Asociación Paleontológica Argentina. Publicación Especial 7 ISSN 0328-347X
VII International Symposium on Mesozoic Terrestrial Ecosystems: 71-75. Buenos Aires, 30-6-2001

Cretaceous brackish water Conchostraca from Potiguar Basin, northeastern Brazil

Cecília CUNHA LANA[1] and Ismar de SOUZA CARVALHO[2]

Abstract. Although conchostracofaunas are common in ephemeral freshwater ponds of hot, alkaline waters, they can occur even in brackish waters of nearshore lagoons and tidally-influenced zones. This is presumed to be the life environments of Late Cretaceous conchostracans in the Potiguar Basin. The *Estheriina astartoides* Jones fauna occurs in the lower section of the Jandaíra Formation. This rock unit ranges from Lower Turonian to Middle Campanian age and consists mainly of carbonate marine facies. The monospecific conchostracofauna was found in exposures of marls within the Jandaíra Formation (Dix-Sept Rosado Gypsum quarry, Rio Grande do Norte State). The paleoenvironmental context, taphonomic features and associated palynofacies suggest that *Estheriina astartoides* could withstand saline conditions, such as those recorded in the evaporitic supratidal environment of the Dix-Sept Rosado Gypsum quarry.

Key words. Conchostraca. Halotolerant. Palynoforaminifera. Late Cretaceous. Potiguar Basin.

Geological setting

The Potiguar Basin is the easternmost of Brazilian equatorial basins (figure 1), and its origin and development are closely related to the geological evolution of the Brazilian continental margin. As in the other marginal basins three main tectono-sedimentary phase sequences are recorded within it: a rift-continental phase, followed by a transitional phase and finally a predominantly marine drift-phase; for a synthesis of the evolution of the Potiguar Basin, see Araripe and Feijó (1994; figure 1 herein).

The Jandaíra Formation consists mainly of carbonate marine facies. This rock unit also includes evaporites, with primary and secondary gypsum layers interbedded with greenish gray and brown shales and marls, that contain remains of bivalves, echinoid spines and plates, benthic foraminifera of the genera *Pyrgo* and *Trilochulina*, *Orbiculoidea* and fragments of crustaceans. These layers are overlain by limestones bearing a less diversified biota (moulds of marine ostracods and worm tubes). The section that is exposed in the Gypsum Quarry of Governador Dix-Sept Rosado county (figure 1) comprises facies associations that have been interpreted as indicating a restricted, evaporitic, supratidal depositional system (Farias *et al.*, 1990). The *Estheriina astartoides* fauna was recovered from a light green marl lying immediately beneath a gypsum-rich layer.

Precise dating of this part of the Jandaíra succession has proved difficult because of a generalized lack of age-diagnostic micro- and macrofossils. The gypsites of Dixt-Sept Rosado county were related to a marine regressive phase of late Turonian age (Pereira, 1994).

Late Cretaceous Conchostraca from Potiguar Basin

The Late Cretaceous assemblage consists of *Estheriina astartoides* Jones. The fossils are very well preserved, composed of entire and undamaged carapaces of the census population. There is no evidence of transportation and reworking of the carapaces.

The systematics can be summarized as follow:

Superfamily LIMNADIOIDEA Baird, 1894
Family LIMNADIIDAE Baird, 1894
Subfamily ESTHERIININAE Kobayashi, 1954

Genus ***Estheriina*** Jones, 1897

Type specie. *Estheriina bresiliensis* Jones, 1897, p. 198-199, Pl.8, Figs. 1-5.

Estheriina astartoides Jones, 1897
Figures 2.a-2.d

Description. Carapace somewhat gibbose, subcircular to subovate. Pronounced concentric ridgelets

[1]PETROBRAS Research and Development Center (CENPES), Ilha do Fundão, Cidade Universitária, CEP 21949-900, Rio de Janeiro, Brazil.
E-mail: lana@cenpes.petrobras.com.br.
[2]Departamento de Geologia, Universidade Federal do Rio de Janeiro, Ilha do Fundão, Cidade Universitária, CEP 21910-200, Rio de Janeiro, Brazil. E-mail: posgeo@igeo.ufrj.br.

 0328-347X/01$00.00+50

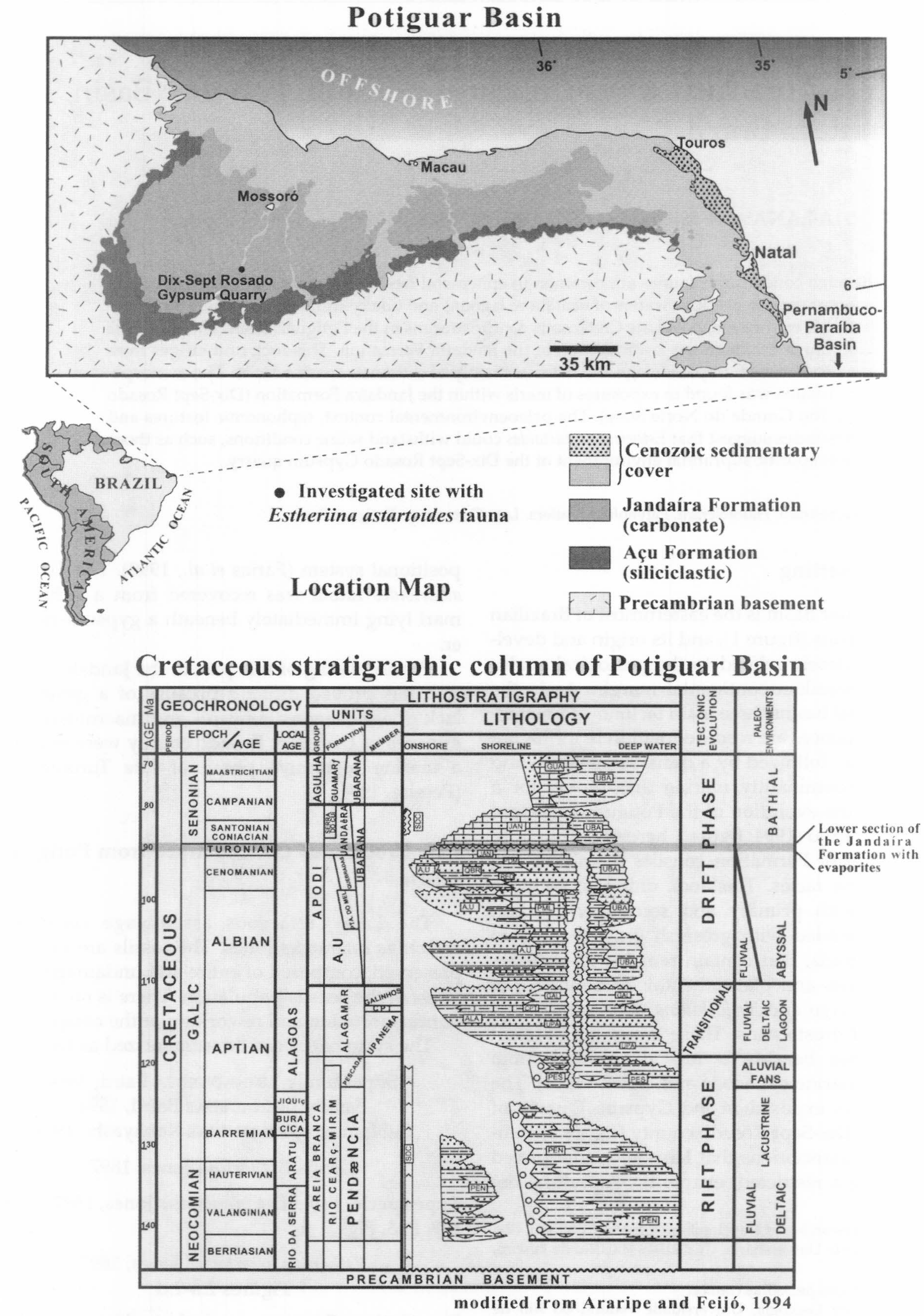

Figure 1. Location map and Cretaceous stratigraphic column of Potiguar Basin.

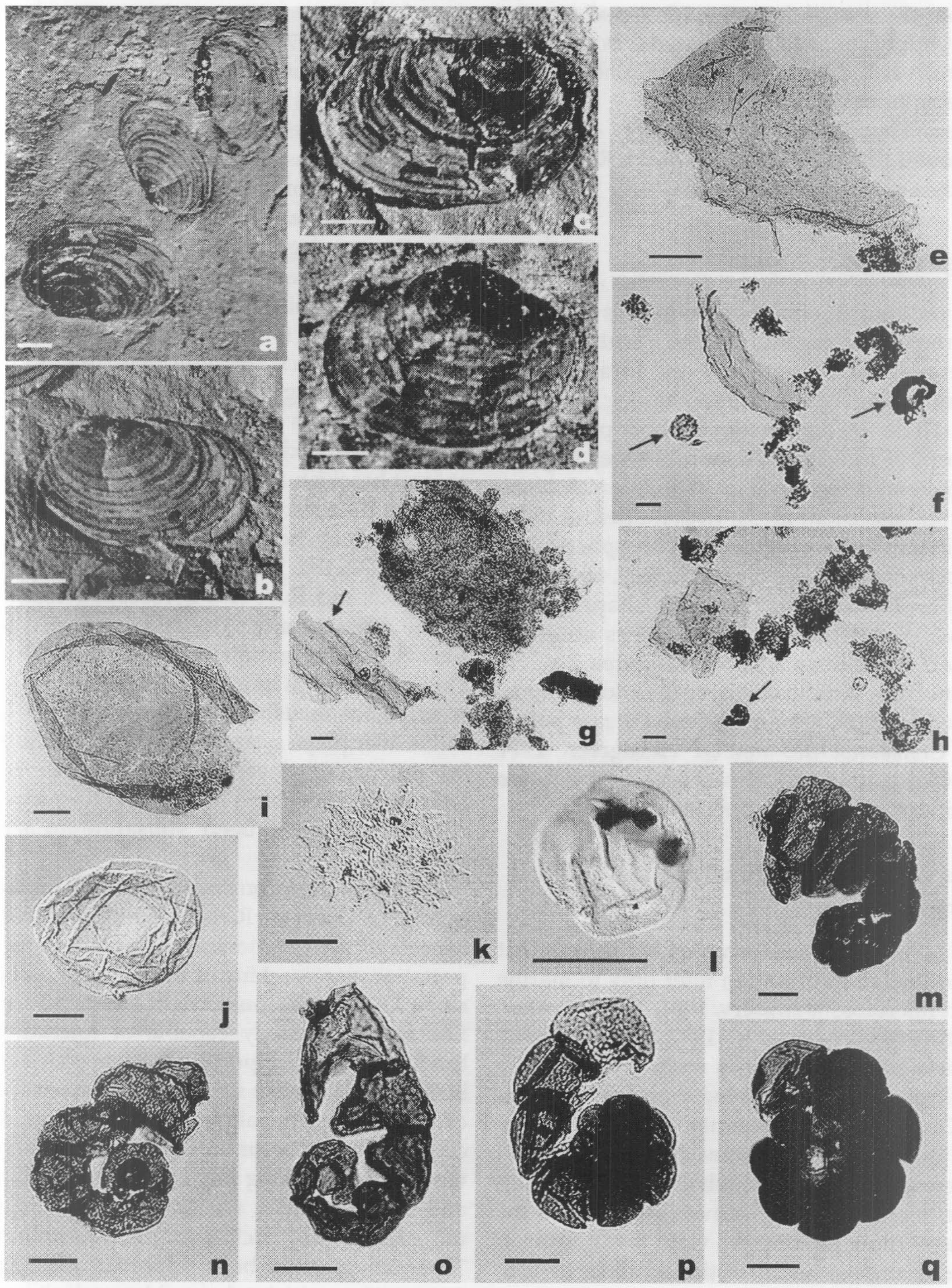

Figure 2. ***Estheriina astartoides*** fauna and associated palynofacies. **a,** general view of the ***E. astartoides*** fauna with well-preserved carapaces. **b-d,** specimens of ***E. astartoides*** Jones showing dimorphic valves: **b-c,** subovate; **d,** subcircular. Scale bar for **a-d** = 1mm. **e-q:** constituents of the palynological slide. All microphotographs under D.I.C. (differential interferential contrast) unless otherwise stated. **e,** chitinous conchostracan fragment with one discernible growth line. **f-h,** general views of palynofacies (without D.I.C.), dominated by amorphous organic matter, with 'chitin-like' fragments. **f,** arrows point to a palynoforaminifer and a possible conchostracan egg shell. **g,** arrow points to a fragment of conchostracan carapace. **h,** arrow points out to palynoforaminifer. Scale bar for e-h = 50 µm. **i-j,** conchostracan egg shells? **k,** ***Pediastrum*** sp. 1, ***Cretacaeiporites mulleri*** Herngreen. **m-q,** indeterminate palynoforaminifera. Scale bar for **i-q** = 20 µm.

near the umbo, on the swollen and thick part of each valve. Faint concentric lines on the broad and flat marginal area on the free borders. Feeble traces of some transverse lineation in the larger concentric interspaces. Differences in the shape of the valves are either related to sexual dimorphism (subcircular, female?; subovate, male?) or to ontogenetic stages. Umbonal sector with widely spaced growth bands is distinct from the rest of the valve (flattened or not), with more widely spaced growth bands. Dorsal margin short both behind and in front of umbo; umbo close to the anterior margin.

Observation. That species was originally described from the Lower Cretaceous section of the Recôncavo Basin, northeastern Brazil (Jones, 1897).

Palynological association

The palynological content of the marl is dominated by amorphous organic matter, and palynoforaminifera (organic remains of foraminifera; foraminiferal linings) predominate among the palynomorphs. These are represented by both planispiral and trochospiral multilocular morphotypes (figures 2.m-2.q). Several specimens of the colonial algae *Pediastrum* sp. also occur along with numerous indeterminate inaperturate corpuscles with spherical to ovoid shapes (conchostracan egg shells?), as seen in the figures 2.i-2.k. Brownish irregular-shaped particles also occur, and the rare growth lines observed suggest their conchostracan origin (figures 2.e-2.h). The sporomorphs, which constitute the allocthonous, land-derived fraction, are represented by rare pollen grains of *Cretacaeiporites mulleri* Herngreen 1974 (Albian to Campanian age), dwarf tricolporate forms and a few indeterminate perisporate spores.

Estheriina astartoides: a brackish water fossil conchostracan

Almost all previous palaeontological reports that concern the Jandaíra Formation refer only to marine macro- and microfossils (Maury, 1924, 1934; Beurlen, 1961a, 1961b, 1964; Viviers *et al.*, 1992; among others), the exception being Rebouças's work (1962) on the sedimentology and paleontology of the gypsum mines of Dix-Sept Rosado county. Rebouças recognized that the delicate, chitinous, two-valved shells with numerous growth lines, which were abundant in argillaceous layers of the mines, belonged to the genus *Estheria* (now no longer a valid conchostracan genus), and that these testify to the existence of temporary freshwater ponds among the general lagoonal-evaporitic environment. The coexistence of unequivocal marine microfossils (palynoforaminifera) and conchostracans, which are presumed to live in freshwater environments, therefore represents an apparent paradox.

Although living conchostracans are commonly found in small temporary freshwater inland pools they can also occur in more saline environments such as large playa lakes and coastal salt flats (Tasch, 1961). Most fossil conchostracans are thought to have lived in freshwater endorheic environments, in conditions similar to those of the most common extant forms (Webb, 1979; Frank, 1988). Nevertheless, based upon analyses of their distribution in Paleozoic and Mesozoic rocks of Europe and Asia, Kobayashi (1954) considered that they could have inhabited shallow seas. Tasch (1961) attributed the association of conchostracans with marine faunas to the existence of temporary pools close to ancient fluctuating shorelines or lagoons, and episodic invasion of the sea over such areas which could have mixed the faunas. Other possibilities include the dispersal of conchostracan eggs to nearshore marine or estuarine areas, and torrential flooding that covered pools temporarily, forming a widespread sheet of water that drained towards the sea, mingling the faunas. Webb (1979) postulated that some fossil species inhabited at least brackish and possibly marine environments, because living forms can withstand brackish water and many conchostracan assemblages have been associated with saltwater faunas. Gierlowsky-Kordesch and Rust (1994) recorded conchostracans in the finely laminated shale facies of the Jurassic East Berlin Formation of the Newark Supergroup. These occur with in a black shale unit which was interpreted as lacustrine facies that accumulated in a saline lake-playa system that was sometimes affected bu palaeosoil development. According to Gierlowsky-Kordesch and Rust (1994) the recovered conchostracans have been subsaline to stenohaline varieties.

The paleoenvironmental context of the gypsite quarry of Dix-Sept Rosado, along with taphonomic aspects of the conchostracans which show no transportation or reworking of the carapaces, suggest that some Late Cretaceous conchostracans were euryhaline forms, certainly capable of tolerating at least brackish water. Supporting evidence for *E. astartoides* being a halotolerant species comes from the analysis of the associated palynofacies. The organic residue consists largely of amorphous, 'blocky' organic matter, virtually lacking any continental palynomorphs and organic matter, and is further characterized by the unequivocal occurrence of palynoforaminifera. These could have been opportunistic agglutinated foraminifera which tolerated low salinity conditions, as has been reported from some levels of the Wealden Group (Lower Cretaceous) in the Isle of Wight (Radley, 1994).

Acknowledgments

We are grateful to PETROBRAS (CENPES), Fundação Universitária José Bonifácio/Rio de Janeiro Federal University, Fundação de Amparo à Pesquisa Carlos Chagas Filho do Estado do Rio de Janeiro (FAPERJ) and Conselho Nacional de

Desenvolvimento Científico e Tecnológico (CNPq) for funding support. José Henrique Gonçalves de Mello is especially thanked for his helpful critical review.

References

Araripe, P.T. and Feijó, F.J. 1994. Bacia Potiguar. *Boletim de Geociências da PETROBRAS* 8: 127-141.

Beurlen, K. 1961a. Observações geopaleontológicas no Cretáceo do Rio Grande do Norte e Ceará, com descrições de amonóides. *Coleção Mossoroense* 58: 1-12.

Beurlen, K. 1961b. O Turoniano marinho do nordeste do Brasil. Boletim da Sociedade Brasileira de Geologia 10: 39-52.

Beurlen, K. 1964. A fauna do Calcário Jandaíra da região de Mossoró (Rio Grande do Norte). *Coleção Mossoroense* 13, 215 p.

Farias, P.R.C, Castro, J.C., Tibana, P. and Barrocas, S.L.S. 1990. [*Cretáceo da Bacia Potiguar. Internal Report of PETROBRAS*, 25 p. Unpublished].

Frank, P.W. 1988. Conchostraca. *Palaeogeography, Palaeoclimatology, Palaeoecology* 62: 399-403.

Gierlowsky-Kordesch, E. and Rust, B.R. 1994. The Jurassic East Berlin Formation, Hartford Basin, Newak Supergroup (Connecticut and Massachusetts): a saline lake-playa-alluvial system. In: R.W. Renault and W.M. Last (eds.), *Sedimentology and Geochemestry of Modern and Ancient Saline Lakes*, SEPM (Society for Sedimentary Geology) Special Publication 50: 249-265.

Herngreen, G.F.W. 1974. Middle Cretaceous palynomorphs from northeastern Brazil. *Sciences Géologique Bulletin* 27: 101-116.

Jones, T.R. 1897. On some fossil Entomostraca from Brazil. *Geological Magazine* 4: 195-202.

Kobayashi, T. 1954. Fossil *Estherian*s and allied fossils. *Journal of the Faculty of Sciences* 9: 1-192.

Maury, C.J. 1924. Fósseis cretáceos do Rio Grande do Norte. In: Fósseis Terciários do Brasil. *Serviço Geológico e Mineralógico do Brasil*, Monografia 4: 495-585.

Maury, C.J. 1934. Fossil Invertebrata from Northeastern Brazil. *Bulletin of the American Museum of Natural History* 67: 123-179.

Pereira, M.J. 1994. [*Seqüências Deposicionais de Segunda e Terceira Ordem (50 a 2,0 Ma) e Tectono-Estratigrafia no Cretáceo de Cinco Bacias Marginais Brasileiras: Comparação com Outras Áreas do Globo e Implicações Geodinâmicas*. Doctoral Thesis, Federal University of Rio Grande do Sul, 1, 280 p. + 2, 210 p. Unpublished].

Radley, J.D. 1994. A foraminiferal datum in the Vectis Formation (Wealden Group, Lower Cretaceous) of the Isle of Wight. *Proceedings of the Geologists Association* 99: 133-140.

Rebouças, A.C. 1962. Estudo sedimentológico e paleontológico do perfil das minas de gipsita-Mossoró (RN). *Coleção Mossoroense Série B*, 61: 245-258.

Tasch, P. 1961. Paleolimnology. Part 2. Harvey and Sedgwick counties, Kansas. Stratigraphy and Biota. *Journal of Paleontology* 35: 836-865.

Viviers, M.C., Richter, A. J., Silva-Telles, A., Moura, J., Nascimento, N.L., Dino, R. and Shimabukuru, S. 1992. [Bacia Potiguar. In: Beurlen, G., Richter, A.J., Cunha, A.S., Silva-Telles, A. *et al*..(Eds.). *Bioestratigrafia das Bacias Mesozóicas-Cenozóicas Brasileiras*. Internal Report of PETROBRAS 1/2: 337-408. Unpublished].

Webb, J.A. 1979. A reappraisal of the palaeoecology of Conchostracans (Crustacea: Branchiopoda). *Neues Jahrbuch für Geologie und Paläontologie Abbhandlungen* 158: 259-275.

Accepted: February 2nd, 2001.