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Factors affecting the distribution of recent lacustrine ostracoda from the Caicedo de Yuso-Arreo Lake (Western Ebro Basin, Spain)

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Abstract

Recent Ostracoda assemblages of the Caicedo de Yuso Lake have been described as representative of palustrine/lacustrine environments in Iberian temperate lakes. This study considers the changes in assemblages at a fixed station during two consecutive annual cycles, as well as their distribution in summer and winter profiles of the lake. Total sample-assemblages have been quantified as species diversities, measured by the Shannon–Wiener index H (S). The trends of this index are compared to physical parameters (temperature, conductivity, dissolved oxygen, CO_2) of the bottom waters of this lake. The Ostracoda assemblages (8100 adults and juvenile living specimens, belonging to 20 species) are dominated by *Cypria ophtalmica, Cypridopsis vidua* and *Pseudocandona marchica.* Biocenotic assemblages are well developed in the western, flat shelf area of the lake (0 to 9 m in depth), where a major substrate of charophytes permits assemblages with moderate diversity levels to be maintained. Waters below 10 m are practically barren of living individuals, and only few specimens of the generalist species *Cypria ophtalmica* have been found alive at that depth. Differential responses of most abundant species to changes in the environmental parameters of the bottom of the lake have been interpreted in terms of the ecological requirements of those species. Most of these responses are clearly influenced by shifts in the parameters mentioned, and decreases in oxygen and increases in CO_2 produce particularly marked falls in assemblage diversity levels. Conversely, when the oxygen increases and the CO_2 falls, the diversity levels increase. The time delay in responding to these changes is estimated at less than one month. This general behaviour of the ostracod assemblages of Caicedo Lake is not followed by *C. ophtalmica,* which is considered a particular species that can stand hypoxic waters, with relatively high CO_2 concentrations. This ability of *C. ophtalmica* allows specimens of this species to occupy deep and environmentally unfavourable niches in the lake, that no other ostracod species of Caicedo Lake does. The knowledge of areal and temporal distribution of Ostracoda species in a temperate lake, such as Caicedo de Yuso, exhibits a good potential for

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applying these results to the interpretation of past lacustrine/palustrine environments of Neogene lakes in similar palaeogeographical contexts.

Keywords: Ostracoda; Caicedo de Yuso Lake; Recent; Ecology

1. Introduction

Studies on recent continental Ostracoda have increased spectacularly over the last decade, due to the usefulness of these microcrustaceans in the characterisation of water masses as fresh, mineralised or saline, temporary or permanent. As a result, several synthetic or review works relative to such environments have been published during this period (Henderson, 1990; Horne et al., 1998; Martens, 1998; Horne and Martens, 2000; Griffiths and Holmes, 2000; Meisch, 2000).

Most species of continental ostracods are found in stable waters of lakes or ponds, but many of them can also dwell in temporary springs, in palustrine ephimeral or even stagnant waters. The environmental factors that control these ecosystems are thus particularly complex, and the hydrological, sedimentological and biological processes characterising this realm involve many variables. The very complexity of those processes makes them, if sufficiently understood, excellent tools for interpreting past continental geological records. To achieve this goal, detailed studies of ostracod assemblages, together with biogeochemical analyses of ostracod carapaces, have been carried out in recent years (Carbonel et al., 1988; De Deckker and Forester, 1988; Holmes, 1992; Palacios-Feist et al., 1994; Curry, 1999; Von Grafenstein et al., 1999, 2000; more references in Griffiths, 1995, and Meisch, 2000).

In recent years, claims have been made for using the trace element content and stable isotope of the biogenic carbonates of ostracod carapaces as a proxy of the waters where they formed (references above). A multidisciplinary study at Lake Caicedo de Yuso, also known as Arreo Lake (Alava, Spain), dealing with carbonate biomineralization on charophytes, gastropods and ostracods, is currently being performed by the authors. The aim of this study is to model the record of environmental parameters in biogenic carbonates in a recent lake and apply the results to palaeolimnologic analyses. In the present paper we describe the ostracod assemblages of this lake and characterise the main parameters affecting the bottom environment where the ostracods live. The work is based on results from a two-year monthly sampling (January 1999 to January 2001) of water and carbonate-producing organisms at a fixed site and run samplings (profiles) at other sites in the lake. The sampling also included control of some parameters and in situ analyses of waters (T, pH, alkalinity, O_2, CO_2). The laboratory analyses of waters involved anion and cation compositions and isotope analyses ($\delta^{18}O$, δD). The results could give interesting clues as to how to interpret ancient lacustrine geological records from the Iberian lakes. The only previous descriptions of ostracods from the Caicedo de Yuso Lake are those of Baltanás (unpublished data) and Rodriguez-Lazaro et al. (1999, 2000). A list of references on Iberian ostracods is presented in Martín-Rubio et al. (2002).

2. Description of site studied

The Caicedo de Yuso/Arreo Lake (also known as Lake Caicedo or Lake Arreo) is located in the western Ebro River Basin, between the localities of Arreo and Caicedo de Yuso (Alava Province, northern Spain). Bedrocks are clays and gypsum with volcanic rocks from the Triassic period and recent alluvial sediments. The western Ebro Basin today is currently influenced by a transitional Atlantic–Mediterranean climate, with mean annual precipitation of 740–800 mm. Lake Caicedo (Zm 24 m) is the deepest body of water with evaporite substrate in the Iberian Peninsula. The main physical parameters of the lake are shown in Table 1. The bathymetry and morphometrics of the lake were analysed by Martínez-Torres et al. (1992) and Rico et al. (1995). A limnological survey of the lake for 1993–1994 (González-Mozo et al., 2000) indicated