BENTHIC OSTRACODS FROM THE SOUTHERN GULF OF MEXICO

Maria Luisa Machain-Castillo and Raúl Gío-Argáez

INTRODUCTION

Ostracods are one of the most abundant groups of benthic microfauna. Besides being important components of the food chain, they are useful ecologic indicators. This chapter presents the present knowledge of ostracod biodiversity in the southern Gulf of Mexico, their distribution patterns and their present use as potential environmental indicators. Ostracods are microcrustaceans ($\leq$0.5 mm) with a bivalved shell that encloses the organism and is an integral part of the body. This shell records characteristics that provide information about the organism's physiological adaptations. Their close relationship with the environment in which develop make them useful as indicators of environmental parameters such as water temperature, salinity, substrate type and the concentration of various elements in water and sediment. Ostracod assemblages may reflect changes in environmental conditions through changes in the taxonomic composition of their populations or in the chemical composition of their shells.

TAXONOMIC COMPOSITION

When oceanographic factors change in an area, for example, alterations in patterns of oceanic circulation and water masses, or changes in salinity, ostracod community composition varies in accordance with the new environmental factors. Increases or decreases in salinity in one area result in different populations associated with different salinity levels. During the rainy season, areas influenced by freshwater discharge near the deltas of rivers are populated by species from brackish or fresh water environments that tolerate lower salinities, such as *Cyprideis* spp, *Limnocythere friabilis*, and *Loxoconcha matagordensis* (Machain-Castillo *et al.* 1990). The presence of these species in marine sediments provides information concerning the geographic extent of riverine influences.

MORPHOLOGIC CHANGES

Some ostracod species modify their shells in response to the concentrations of various ions/cations present in their habitat. For instance, the same species may have a heavier and more ornamented shell in areas with high concentrations of carbonates than in areas where carbonate concentrations are lower. Changes in salinity can also modify the shape and ornamentation of the valves. A stratigraphic study of the Cobweb swamp, in southern Quintana Roo, found that populations of *Cyprideis ovata* were composed of smooth organisms in brackish water, whereas the shells of freshwater populations exhibited nodes (Machain-Castillo *et al.* 1992).

CHEMICAL COMPOSITION

Just like all other crustaceans, ostracods grow by shedding their "skins" (shells) and their new shells calcify in a few hours (Palacios-Fest, personal communication). The chemical composition of the shell provides a "snapshot" of the environmental conditions of the surrounding water in which it was formed. Thus, the analysis of the chemical composition of the shells can indicate the presence and concentrations of certain elements in water during the period when the shell formed. This feature makes them potential indicators of chemicals, whether natural or of human origin, and, in contrast with other indicator organisms that metabolize or accumulate pollutants, through time, ostracod shells provide a snapshot of the presence or absence of contaminants at the time they calcify. An additional advantage is that the shell is preserved in the sediment and documenting them through time allows the reconstruction of the environmental history of an area.

BIODIVERSITY & DISTRIBUTION PATTERNS

Until 1985, the only studies of ostracods in the Mexican exclusive economic zone of the Gulf of Mexico and the Caribbean were the works of Krutak and his collaborators for the Veracruz coral reefs (Krutak 1982; Krutak and Rickles 1979; Krutak *et al.* 1980) and the work of Palacios-Fest and Gío-Argáez (1979) and Palacios *et al.* (1983) for the Mexican Caribbean.

Since 1985, we began a systematic study of the Mexican exclusive economic zone of the Gulf of Mexico and the Caribbean. The study material comes from more than 10 oceanographic cruises on board the *Justo Sierra*, an oceanographic research vessel belonging to the Universidad Nacional Autónoma de México (UNAM), where diverse taxonomic groups were collected and physicochemical and geologic parameters were obtained. To date, nearly 200 different species of ostracods have been identified in the Gulf of Mexico south of 21º N latitude at depths from 15-3500 m. The species present a clear pattern of distribution in six faunistic associations, related to depth, substrate and oceanic dynamics. On the inner continental shelf of the southern Gulf of Mexico, two main associations can be found: a) ostracod assemblages with terrigenous affinities, west of the Laguna de Términos; and b) ostracod assemblages associated with the carbonate shelf of the Campeche Bank

