

The systematic position and zoogeography of the Family Saididae ARANKI *et al.* (Crustacea, Ostracoda), with the description of a new genus

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Abstract

New material from the Indian Ocean yielded specimens with preserved limbs of a species belonging to a new genus, closely related to the genus *Saida* HORNIBROOK, 1952. The new genus is described in the present paper. Both genera are discussed, and the known species are listed. The subfamily Saidinae ARANKI *et al.*, 1992 is raised to the rank of family. The systematic position of the family Saididae is discussed and it can be concluded that it is a family in its own right, with a mosaic of loxoconchid and cytherurid characters. The (palaeo)zoogeographical analysis shows that the family has a Tethyan distribution.

Key-words

Ostracoda, family Saididae, taxonomy, new genus, palaeozoogeography, Indian Ocean, Papua New Guinea.

INTRODUCTION

When describing the new genus *Saida*, HORNIBROOK (1953, p. 67) did not assign it to a particular family, but left it in "Family incertae sedis". Many subsequent authors followed HORNIBROOK, by leaving the genus *Saida* in familia incertae sedis, family uncertain etc. It was GRÜNDEL (1969, p. 356) who for the first time attempted to place *Saida* in a broader taxonomic framework, by assigning the genus, tentatively (i.e. with a question mark), to the family Cytheruridae, subfamily Cytherurinae, tribe Orthonatocytherini (together with the genera *Orthonatocythere* and *Stillina*). A few years later MCKENZIE (1974, p. 161) suggested that the systematic position of *Saida* may be with the Cytherinae, which would associate it with *Loxocythere*. This point of view is shared by some later authors, such as NEALE (1975, p. 13), WHATLEY & DOWNING (1983, p. 363), COLES & WHATLEY (1989, p. 83) and WHATLEY *et al.* (1993, p. 353). In 1992, finally, ARANKI *et al.* introduced the

monotypic subfamily Saidinae (raised to the rank of family in the present paper). The discovery in the Indian Ocean (Comoro Islands and Maldives) of specimens with soft parts of *Cytherura gushikamiensis* NOHARA, a species redescribed in the present paper and placed in a new genus closely related to *Saida*, throws a new light on the systematic position of the family Saididae.

SYSTEMATIC DESCRIPTIONS

Class Ostracoda LATREILLE, 1806

Order Podocopida SARS, 1866

Superfamily Cytheroidea BAIRD, 1850

Family Saididae ARANKI, MCKENZIE, REYMENT & REYMENT, 1992

1992 Subfamily Saidiinae ARANKI, MCKENZIE, REYMENT & REYMENT, p. 8; originally described as subfamily of the family Cytheridae; raised to the rank of family in the present paper.

EMENDATION

The family name should be spelled Saididae instead of Saidiidae (originally described as subfamily Saidiinae by ARANKI *et al.*, 1992). The stem of the genus name *Saida* is Said-. By adding the family suffix -idae, the family name becomes Saididae.

TYPE GENUS

Saida HORNIBROOK, 1952.

DIAGNOSIS

Oval to subrectangular small to medium-sized valves;

ventro-lateral arched carina, sometimes prominent; valves punctate to nearly smooth; with or without caudal process; anterior and posterior submarginal denticles; inner lamella wide; line of conrescence and inner margin coinciding; marginal pore canals few, rarely branching; hinge lophodont to merodont.

Appendages (only known from *Saidella* gen. nov.): antenna with one terminal claw; setation of mandibular palp reduced; masticatory process with large distal hook; maxillule with one short aberrant ray and with two endites (one endite and palp absent).

GENERA ASSIGNED TO SAIDIDAE

Saida Hornibrook, 1952 and *Saidella* gen. nov.

RANGE

Lower Albian - Recent.

Genus *Saida* HORNIBROOK, 1952

TYPE-SPECIES

Saida truncata (by original designation). According to SWANSON (pers. comm. of HORNIBROOK to SWANSON, in SWANSON, 1969, p. 47) and WHATLEY & DOWNING (1983, p. 363), *Saida truncata* HORNIBROOK, 1952 is a junior synonym of *Cythere torresi* BRADY, 1880 (= *Saida*). Morphological differences between *Saida*-species, however, are very small, and it is not excluded that both species are not synonymous after all. Further study of the type specimens is required to resolve this problem. Whatever the outcome, it does not affect the validity of the genus *Saida*.

DIAGNOSIS

Small to medium-sized suboval valves with straight to convex dorsal margin; valves without caudal process; valve surface punctate; ventro-lateral keel sometimes forming a blunt wing-like expansion; hinge lophodont to merodont; line of conrescence coinciding with inner margin; few radial pore canals, simple, rarely branched (soft parts unknown).

SPECIES ASSIGNED TO THE GENUS *SAIDA*.

Saida truncata HORNIBROOK, 1952, the type species. Also mentioned by HARTMANN, 1985.

Saida torresi (BRADY, 1880); also mentioned by HORNIBROOK (1953), SWANSON (1969), PURI & HULINGS

(1976, redescription of type specimen), ISHIZAKI (1977, 1981), NOHARA & YABU (1983), WHATLEY & DOWNING (1983), RUAN & HAO (1989), YASSINI & JONES (1995), TABUKI (2001). According to ZHOU (1995), *S. torresi* HORNIBROOK *sensu* RUAN & HAO (1989) does not belong to this species, but is identical with their *Saida* sp.

Saida elliptica (BONNEMA, 1941); also mentioned by HOWE & LAURENCICH (1958), SZCZUCHURA (1965) and HERRIG (1968).

Saida pulchra RUSSO, 1964; also mentioned by ASCOLI (1968), DALL'ANTONIA *et al.* (2001, 2003).

Saida nettgauensis GRÜNDEL, 1966, oldest record of the genus (Lower Albian), also mentioned by WILKINSON (1990).

Saida crassa HERRIG, 1968; also mentioned by HERRIG (1966 and 1996, as *Saida elliptica sensu* HERRIG, *partim*), by JØRGENSEN (1979) and by HERRIG (1993b).

Saida exilis HERRIG, 1968.

Saida media HERRIG, 1968.

Saida rhomboidea NEALE, 1975.

Saida herrigi KEIJ, 1975; also mentioned by HANAI, IKEYA & YAJIMA (1980), CAI & TU (1983), NOHARA & YABU (1983), NOHARA (1987), CAI (1991), TABUKI (2001).

Saida limbata COLALONGO & PASINI, 1980.

Saida cuneata CIAMPO, 1983; also mentioned by MICULAN (1992).

Saida ovata CIAMPO, 1983.

Saida recta CIAMPO, 1983.

Saida ionica CIAMPO, 1988. Also mentioned by CIAMPO (1992) and DALL'ANTONIA (2002, 2003).

Saida micropunctata COLES & WHATLEY, 1989. HERRIG (1993a) emphasizes the strong similarity between this species and *Saida crassa* HERRIG, 1968. Also mentioned by ZHAO (2005).

Saida bellsensis MCKENZIE, REYMENT & REYMENT, 1991.

Saida sissinghi ARANKI *et al.*, 1992.

Saida daisa MCKENZIE, REYMENT & REYMENT, 1993. According to AYRESS (1995), this species has to be considered a junior synonym of *Saida limbata* COLALONGO & PASINI, 1980.

Saida centralis HERRIG *et al.*, 1997.

Saida nudata HERRIG *et al.*, 1997.

Saida prasutegusi PYNE, WHATLEY & WILKINSON, 2003.

In open nomenclature

Saida ? sp. DELTEL, 1963; also mentioned by DUCASSE (1974, 1975, 1977), DUCASSE & CAHUZAC (1997) and by CHAROLLAIS *et al.* (1980).

Saida ? sp. PIETRZENIUK, 1969.

Saida sp. ASCOLI, 1969.

Saida sp. SISSINGH, 1972 (= *S. sissinghi* ARANKI *et al.*, 1992).

Saida sp. BABINOT *et al.*, 1987.

Saida sp. MCKENZIE, 1974.

Saida sp. 2 DUCASSE & GRÉKOFF, 1976.

Saida sp. Pokorny, 1981.

