the summer of 1993–1994 and 1994–1995.

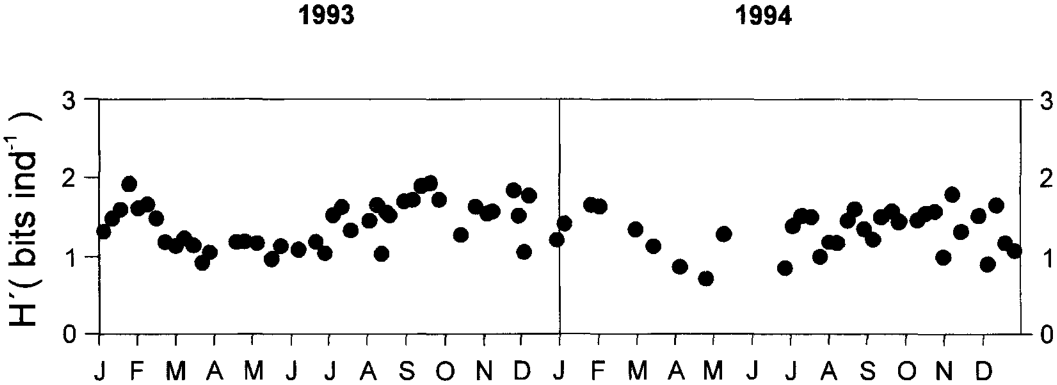

Fig. 4. Seasonal shifts in specific diversity of crustacean plankton in Lake El Plateado.

(ii) *T. diabolicus* was only numerically dominant during the summer of 1992–1993.
(iii) Cyclopoids tended to be more numerous in winter in the first year, and in autumn during the second year.

In a way similar to the pattern of physical characteristics during the same period (RAMOS et al. 1997), these inter-annual differences in microcrustacean zooplankton dynamics can be seen as 'shifts' that depend indirectly on the behaviour of the dominant herbivore population. *Bosmina* alternates dominance with *Tumeodiaptomus* (Figs 2, 3). Perhaps *Tumeodiaptomus* determines suitable conditions for the development of cyclopoids, taking into account the differences in feeding and modes of defaecation between cladocerans and herbivorous copepods.

Measures of specific diversity (Fig. 4) do not show great differences in time, but in both years the lowest values appear in summer (stagnation period) and early winter (when homothermal conditions begin). This low variation in diversity suggests that the relative importance of the different constituent populations remains constant throughout the year. Temporal extinction is observed only in numerically unimportant groups.

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