The inner continental shelf in the southern Gulf of Mexico west of Laguna de Términos is characterized by the presence of clastic sediments and by the influence of numerous rivers with seasonal discharges of variable quantities of freshwater, sediments, organic matter, pollutants, etc. Such discharges contribute to a markedly variable environment of all these factors. The ostracod fauna in this area has adapted to the environment's instability and is dominated by the following species: *Loxoconcha moralesi*, *Loxoconcha* sp. A, *Cytherella vermilionensis*, *Cytherura* spp. and *Pontocythere* spp. Also important in this association are *Cytheromorpha paracastanea* and *Paradoxostoma* spp (Fig. 5.1).

On Campeche Bank, carbonate sediments with little to no riverine influence and turbidity are found. Salinity and temperature are nearly stable and the content of organic matter in the sediments is low. The characteristic species found in this zone are: *Macrocyprina skinneri*, *Orionina* sp. A, *Loxocorniculum* spp., and species the family Bairdiaceae (Fig. 5.2)

Between these two areas is a large transition zone with seasonal changes around the Laguna de Términos. The ostracod assemblage of this zone is made up of combinations of species from both previously described associations. Most of these species tolerate large variations in environmental factors, such as *Proteoconcha* sp. A, *Basslerites minutus, Cytheromorpha paracastanea, Cytherura sandbergi, Cytheromorpha swaini, Loxoconcha moralesi* z, *Paracytheroma stephensoni*, *Orionina* sp. A , *Pellucistoma magniventra*, *Pumilocytheridea ayalai* and *Xestoleberis rigbyi*, that are found both in Laguna de Términos and zones adjacent to Campeche Bay. (Machain-Castillo and Gío Argáez 1989).

Outside the continental influence the both the northern and southern Gulf of Mexico at depths from approximate 60 to 110 m (middle shelf), the same association of ostracods are found. This association is dominated by *Echinocythereis margaritifera, Pontocythere*

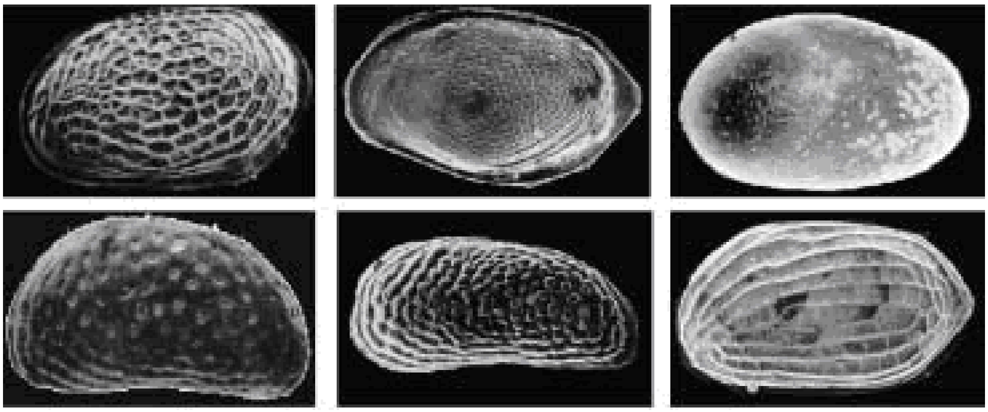

Figure 5.1. Ostracod species representative of the terrigenous community on the inner continental shelf west of Laguna de Términos. Top row, left to right: *Loxoconcha moralesi*, *Loxoconcha* sp. A, *Cytherella vermilionensis.* Bottom row, left to right: *Pontocythere semicularis*, *Pontocythere tuberculata* and *Cytherura* spp.