Saida cf. *S. nettgauensis* GRÜNDEL, 1966, *sensu* WEAVER (1982).

Saida sp. A CRONIN, 1983; also mentioned by COLES, AYRESS & WHATLEY (1990).

Saida WHATLEY, 1983.

Saida sp. MCKENZIE & PEYPOUQUET, 1984.

Saida sp. GOU & CHEN, 1988.

Loxoconcha sp. CARBONNEL, 1988; tentatively assigned here to *Saida*.

Saida sp. GARCIA ZARRAGA & RODRIGUEZ LAZARO, 1990.

Saida sp. AYRESS, 1993.

Saida sp. ZHOU, 1995.

Saida sp. 1 WHATLEY & BOOMER, 1995.

Saida sp. 2 WHATLEY & BOOMER, 1995.

Saida sp. MAJORAN, 1996.

Saida MAJORAN, 1997.

Saida sp. IRIZUKI *et al.* 1998.

Saida sp. WHATLEY *et al.*, 1998.

Saida sp. WHATLEY & ROBERTS, 1999.

Saida sp. cf. *S. recta* CIAMPO, 1984 (DALL'ANTONIA *et al.*, 2001).

Saida sp. 1 AIELLO & SZCZECURA, 2004.

Saida sp. MAZZINI, 2004.

Saida sp. BERGUE *et al.*, 2006.

RANGE

Lower Albian - Recent.

Genus *Saidella* gen. nov.

TYPE SPECIES

Cytherura gushikamiensis NOHARA, 1987 (here designated).

DIAGNOSIS

Very small subrectangular valves; dorsal margin slightly concave; prominent horizontal postero-dorsal and vertical posterior ridge, ending in a postero-ventral spine; prominent arched lateral ridge running from antero-ventral to postero-dorsal area; carapace laterally compressed below this ridge; caudal process present; valve surface punctate to nearly smooth; hinge merodont; inner lamella wide; line of concrescence and inner margin coinciding; marginal pore canals few, postero-dorsal one distinctly branched; muscle scar pattern consisting of four small adductor scars and a small subtriangular frontal scar.

DERIVATION OF NAME

Saida and suffix *-ella*, meaning little *Saida*; gender feminine.

SPECIES ASSIGNED TO *SAIDELLA* gen. nov.

Cytherura gushikamiensis NOHARA, 1987, the type species.

Saida nana HERRIG, 1968. Also mentioned by HERRIG (1996) as *Saida elliptica* (BONNEMA 1941) *sensu* HERRIG, 1968 *partim*, oldest record of the genus (Lower Maastrichtian).

Cytherura kingmai BOLD, 1946, = *Saida ? kingmai* (BOLD), BOLD, 1988.

Saida hobros RUAN & HAO, 1988.

Cytherura nonspinosa AYRESS, 1996.

Saida sp. MCKENZIE, REYMENT & REYMENT, 1993 (= *Cytherura nonspinosa* AYRESS, 1996).

Cytherura cf. *gushikamiensis* AYRESS, 1993.

RANGE

Lower Maastrichtian - Recent.

REMARKS

The new genus *Saidella* differs from *Saida* HORNIBROOK,

1952 by its subrectangular shape with a slightly concave dorsal margin, the presence of a caudal process, a strongly developed dorsal rib and a perpendicular posterior rib.

DISCUSSION

See below.

Saidella gushikamiensis (NOHARA, 1987)
(Figs 1-15; Plate 1, Figs 1-9)

1987 *Cytherura gushikamiensis* NOHARA: 57, pl. 7, figs 1a, 1b.

TYPE LOCALITY

S. Okinawa-jima (sample 75122802C of NOHARA).

TYPE HORIZON

Chinen Sands, Pleistocene. The species is also mentioned from the Shinzoato Tuff, Upper Pliocene, Okinawa-jima.

MATERIAL

One male specimen, with valves stored dry (O.C.1317a) and dissected limbs preserved in a sealed glycerine preparation (O.C.1317b), from the Comoros, Grande Comore, Fomboni, collected at a depth of 14 m, in coral sand. Leg.: Expédition Karthala 81, Groupe Plongée, August 1st, 1981 (Station 6).

One male specimen, with valves stored dry (O.C.1318a) and dissected limbs preserved in a sealed glycerine preparation (O.C.1318b) from the Republic of Maldives, South Malé Atoll, Villi Varu Island, depth 1 m, in sand. Leg.: F. FIERS, December 3rd, 1984 (station 84/66).

One left and one right valve (O.C. 1319) from N. Papua New Guinea, Madang Province, Megiar Harbour, 145° 46' 04" E, 4° 48' 57" S, coral sand from shallow tidal pool. Leg.: J. VAN GOETHEM, July 21st, 1981 (station 81/496).

One left valve (O.C.1319bis) from N. Papua New Guinea, Madang Province, Malagere Island, 144° 56' 33" E, 4° 13' 46" S, coral sand, depth 3 m. Leg.: J. PIERRET, June 10th, 1979 (station 79/292).

The studied material is deposited in the ostracod collection of the Royal Belgian Institute of Natural Sciences, Brussels (Belgium).

DESCRIPTION

Very small and subrectangular valves; dorsal and ventral margin slightly concave and parallel; anterior margin broadly rounded; posterior margin with laterally compressed caudal process, situated at about 2/3 of the height; in loose valves the caudal process is often worn off; anterior and posterior cardinal angles present but not prominent; anterior submarginal rib, with anteriorly directed very short ribs, forming about six anterior denticles; postero-dorsal rib just below the dorsal margin; conspicuous, nearly straight and perpendicular posterior rib ending in a large postero-ventral spine; weak submarginal ventral rib; ventro-lateral carina extending diagonally upwards in posterior direction, to the contact point between postero-dorsal and posterior rib, but not reaching this point; ventro-lateral carina slightly developed as a wing-like expansion. Below this carina the valves are laterally compressed. Carapace punctate, with exception of the ribs; punctations subcircular in the anterior and antero-dorsal area or elongate near the lateral carina and in the postero-ventral area. Inner lamella wide; selvage very distinct all around the right valve and along the anterior and posterior margin in the left valve; seven anterior marginal pore canals, the antero-ventral one divided; three posterior marginal pore canals; postero-dorsal one divided in two branches near the inner margin, each branch being divided again in two smaller branches near the outer margin; muscle scar pattern consisting of four small adductor scars and a small subtriangular frontal scar; hinge merodont, with (in the right valve) an anterior tooth divided in two toothlets, a smooth median groove and a crenulate posterior tooth, consisting of five toothlets; left valve with a narrow accommodation groove.

Antennule: slender, six-segmented; setation reduced; third segment with one, and fifth segment with two dorso-distal setae; terminal segment with two long setae.

Antenna: four-segmented; one ventro-distal seta on second segment; strongly developed, two-segmented exopodite; third segment consisting of fusion of two segments, bearing three setae, a ventral and dorsal median one, and a ventro-distal one; terminal segment short, bearing only one strong claw.

Mandible: palp four-segmented; first segment without setae; epipodite not seen, probably absent; second segment with one ventro-distal seta implanted on a distal semi-oval widening of the second segment; third segment with four setae: a dorso-proximal one, a dorso-distal one and two ventro-distal setae; terminal segment subquadrate, bearing three short curved setae; masticatory process with irregular molar teeth; dorso-distal seta developed

as a large claw-like hook, connected with a joint to the process.

Maxillule: one short aberrant ray; 15 or 16 normal rays; only two endites present, bearing respectively three and four curved short claw-like setae; palp and one endite absent.

First leg: with four segments; first segment with one ventral and 1+1+2 dorsal setae; second segment with one antero-distal seta; third and fourth segments without setae; fourth segment with one stout, curved claw.

Second leg: first segment slightly longer, with 1 ventral and 1+1+1 dorsal setae; second segment with one antero-distal seta.

Third leg: large first segment with 1+1 dorsal setae; second segment long, with one antero-distal seta; fourth segment with obliquely inserted, curved terminal claw. Brush-like organ present, with medium-sized shaft and relatively short hairs.

Copulatory appendage very small, with a sub-rectangular basal part, two lobe-like distal expansions and a strongly chitinized club-like process.

Abdominal extremity with an elongate triangular blade-like prolongation, dorsally set with fine setules.

Dimensions: length 0.243-0.253 mm; height 0.132-0.141 mm.

Specimens of NOHARA (1987, p. 58) are somewhat larger: length 0.27-0.29 mm; height 0.15-0.17 mm.

Discussion

A NEW GENUS

In his review paper on the genus *Saida* in the Cretaceous, HERRIG (1968) already foreshadowed the possibility of a new genus, by dividing the genus into three groups. His group 3, with *Saida nana* HERRIG, 1968, corresponds with the here described new genus *Saidella*.

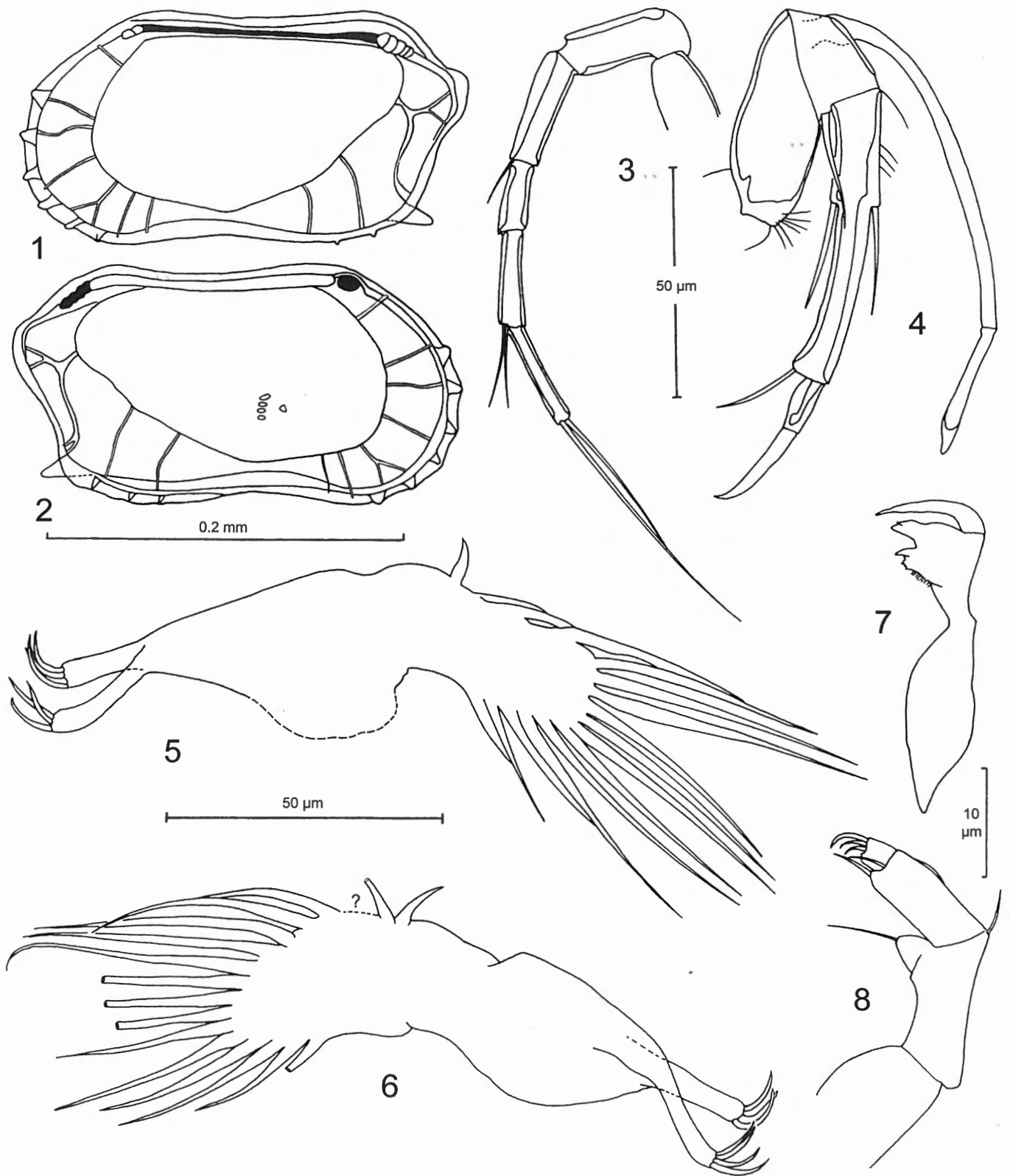
As far as the valves are concerned, the new genus *Saidella* can be easily distinguished from *Saida* by its subrectangular shape with a slightly concave dorsal margin, the presence of a caudal process, a strongly developed dorsal rib and a perpendicular posterior rib. The appendages show a unique set of features: reduced setation on antennule (fig. 3), antenna (fig. 4) and mandibular palp (figs 8 and 9), only two endites (instead of three) and absence of palp on the maxillule (figs 5 and 6), and a large dorso-distal hook (figs 7 and 9). Some of these characteristics, such as the reduction of setation, the absence of one endite and the palp of the maxillule and the small dimensions of the valves may be adaptations to an interstitial way of life. Because the soft parts of the genus *Saida* are unknown, it is difficult to distinguish

between generic and family characters.

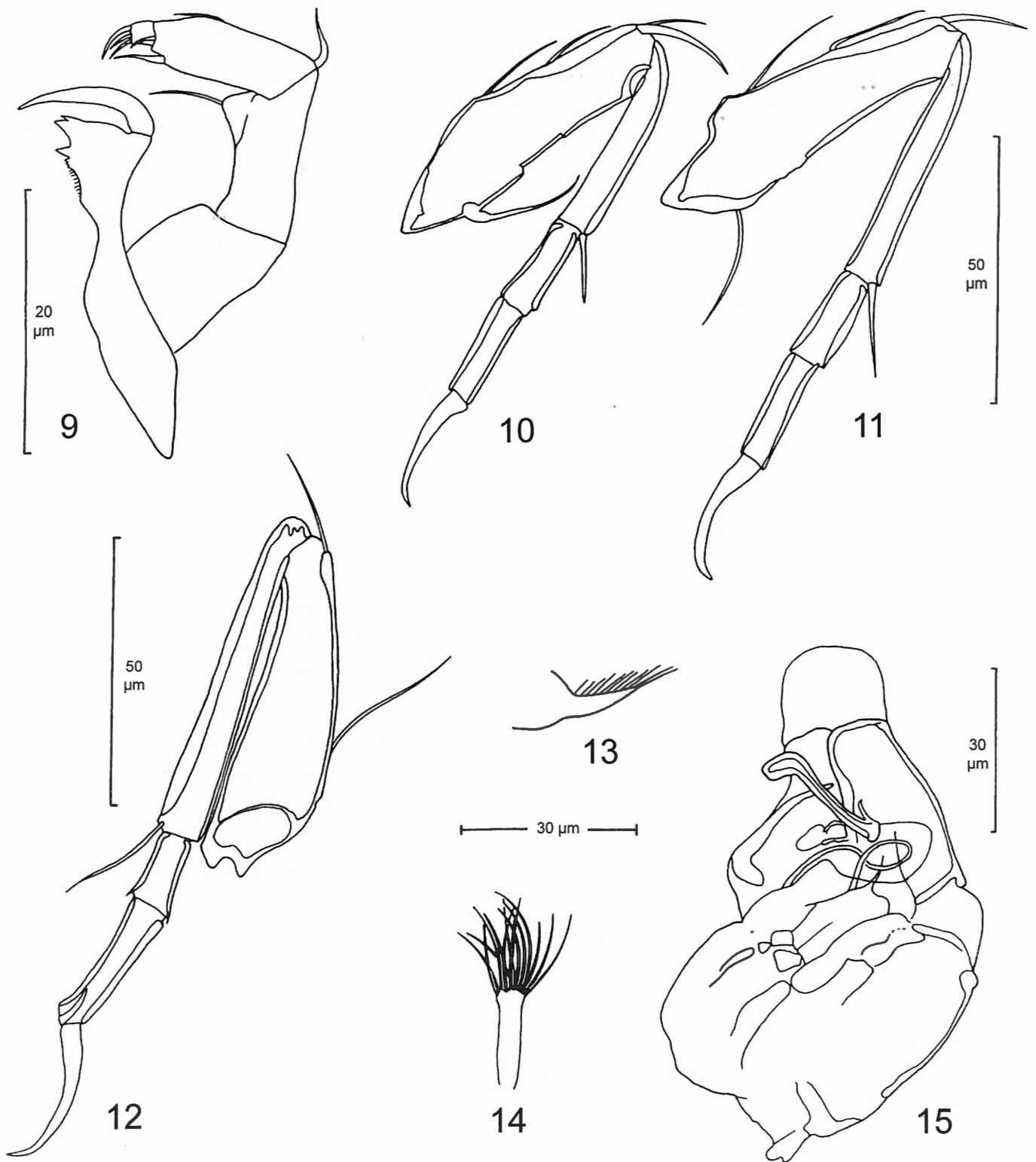
SYSTEMATIC POSITION OF THE FAMILY SAIDIDAE

ARANKI *et al.* (1992) described the Saidinae as a subfamily of the Cytheridae. It was MCKENZIE (1974, p. 161) who suggested for the first time that the systematic position of *Saida* may be with the Cytherinae, which would associate it with *Loxocythere*. This point of view is shared by some later authors, such as NEALE (1975, p. 13), WHATLEY & DOWNING (1983, p. 363), COLES & WHATLEY (1989, p. 83), and WHATLEY *et al.* (1993, p. 353). In the present paper, however, the subfamily Saidinae is raised to the level of family, with a somewhat different position. When comparing the characters of the valves and limbs of *Saida* and *Saidella* with those of members of other families, it can be concluded that the family Saididae shows relationships as well with Loxoconchidae as with Cytheruridae. Both families are closely related, as shown by ELOFSON (1941, p. 305) and HARTMANN (1964, p. 63-65). The limbs of *Saidella* are reminiscent of those of the Loxoconchidae. The middle segment of the antenna is divided in *Cytherura* and *Cytheropteron* and undivided in *Loxoconcha* and *Saidella*. The number of setae on the proximal endopodite segment of the antenna is 2 in *Cytherura* and *Cytheropteron*, and 1 in *Loxoconcha* and *Saidella*. The number of aberrant "Strahlen" on the respiratory plate of the maxillule is 2 in *Cytherura* and *Cytheropteron* and 1 in *Loxoconcha* and *Saidella*. The number of dorsal setae on the protopodite of the legs is 1, 2, 0 in *Cytherura* and *Cytheropteron*, and 2, 1(2), 1(2) in *Loxoconcha* and 2, 2, 1 in *Saidella*.

The valve characteristics of *Saidella*, on the other hand, are closer to the cytherurids because of the broad inner lamella, the number and nature of the marginal pore canals, and the merodont hinge (loxoconchids have a gongylodont hinge). Some cytherurid species show a remarkable resemblance to the valves of *Saidella*, such as *Semicytherura pulchra* (for description, see AYRESS & CORREGE, 1992, p. 57), by the presence of a caudal process, a horizontal postero-dorsal and vertical posterior ridge, an anterior and ventro-lateral ridge and anterior marginal denticles. The valves of *Saida*-species are somewhat different from those of *Saidella*-species, and look in some instances like instars of loxoconchids. It is not to be excluded that in the loxoconchid-cytherurid family-complex, heterochrony played a role in the evolution of the family characters of the Saididae. Unfortunately, the limbs of the genus *Saida* remain unknown. It can be concluded that the family Saididae is a family in its own right, with a mosaic of loxoconchid and cytherurid characters.



Figs 1-8. *Saidella gushikamiensis* (NOHARA, 1987). 1. Right valve, internal view. 2. Left valve internal view. 3. Antennule. 4. Antenna. 5. Maxillule. 6. Maxillule. 7. Mandible. 8. Mandibular palp. Figs 1-4 and 6: Fomboni, Grande Comore, Comoros (O.C. 1317). Figs 7-8: Villi Varu, South Malé Atol, Maldives (O.C. 1318).



Figs 9-15. *Saidella gushikamiensis* (NOHARA, 1987). 9. Mandible. 10. First leg. 11. Second leg. 12. Third leg. 13. Abdominal extremity. 14. Brush-like organ. 15. Copulatory appendage. Figs 9-11 and 13-15: Fomboni, Grande Comore, Comoros (O.C. 1317). Fig. 12: Villi Varu, South Malé Atol, Maldives (O.C. 1318).

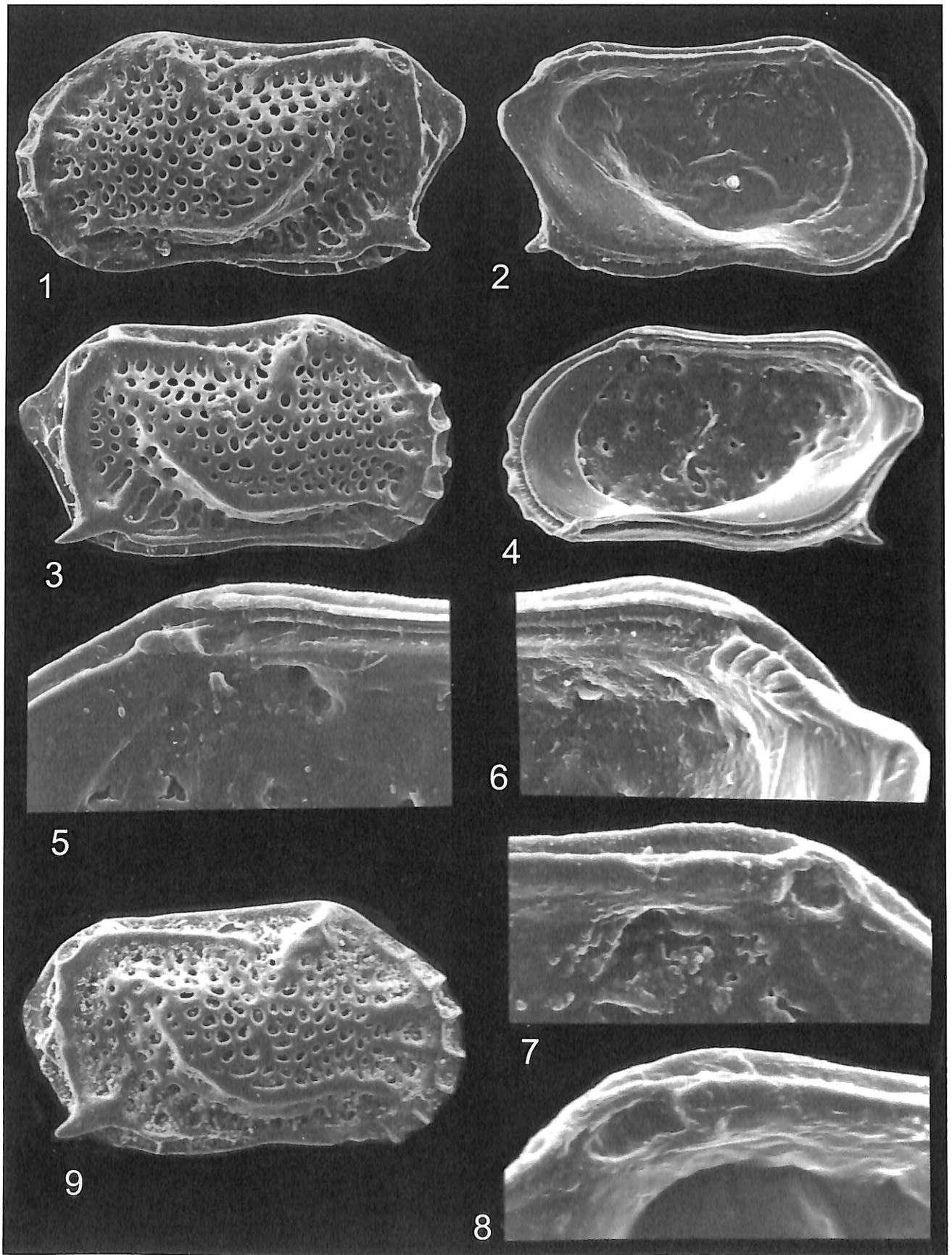


Plate 1. *Saidella gushikamiensis* (NOHARA, 1987). Fig. 1. Left valve external view, male, Comoros (O.C. 1317). Fig. 2. Left valve internal view, male, Comoros (O.C. 1317). Fig. 3. Right valve external view, male, Maldives (O.C. 1318). Fig. 4. Right valve internal view, male, Maldives (O.C. 1318). Figs 5-6. Hinge right valve, male, Maldives (O.C. 1318). Figs 7-8. Hinge left valve, male, Comoros (O.C. 1317). Fig. 9. Right valve, external view, Papua New Guinea (O.C. 1319).

Zoogeography of the family Saididae

Figs 16-19 illustrate the known distribution of fossil and Recent *Saida*-species, and fig. 20 of *Saidella*-species.

The oldest known species of the genus *Saida*, *S. nettgauensis* GRÜNDEL, 1966, was found in lower Albian deposits in borehole Nettgau, Saxony, north-central Germany. Most other Cretaceous localities are situated in Europe. There is one record of the genus, however, in Australia, namely *Saida rhomboidea* NEALE, 1975 from the Santonian chalk of Gingin (W. Australia). In Post-Mesozoic times the genus is spreading slowly to the Indian and Pacific Oceans, and later to the Atlantic. The genus *Saidella* is much younger. The oldest known species of the genus was found in the lower Maastrichtian of the Isle of Rügen (N. Germany). Post-Cretaceous occurrences are sporadic in Paleogene and Neogene deposits, and only four Recent localities are known. The species of the genus *Saidella* probably descended from a *Saida*-ancestor, and given the small dimensions of the valves, and the partial reduction of the limbs, most likely adapted to interstitial life.

Both genera, *Saida* and *Saidella*, have their oldest record in the Cretaceous, in the North European Province. This province, belonging to the Temperate Realm, was close to the boundary of the Tethyan Realm and predominantly comprised warm to mid-temperate

fauna (KAUFMANN, 1973). The family Saididae, with the genera *Saida* and *Saidella*, can therefore be called a Tethyan family, which may have originated along the northern Tethyan margin and dispersed slowly. MCKENZIE (1973) already stressed the importance of Tethys for the distribution of ostracods in general, and of *Saida*-species in particular.

There are remarkable similarities between the origin and distribution of *Saida/Saidella* and *Microceratina* (see NAMIOTKO *et al.* 2004). The three genera have their oldest record in the Cretaceous of the North European Province of Tethys, where they probably originated, and from where they dispersed over different parts of the world. Furthermore, species of these genera are rare. This means that in a single locality the number of individuals per species is always very low, throughout geological time, but also that the number of localities where species of the three genera occur is low. This means rarity in two senses, namely rarity of individuals within areas (density rarity), and the condition of occurring infrequently (range-size rarity). Finally, it remains puzzling to see that some ancient low diversity lineages survived over so long periods of time, e.g. *Microceratina* (NAMIOTKO *et al.* 2004), *Liasina* (WOUTERS, 1996, 1998), and now *Saidella* and to a lesser extent *Saida*.

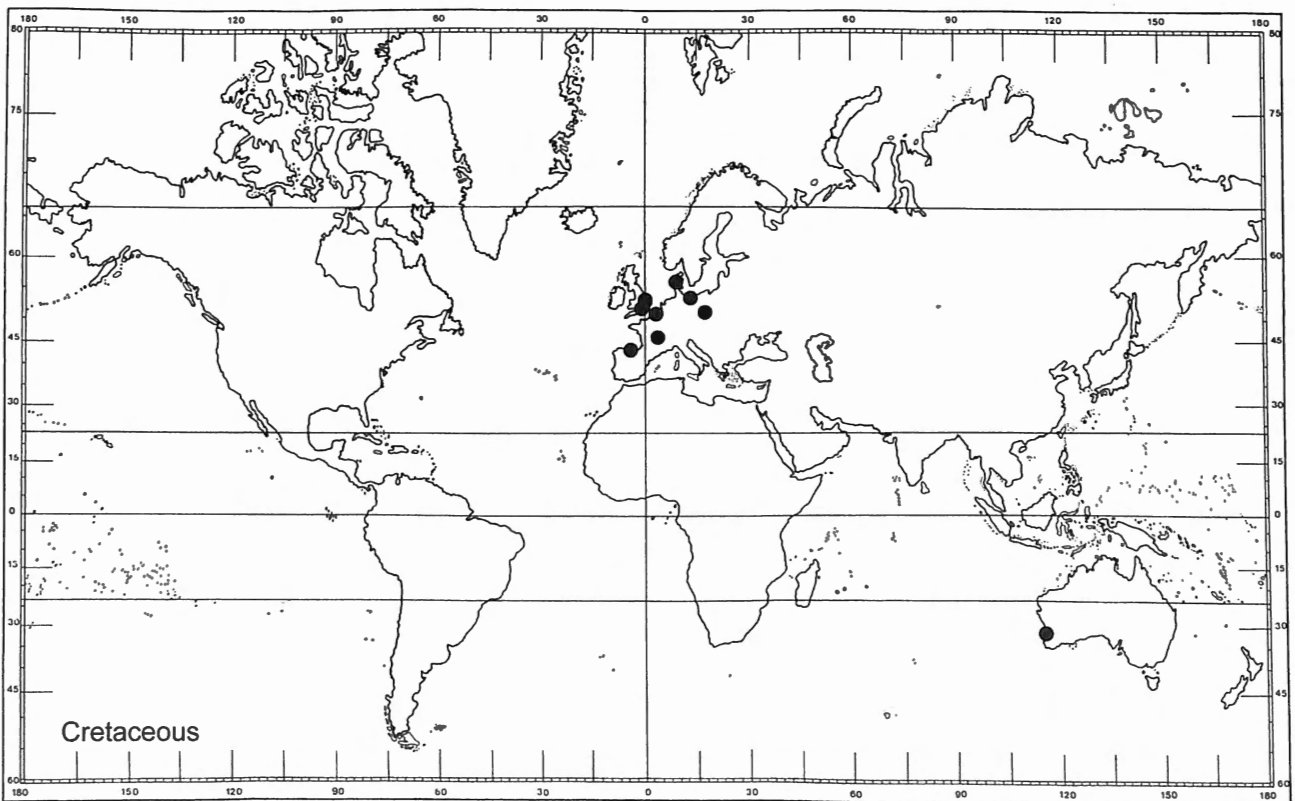


Fig. 16. Distribution of the genus *Saida* in the Cretaceous.

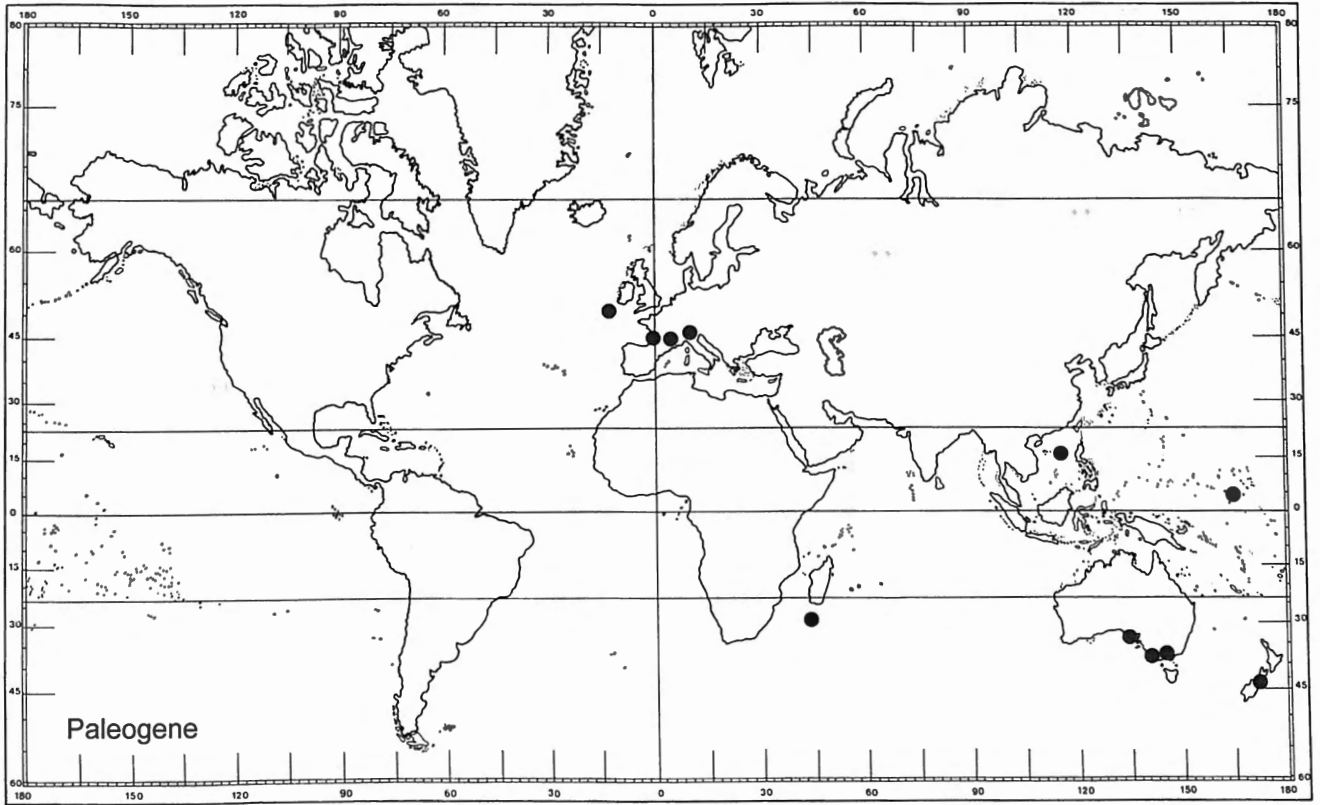


Fig. 17. Distribution of the genus *Saida* in the Paleogene.

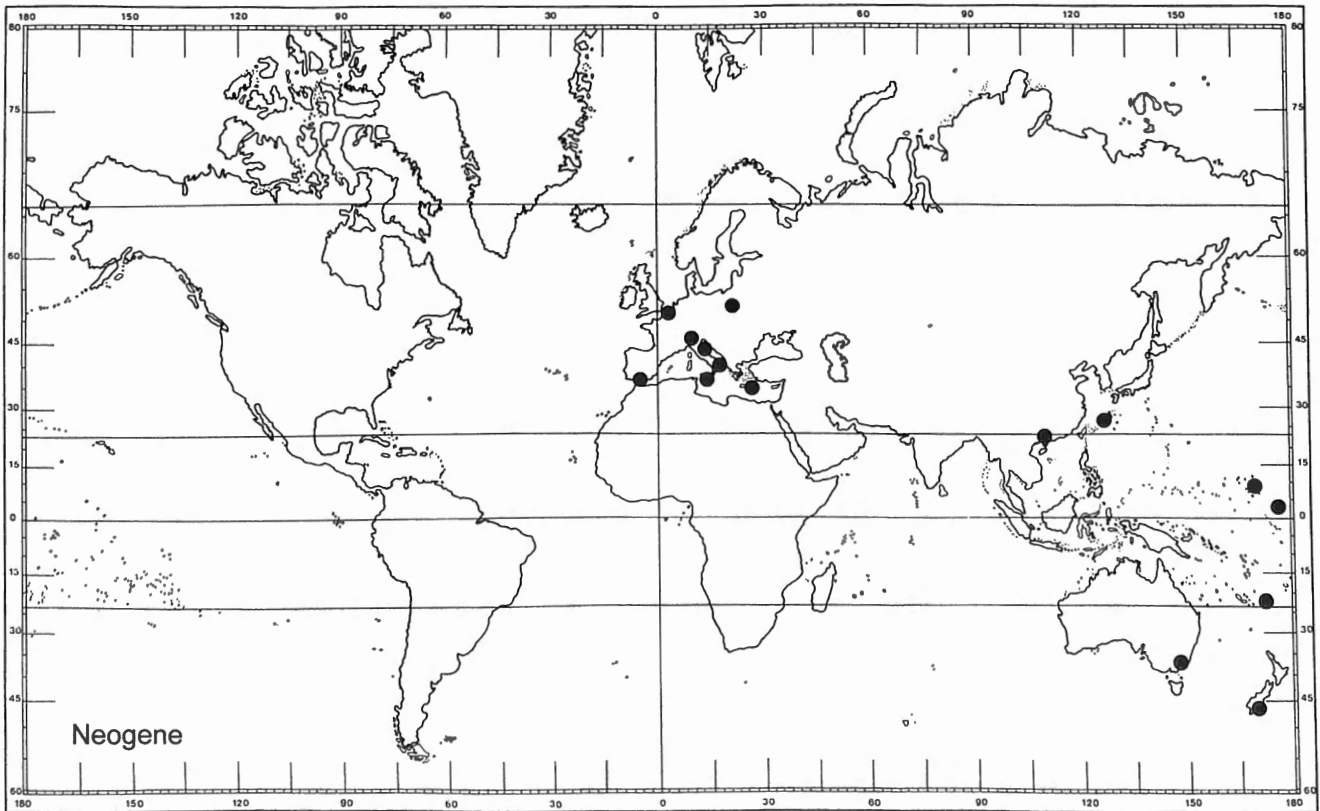


Fig. 18. Distribution of the genus *Saida* in the Neogene.

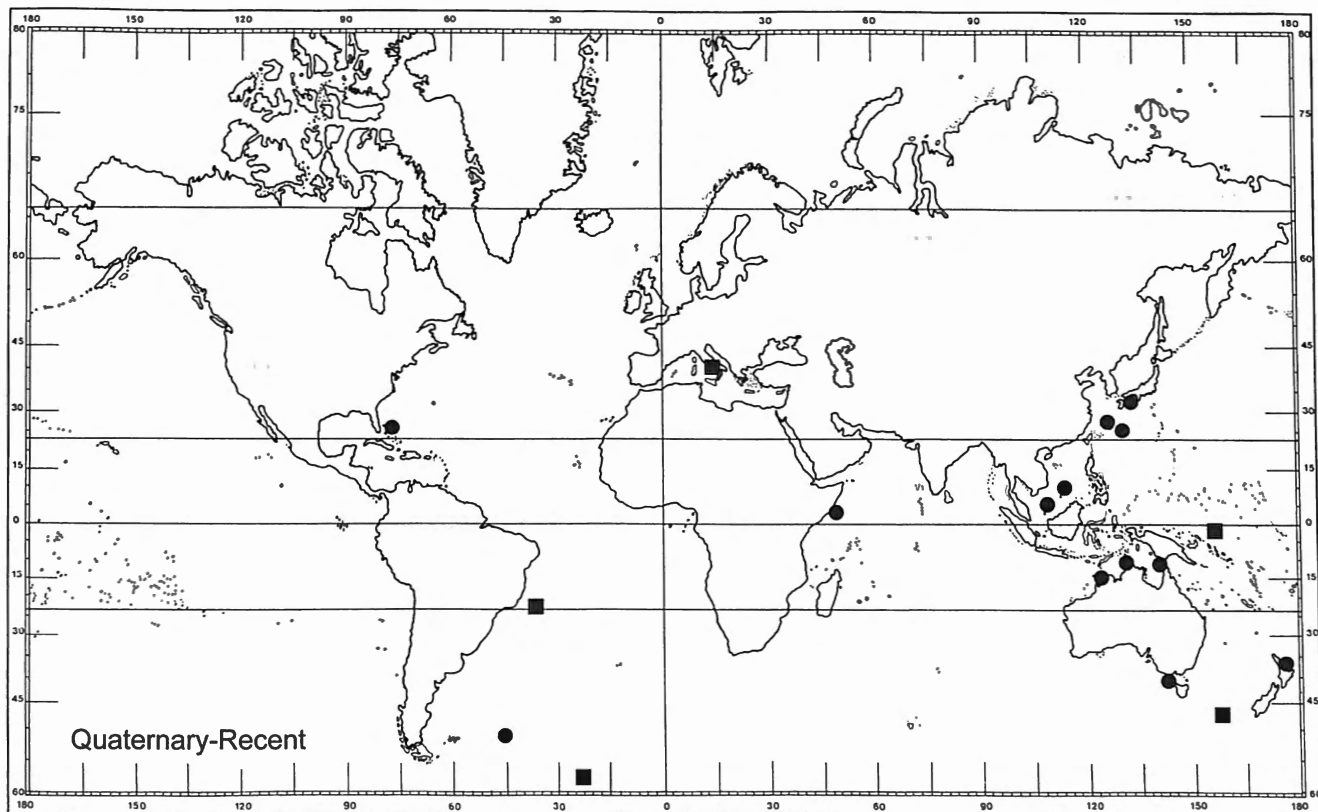


Fig. 19. Distribution of the genus *Saida* in Quaternary (squares) and Recent (circles) deposits.

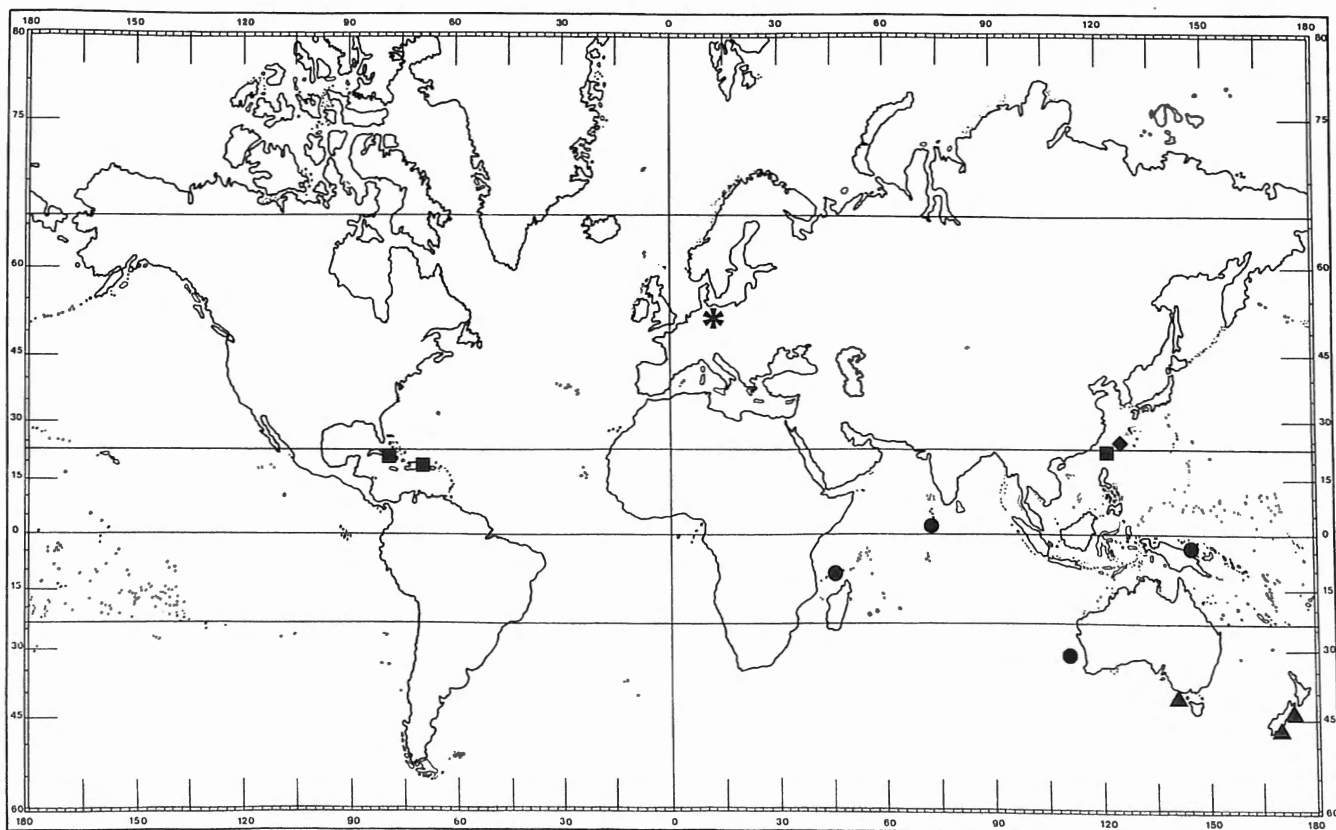


Fig. 20. Distribution of the genus *Saidella* gen. nov. in space and time (star: Cretaceous; triangles: Paleogene; squares: Neogene; diamond: Quaternary; circles: Recent).

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REFERENCES

- AIELLO, G. & SZCZECURA, J., 2004. Middle Miocene ostracods of the Fore-Carpathian Depression (Central Paratethys, southwestern Poland). *Bolletino della Società Paleontologica Italiana*, 43(1-2): 11-70.
- ARANKI, J.F., MCKENZIE, K.G., REYMENT, E.R. & REYMENT, R.A., 1992. Marine Late Miocene to Early Pleistocene Ostracoda of Southern Spain, with description of *Vejeria* new genus. *Bulletin of the Geological Institute of the University of Uppsala, N.S.*, 17: 1-20.
- ASCOLI, P., 1968. Preliminary report on the Ostracoda of the Type Tortonian. *Giornale di Geologia*, 25(2): 31-54.
- ASCOLI, P., 1969. First data on the Ostracod biostratigraphy of the Possagno and Brendola Sections (Paleogene NE Italy). *Mémoires du B.R.G.M.*, 69: 51-71.
- AYRESS, M.A., 1993. Ostracod biostratigraphy and palaeoecology of the Kokoamu Greensand and Otekaike Limestone (Late Oligocene to Early Miocene), North Otago and South Canterbury, New Zealand. *Alcheringa*, 17: 125-151.
- AYRESS, M.A., 1995. Late Eocene Ostracoda (Crustacea) from the Waihao District, South Canterbury, New Zealand. *Journal of Paleontology*, 69(5): 897-921.
- AYRESS, M.A., 1996. New species and biostratigraphy of Late Eocene Cytherurid Ostracoda from New Zealand. *Revista Española de Micropaleontología*, 28(3): 11-36.
- AYRESS, M.A. & CORREGE, T., 1992. On *Semicytherura pulchra* (Coles & Whatley). *Stereo-Atlas of Ostracod Shells*, 19(13): 57-60.
- BABINOT, J.-F., COLIN, J.-P., DAMOTTE, R. & DONZE, P., 1978. Les ostracodes du Cénomaniens français: mise au point biostratigraphique et paléogéographique. *Géologie Méditerranéenne*, 5(1): 19-26.
- BERGUE, C.T., COSTA K.B., DWYER, G. & MOURA, C.A., 2006. Bathyal ostracode diversity in the Santos Basin, Brazilian southeast margin: response to late Quaternary climate changes. *Revista Brasileira de Paleontologia*, 9(2): 201-210.
- BOLD, W.A. VAN DEN, 1946. *Contribution to the study of Ostracoda with special reference to the Tertiary and Cretaceous of the Caribbean Region*. Ph.D. Thesis, University of Utrecht, 167 p., Uitgeverij J.H. De Bussy, Amsterdam.
- BOLD, W.A. VAN DEN, 1988. Neogene Paleontology in the northern Dominican Republic. 7. The Subclass Ostracoda (Arthropoda: Crustacea). *Bulletins of American Paleontology*, 94 (329): 1-105.
- BOOMER, I. & WHATLEY, R., 1995. Cenozoic Ostracoda from guyots in the Western Pacific: holes 865B and 866B (Leg 143). *Proceedings of the Ocean Drilling Program Scientific Results*, 143: 75-86.
- BRADY, G.S., 1880. Report on Ostracoda dredged by H.M.S. Challenger during the years 1872-1876. *Report of the Scientific Results of the Voyage of HMS Challenger, 1873-1876 (Zoology)*, 1(3): 1-184.
- CAI, H.M., 1991. Ostracoda from the Nansha Islands and the adjacent sea areas. In: *Quaternary biological groups of the Nansha Islands and the neighboring waters*, p. 82-118, 8 pls, Zhongshan University Publishing House.
- CAI, H.M. & Tu, X., 1983. Distribution of Foraminifera and Ostracoda from the surface of the bottom sediments off the Xisha-Zhongsan Islands, South China Sea. *Nanhai Studia marina Sinica*, 4: 25-63.
- CARBONNEL, G., 1988. Ostracodes paléogènes et néogènes des sondages offshore de Cap Timiris: Mauritanie. *Revue de Micropaléontologie*, 31(3): 147-155.
- CHAROLLAIS, J., HOCHULI, P.A., OERTLI, H.J., PERCH-NIELSEN, K., TOUMARKINE, M., RÖGL, F. & PAIRIS, J.-L., 1980. Les Marnes à Foraminifères et les Schistes à *Meletta* des chaînes subalpines septentrionales (Haute-Savoie, France). *Eclogae Geologicae Helvetiae*, 73(1): 9-69.
- CIAMPO, G., 1983. Alcuni ostracodi del Miocene superiore piemontese. *Bolletino della Società Paleontologica Italiana*, 22(3): 247-262.
- CIAMPO, G., 1988. Nuove specie di ostracodi pliocenici della Calabria ionica. *Bolletino della Società Paleontologica Italiana*, 27(3): 307-321.
- CIAMPO, G., 1992. Ostracofaune plioceniche della Calabria ionica. *Bolletino della Società Paleontologica Italiana*, 31(2): 223-239.
- COLALONGO, M.L. & PASINI, G., 1980. La Ostracofaune plio-pleistocenica della sezione Vrica in Calabria (con considerazione sul limite Neogene-Quaternario). *Bolletino della Società Paleontologica Italiana*, 19(1): 44-126.
- COLES, G., AYRESS, M. & WHATLEY, R.C., 1990. A comparison of North Atlantic and Pacific Cainozoic deep-sea Ostracoda. In WHATLEY, R.C. & MAYBURY, C. (Eds), *Ostracoda and Global Events*, 287-305, Chapman and Hall, London.
- COLES, G. & WHATLEY, R., 1989. New Palaeocene to Miocene genera and species of Ostracoda from DSDP sites in the North Atlantic. *Revista Española de Micropaleontología*, 21(1): 81-124.
- CRONIN, T.M., 1983. Bathyal Ostracodes from the Florida-Hatteras slope, the Straits of Florida, and the Blake Plateau.

- Marine Micropaleontology*, 8: 89-119.
- DALL'ANTONIA, B., 2002. Short palaeoecological notes on the middle Serravallian-basal Tortonian ostracods from the Tremiti Islands. *Rivista Italiana di Paleontologia e Stratigrafia*, 108: 289-296.
- DALL'ANTONIA, B., 2003. Miocene ostracods from the Tremiti Islands and Hyblean Plateau: biostratigraphy and description of new and poorly known species. *Geobios*, 36: 27-54.
- DALL'ANTONIO, B., DI STEFANO, A. & FORESI, L.M., 2001. Integrated micropalaeontological study (ostracods and calcareous plankton) of the Langhian Western Hyblean successions (Sicily, Italy). *Palaeogeography, Palaeoclimatology, Palaeoecology*, 176: 59-80.
- DELTEL, B., 1963. Nouveaux Ostracodes de l'Eocène et de l'Oligocène de l'Aquitaine Méridionale. *Actes de la Société Linnéenne de Bordeaux*, 100: 127-262.
- DUCASSE, O., 1974. Quelques remarques sur la faune d'ostracodes des faciès profonds du Tertiaire Aquitain. *Bulletin de l'Institut Géologique du Bassin d'Aquitaine*, 16: 127-135.
- DUCASSE, O., 1975. Les associations fauniques d'ostracodes de l'Eocène moyen et supérieur dans le Sud du Bassin d'Aquitaine. Distribution schématique et valeur paléocologique. *Bulletin de l'Institut Géologique du Bassin d'Aquitaine*, 17: 17-26.
- DUCASSE, O., 1977. La faune d'Ostracodes des dépôts tertiaires du plateau continental dans la partie centrale du Golfe de Gascogne: intérêt paléocologique-relations avec le continent. In: LÖFFLER, H. & DANIELOPOL, D. (Eds); *Aspects of Ecology and Zoogeography of Recent and Fossil Ostracoda*, 417-423, W. Junk Publishers, The Hague.
- DUCASSE, O. & CAHUZAC, B., 1997. Les ostracodes indicateurs des paléoenvironnements au Miocène moyen (Serravallien) en Aquitaine (Sud-Ouest de la France). *Revue de Micropaléontologie*, 40(2): 141-166.
- DUCASSE, O. & GRÉKOFF, N., 1976. Quelques ostracodes de l'Eocène inférieur du Sud-Ouest de l'Océan Indien: site 246, croisière 25, «Glomar Challenger», Deep Sea Drilling Project. *Revista Española de Micropaleontología*, 19(3): 134-152.
- ELOFSON, O., 1941. Zur Kenntnis der marinen Ostracoden Schwedens mit besonderer Berücksichtigung des Skageraks. *Zoologiska Bidrag från Uppsala*, 19: 215-534.
- GARCIA ZARRAGA, E. & RODRIGUEZ LAZARO, J., 1990. Late Cretaceous ostracode faunas from the Biscay synclinorium (Basque Arc, northern Spain). *Courier Forschungsinstitut Senckenberg*, 123: 229-238.
- GOU, Y.S. & CHEN, D.-Q., 1988. On the occurrence of *Javanella* and *Saida* in the Pliocene of Leizhou Peninsula, Guangdong, China. In: HANAI, T., IKEYA, N. & ISHIZAKI, K. (Eds), *Evolutionary Biology of Ostracoda. Developments in Palaeontology and Stratigraphy*, 11: 797-803, Elsevier.
- GRÜNDEL, J., 1966. Taxionomische, biostratigrafische und variationsstatistische Untersuchungen an den Ostracoden der Unterkreide in Deutschland. *Freiberger Forschungshefte*, C 200: 1-105.
- GRÜNDEL, J., 1969. Neue taxionomische Einheiten der Unterklasse Ostracoda (Crustacea). *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, 1969(6): 353-361.
- HANAI, T., IKEYA, N. & YAJIMA, M., 1980. Checklist of Ostracoda from Southeast Asia. *University Museum University of Tokyo Bulletin*, 17: 1-236.
- HARTMANN, G., 1964. Zur Kenntnis der Ostracoden des Roten Meeres. *Kieler Meeresforschungen*, 20 Sonderheft: 35-127.
- HARTMANN, G., 1985. Ostracoden aus der Tiefsee des Indischen Ozeans und der Iberischen See sowie von ostantlantischen sublitoralen Plateaus und Kuppen. *Senckenbergiana maritima*, 17(1/3): 89-146.
- HERRIG, E., 1966. Ostracoden aus der Weissen Schreieckreide (Unter-Maastricht) der Insel Rügen. *Paläontologische Abhandlungen Berlin*, A 2(4): 693-1024.
- HERRIG, E., 1968. Zur Gattung *Saida* Hornibrook (Ostracoda, Crustacea) in der Oberkreide. *Geologie, Berlin*, 17: 964-981.
- HERRIG, E., 1993a. Gleiche Ostracodenarten aus Oberkreide und Tertiär/Quartär. *Zitteliana*, 20: 349-359.
- HERRIG, E., 1993b. The preservation of ostracod shells in the siliceous chalk of the Danish-Polish Furrow (Baltic Sea). *Facies*, 28: 77-86.
- HERRIG, E., 1996. Revision der Ostrakoden (Crustacea) der Schreieckreide (Unter-Maastrichtium) der Insel Rügen/Ostsee. *Greifswalder Geowissenschaftliche Beiträge*, 3: 21-28.
- HERRIG, E., FRENZEL, P. & REICH, M., 1997. