PREDATION ON RECENT MARINE AND FRESH-WATER OSTRACOD POPULATIONS OF THE CENTRAL REGION OF THE REPUBLIC ARGENTINA

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ABSTRACT: The presence of evidence of depredation in ostracods valves from marine and freshwater environments of the central region of the republic Argentina are studied in this paper. In samples from intertidal environment (Puerto Rosales) a total of 800 shells of ostracods were recovered of which only 0.50% (4 valves) presented evidence of predation. In freshwater environments (Laguna Don Tomás) a total of 1447 valves were recovered of which only 1.10% (16 valves) presented evidence of predation. Two types of depredation fossil traces were determined: *Oichnus simplex* Bromley and *Oichnus paraboloides* Bromley. *Oichnus simplex* Bromley predominate over drilling *Oichnus paraboloids* Bromley attributed to predatory gastropods activity, both marine and continental environments. There was not relationship between the borehole diameter and the size of the predated valves. The ornamentation of the valves is not a character that conditions predation, since the species predated have different type of ornamentation from thin ribs to crosslinks with very prominent ribs.

KEY WORDS: Ostracodes, Puerto Rosales, Santa Rosa, predation.

The ostracods are microcrustaceans with calcareous shell, mainly benthic, which have a wide ecological range (inhabit freshwater environments, brackish, marine and hypersaline) (Horne et al., 2002). These microcrustaceans are predated by various organism such as gastropods, bivalves carnivores, echinoderms and fish, although they constitute a very small percentage of the diet of the mentioned groups (Leal, 2008). Such predation is recorded through perforations caused by the erosive action on the surface of the vales of these invertebrates. There are several studies analyzing the importance of bioerosiones recorded in the fossil shells of molluscs as indicators mainly paleoecological (Farinati et al., 2006). Evidence of predation in shells of ostracods are recorded from the Cambrian, studies comprise populations of marine and freshwater ostracods come from both recent and fossil sediments (Reyment, 1963, Reyment et al., 1987; Ruiz, 1997; Ruiz et al., 2010; 2011; Kihn et al., 2011).

In this paper evidence of predation are studied in recent populations of freshwater and marine octracods; and compared with the results obtained in holoceno sediments.

Study area

Don Tomás lagoon

The "Laguna Don Tomas" (36 º 18 '18.31'' S and 64 º 18' 49.02'' W) is a highly modified shallow hypereutrophic water-body located west of the city of Santa

Rosa (Figs. 1 and 2). It is surrounded by three basins that were built to prevent flooding of the surrounding city. It has an average depth of 2.3 m, which varies according to the rainy season, and covers an area of 135.2 ha. Maximum length and width are 1565 and 1181 m, respectively (Echaniz et al., 2008).

In the vicinity of the lagoon there are sites that have been anthropogenically modified and where the vegetation composition is variable, i.e., halophiles in flood areas, and psammophile in the grasslands. It lies within the eastern subhumid-dry climate physiographic region, where the average annual rainfall is 600 mm (Pall et al., 2011).

Puerto Rosales

Puerto Rosales integrates one of the most important port complexes deep waters of Argentina. It is located on the north coast of the Main Canal estuary of Bahia Blanca in the province of Buenos Aires, Argentina, between 38º40 'and 39º45' S and 61º45 'and 62º30'W (Figs. 3 and 4). The region is crossed by numerous canals that drain into the Canal Principal and separate extensive tidal flats, salt marshes, salt low and islands (Perillo & Piccolo, 1991). The system is semi-diurnal tide, with a range varying from 2.3 to 1.4 m in the mouth and between 3.8 and 2.7 m at the head of the estuary during spring and neap tides, respectively (Gómez et al., 2005).

The climatic characteristics of the area corresponding to dry and temperate climate, with average annual values of temperature comprised between 14 and 20 ° C and thermal distinct seasons (Piccolo & Diez, 2004).

MATERIALS AND METHODS

Puerto Rosales

El muestreo fue realizado en los meses de enero, marzo, julio y octubre de 2011 desde una embarcación durante marea subiente a lo largo de una transecta perpendicular a la línea de marea. Se establecieron 5 estaciones de muestreo, correspondiendo la E1 al sector intermareal inferior y la E5 al superior (Fig. 5).

Laguna Don Tomás

Sediment samples were taken using a 10 cm diameter and 2 cm high metal ring. The northern shore basin was sampled, because it is the site subject to less human action and lacks a wire mesh on the shore that prevents the deposition of sediment, as occurs with the other two basins. Sampling was conducted in July and October 2011 and January 2012 (Fig. 6).

All samples were wet sieved with a sieve of 63 mm and then dried in oven at 50° C. Whenever possible, at least 150 individuals was extracted from each sample. Furthermore, the number of individuals per 10 g of dry sediment was calculated. If the number of ostracods was less than 150, the total number of individuals recovered.

A total of 40 samples were studied, 20 corresponding to marine environments and 20 freshwater environments. 2,247 shells were analyzed, which were considered only specimens with evidence of predation.

Finally, the external diameter or the major axis was measured, as were circular or elliptical perforations respectively. These measurements were compared with the length and height of the leaflets that contain them. The location of the perforations was classified according Ruiz (1997) and Ruiz et al. (2010).

RESULTS

Samples of marine environments

In samples from intertidal environment (Puerto Rosales) a total of 800 shells of ostracods were recovered of which only 0.50% (4 valves) presented evidence of predation. All specimens were retrieved with holes corresponding to a marsh with *Spartina alterniflora* (E4). Species that show evidence of predation are: *Cushmanidea echevarriae* Bertels y Martínez, 1997, *Xestoleberis* sp. and *Cytheretta punctata* Sanguinetti, 1979. Only perforated specimens relevant to ontogenetic stages 3-5were found.

Samples of freshwater environments

A total of 1447 valves assigned to four species were recovered. *Limnocythere* sp, *Cypridopsis vidua* (OF Müller, 1776), *Heterocypris similis* (Wierzejski in Ramirez, 1967) and *Kapcypridopsis* sp.. Of the specimens recovered 1.10% (16 valves) presented evidence of predation. *Heterocypris similis* was the only species that presented perforations (Fig. 7). The ontogenetic stages that showed evidence of predation were 5-7.

Analysis of the perforations

It was possible distinguish two types of perforations:

***Oichnus paraboloides* Bromley, 1981** is elliptical perforations or subparabólicas in external view, with a greater outer diameter than the inner. These perforations are usually attributed to the action of naticid gastropods (Reyment, 1966; Jonkers, 2000), although other groups should be considered gastropodsas potential predators (Ruiz et al., 2010, 2011; Kihn et al., 2011).

***Oichnus simplex* Bromley, 1981** includes cylindrical perforations with internal and external opening of similar diameter attributed to the action of muricid gastropods or eulimínidos (Reyment, 1963; Donovan & Pickerill, 2004; Ruiz et al., 2010, 2011; Kihn et al., 2011).

Comparing the diameter of the perforations and the dimensions of the perforated shells reflects an absence of correlation. As for the location of the perforations are in the front, back and central region of the valve, but are most frequent of which are in the front area.

In samples from freshwater environments the evidence of predation were observed only in *Heterocypris similis*. In marine environments the valves of species showed evidence of predation have very different characteristics of ornamentation: Smooth valves (*Xestoleberis* sp., *Heterocypris similis*); crosslinked and ribs (*Cytheretta punctata*); with scores (*Cushmanidea echevarriae*). In general all the valves had a single perforation; only one specimen of the Laguna Don Tomas presented two perforations.

DISCUSSION

In marine samples from Puerto Rosales only presented perforations some valves retrieved of the E4 corresponding to Spartina alterniflora marshes, which is attributed to the presence of *Spartina* provides greater diversity of ecological niches and reduces environmental energy providing suitable conditions for the development of predators; gastropods since his early ontogenetic stages associated living vegetation (Reyment, 1987). This coincides with that found in marine samples Holocene southern province of Buenos Aires where it is concluded that as many leaflets with evidence of predation was recorded in environments of lower energy and abundant vegetation (Kihn et al., 2011).

In other sampling stations in this town are not were recorded shells with evidence of predation; the E5 located in the upper intertidal resulted sterile ostracods, this may be due to the frequent air show which makes environment it little conducive to the development of ostracofauna. At E3, E2 and E1 the absence of leaflets with evidence of predation is due to the reduced availability of nutrients, lack of vegetation and possibly the conditions of energy from the environment.

Contrary to the claims by Kihn et al. (2011) and Ruiz et al. (2010, 2011); species what presented valves with evidence of predation did not correspond to species that occurred in dominant form in different environments studied. Therefore, it can be deduced that predation not related to the abundance of a kind, but the total abundance of the present ostracofauna.

The ornamentation is not a limiting factor for the predation, since there have been completely smooth shells and ornamented shells. In the case of the specimens with smooth valves predation evidence correspond to sub-adult or adult stages; whereas in the ornate species specimens belong to youth punched one the first ontogenetic stages.

The dominance of adult shells with holes in the fossil samples studied in previous works (Kihn et al., 2011) may be due to less chance of preserving the juveniles or losses minors ontogenetic stages during processing of samples, since in the present work done on current samples have been recovered juveniles with perforations. The fact that only *Heterocypris similis* present evidence of predation on freshwater samples can be attributed to the larger size of the shell and possess valves without ornamentation what makes drilling easier by predators.

CONCLUSIONS

The highest percentage of signs of predation were recorded in samples of the lagoon Don Tomás due to ambient energy low, high levels of available nutrients and the highest density of ostracods; only the last stages otogenéticos present evidence of predation. In intertidal environments samples decreases the percentage of perforated shells. Factors influencing predation ostracod fauna are the development of populations, environmental energy, depth (in shallow environments percentage of predation is higher) and the availability of nutrients. The cylindrical bores (*Oichnus simplex* Bromley) predominate over drilling *paraboloid* type (*Oichnus paraboloids* Bromley) attributed to predatory gastropods activity, both marine and continental environments. The ornamentation of the valves is not a character that conditions predation, since the species predated have different type of ornamentation from thin ribs to crosslinks with very prominent ribs. This work is a first contribution to the study of traces on actual samples ostracods of Argentina, it is important to deepen this knowledge from future studies.

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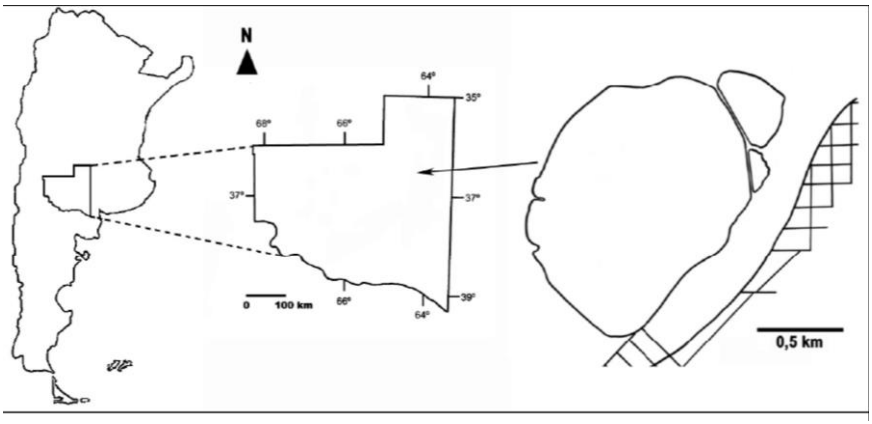

Figure 1. Geographical location of the Lagoon Don Thomas in the province of La Pampa, central Argentina.

Figure 2. Satellite image taken from google earth of the Lagoon Don Thomas.

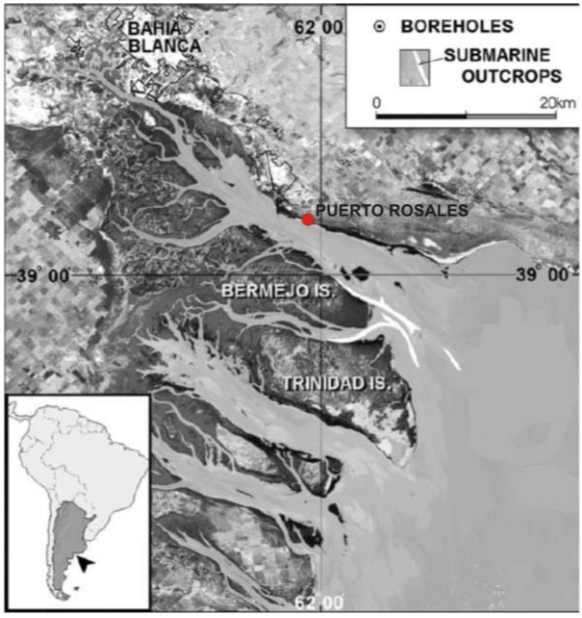

Figure 3. Location of the town of Puerto Rosales in Bahia Blanca Estuary.

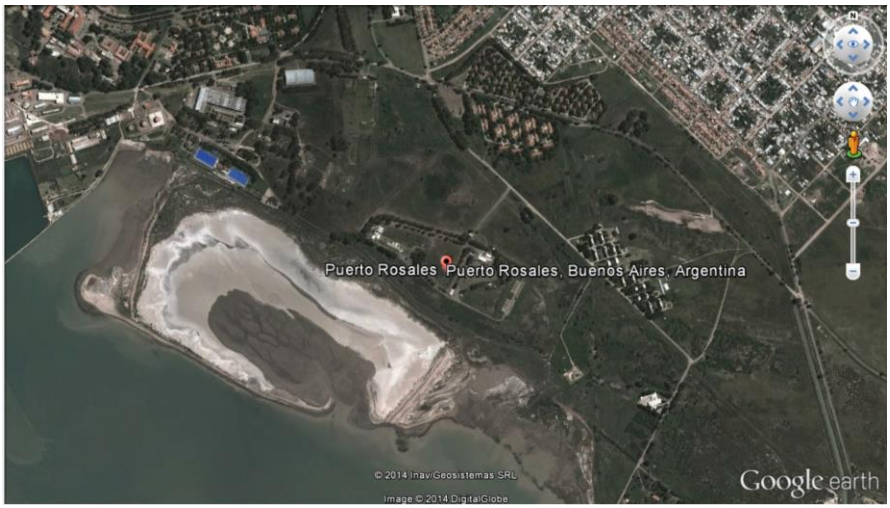

Figure 4. Satellite image taken from google earth of the Puerto Rosales.

Figure 5. Sampling points on Puerto Rosales.

Figure 6. Location of the North basin and sampling sites (red) in Laguna Don Thomas (near the city of Santa Rosa) in the province of La Pampa, Argentina.

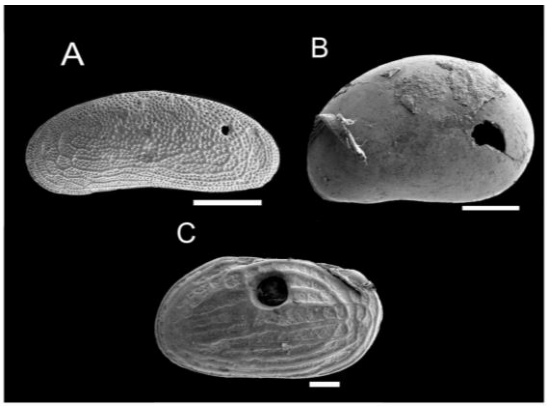

Figure 7. Specimens with evidence of predation from Puerto Rosales. A-B: *Oichnus simplex,* C: *Oichnus paraboloides* (scale= 100 µm).

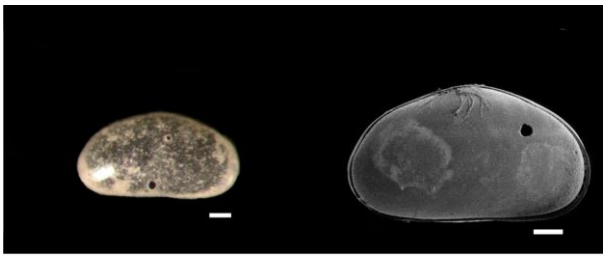

Figure 8. Samples of *Heterocypris similis* with evidence of predation (scale= 100 µm).