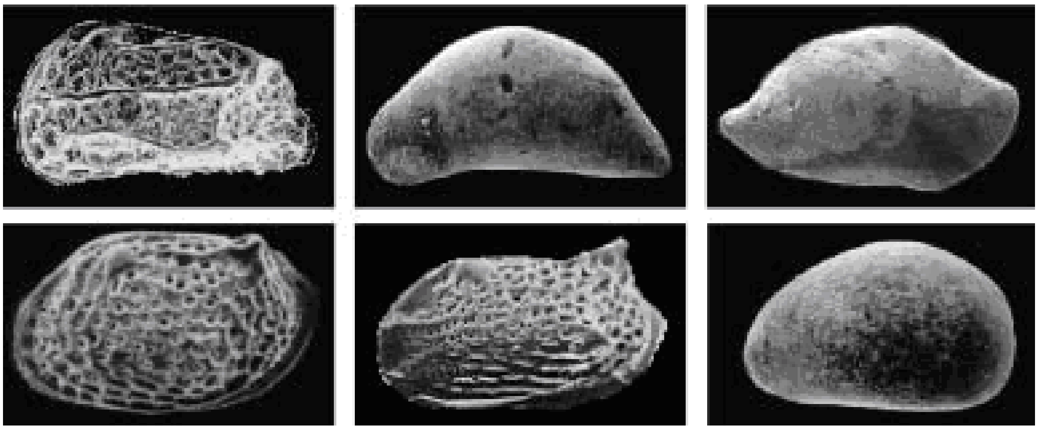

Figure 5.2. Ostracod species representative of the community on the inner continental shelf on Campeche Bank. Top row, left to right: *Orionina* sp. A, *Macrocyprina skinneri, Bairdoppilata cushmani*. Bottom row, left to right: *Loxocorniculum tricornatum, Loxocorniculum dorsotuberculata* and *Xestoleberis antillea.*

tuberculata, *Pterygocythereis alophia* and to a lesser degree, *Cytheropteron yorktownensis*, *Munseyella louisianensis* and *Pterygocythereis inexpectata* (Fig. 5.3).

On the outer shelf, the ostracod assemblage is comprised *Ambocythere* sp cf. *Ambocythere* sp, A. Cronin, *Argilloecia posterotruncata*, *Cytheropteron* spp., *Echinocythereis spinireticulata*, *Henryhowella* ex. gp . *asperrima, Pseudopsammocythere* ex. gp. *vicksburgensis* and species in the genera *Krithe* and *Parakrithe,* which may comprise up to 60% of total abundance (Fig. 5.4).

In the bathyal and abyssal regions of the Gulf of Mexico, ostracod populations decline in both abundance and in diversity and are dominated by the genera *Krithe*, *Cytheropteron* and *Parakrithe*. Other species in this association include *Argilloecia posterotruncata, Cytheropteron palton* and *Bradleya dictyon*. The genus *Krithe* is first present in the middle

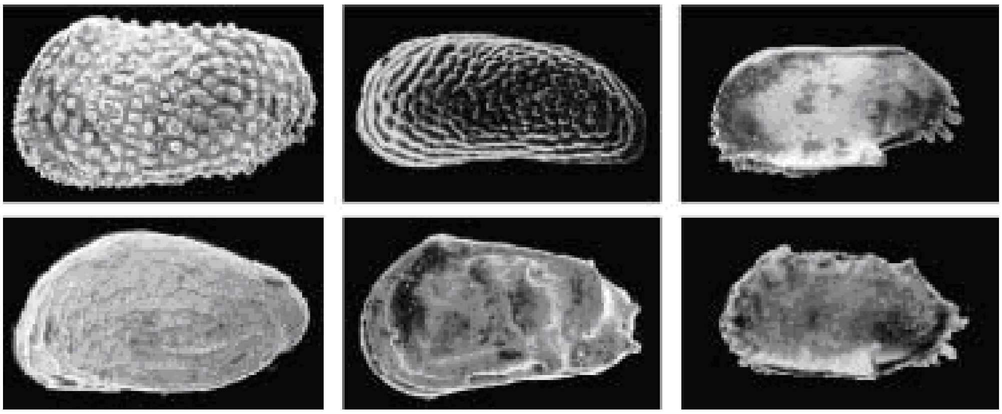

Figure 5.3. Ostracod species representative of the community on the middle continental shelf in both northern and southern Gulf of Mexico. Top row, left to right: *Echinocythereis margaritifera*, *Pontocythere tuberculata*, and *Ptergocythereis alophia*. Bottom row, left to right: *Cytheropteron yorktownensis*, *Munseyella louisianensis* and *Pterygocythereis inexpectata*.

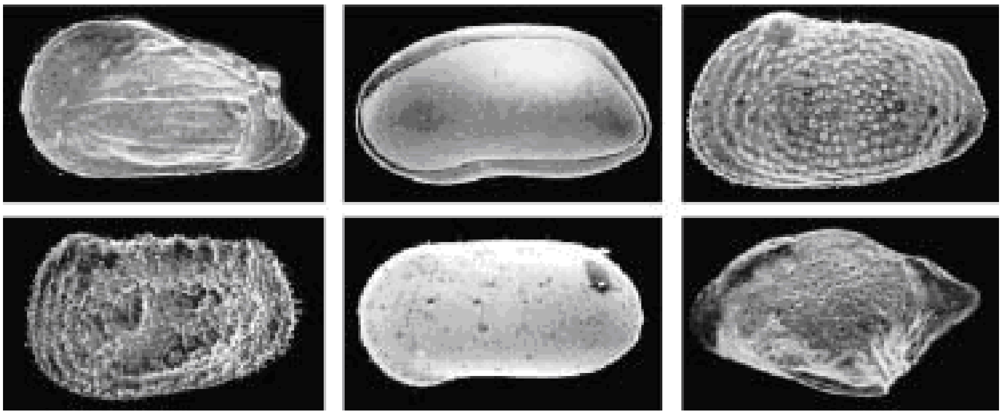

Figure 5.4. Ostracod species representative of the community on the outer continental shelf of the Gulf of Mexico. Top row, left to right: *Ambocythere* sp. cf. *Ambocythere* sp. A Cronin, *Argilloecia posterotruncata*, *Echinocythereis spinireticulata*. Bottom row, left to right: *Henryhowella* ex. gp. *asperrima*, *Pseudopsammocythere* ex. gp. *vicksburgensis* and *Cytheropteron morgani.*

outer shelf and relative abundance (%) increases as depth increases. In the abyssal zone, members of this genus make up 85% of the total population (Fig. 5.5).

POLLUTION

Ostracods have been used as indicators of water quality and several types of pollution (Bromley and Por 1975; Rosenfeld and Ortal 1983; Mesquita *et al.* 1996; Milhau *et al.* 1997, among others). Their close relationship with their environment allows them to be used as ecologic indicators of several parameters including pollution, to which they respond with variations in abundance, diversity or the taxonomic composition of their populations, or in the chemical composition of their shells that incorporate pollutants.

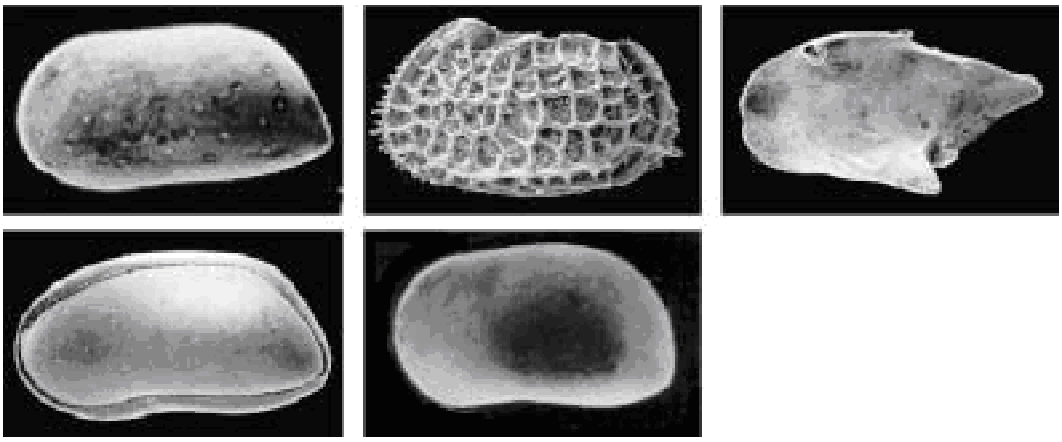

Figure 5.5. Ostracod species representative of the community on the continental slope of the Gulf of Mexico. Top row, left to right: *Krithe producta, Bradleya dictyon, Cytheropteron palton*. Bottom row, left to right: *Argilloecia posterotruncata* and *Parakrithe alta*.

Rosenfeld *et al.* (2000) found that in rivers polluted by discharges from human settlements, ostracod communities exhibited biotic zonation that allowed the delineation of zones of high, moderate and low pollution. These authors believe that the ostracod assemblage reveals the presence and extent of pollution better than measurements of physicochemical factors and that both taxonomic analyses and analysis of population density and diversity are useful in the determination of pollution levels.

In order to evaluate the impact of hydrocarbon exploitation activity on ostracod communities, samples were taken from the area where much of the offshore oil production occurs in the southern Gulf of Mexico. Preliminary results indicate that the taxonomic composition of ostracod communities in the area does not vary with respect to neighboring zones, but population density does. We found that population density (#/g of sediment) is higher where hydrocarbons were present in the sediments when compared to sediment samples from the same zone and depth without hydrocarbons (Fig. 5.6). In addition, higher concentrations of organic matter was detected in stations with higher hydrocarbon content, which suggests that the increase in ostracod populations may be related to the increase of organic matter (Fig. 5.7).

With respect to the analysis of trace metals and other elements from naturally occurring or anthropogenic contaminants in the environment, no studies have been performed to date on the chemical composition of ostracod shells of the south of the Gulf of Mexico. This area offers great potential for the study of pollutants in the aquatic medium, not just at present, but through time, since the preserved shells in sediment may reflect the history of the presence of contaminants in the environment.

CONCLUSIONS

Diversity and distribution patterns of ostracods in the southern Gulf of Mexico show that these organisms are sensitive to diverse oceanographic parameters and that they have potential for use as ecological indicators. Preliminary studies in the area where much of the offshore oil production occurs in the southern Gulf of Mexico indicate that taxonomic composition of ostracod communities does not vary with respect to neighboring zones, but abundance varies, apparently due to the greater quantity of organic matter present in samples where hydrocarbons were present in the sediment. Studies using ostracods as indicators or

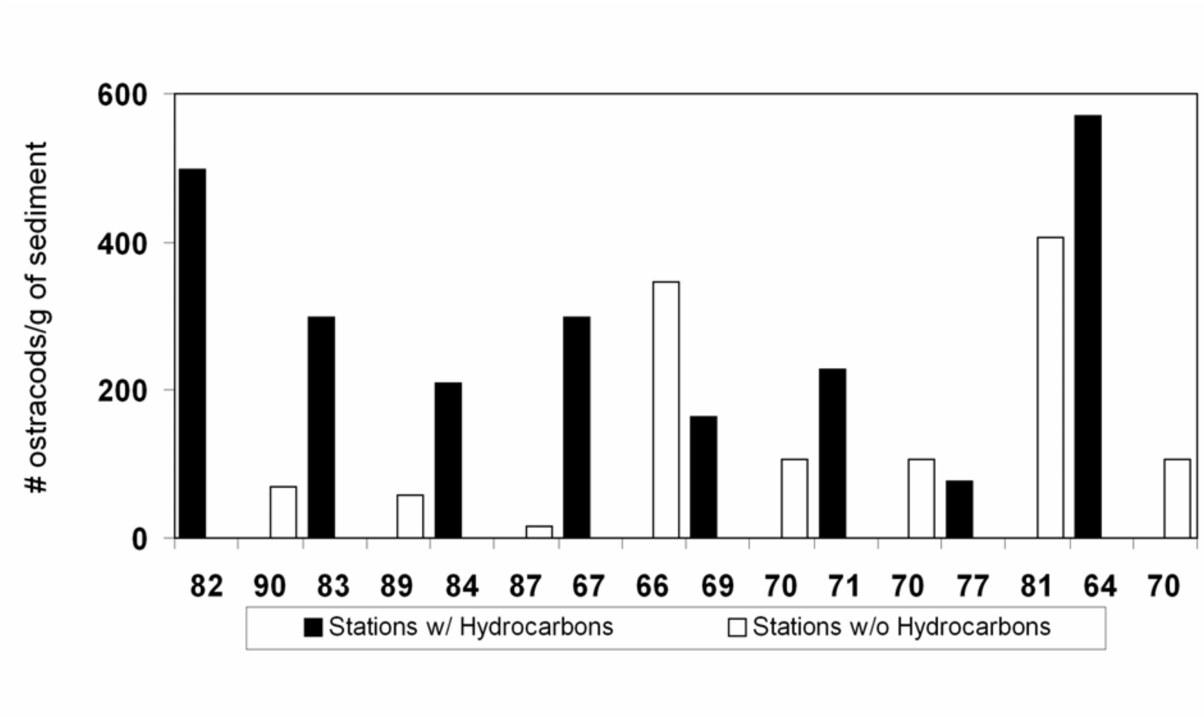

Figure 5.6. Abundance of ostracods (#/g sediment) in stations with and without hydrocarbons present in sediments in the southern Gulf of Mexico offshore oil production zone.

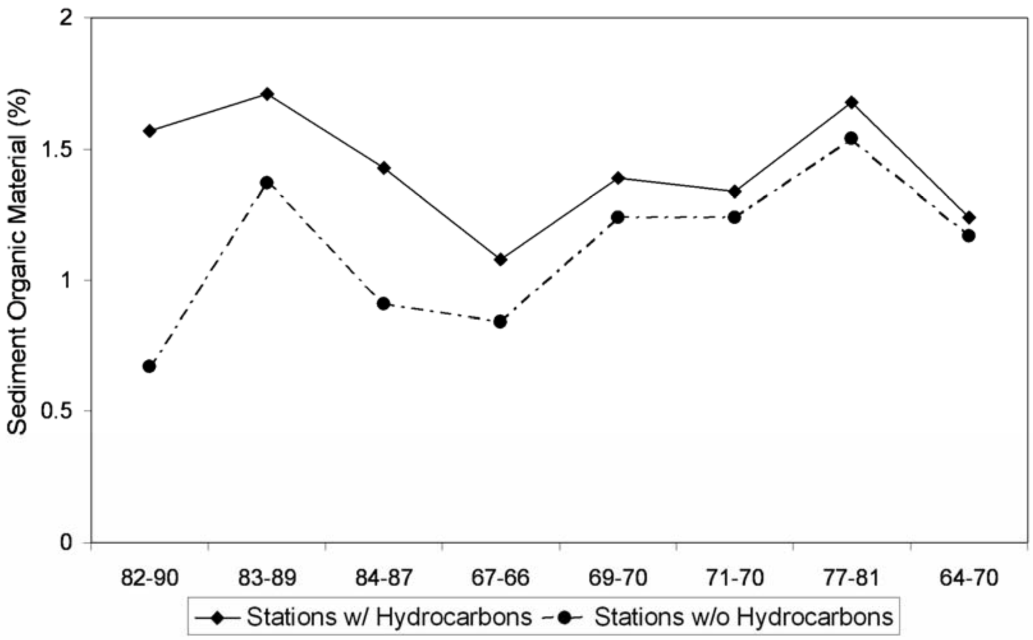

Figure 5.7. Comparison of the percentage of organic material in sediments in stations with and without hydrocarbons present in sediments in southern Gulf of Mexico stations in the offshore oil production zone.

biomarkers of pollution in the Gulf of Mexico are just beginning. However, these studies suggest that use of ostracods is highly promising and may contribute not just to the study of present day pollution but also to the study of the history of environmental quality in aquatic regions.

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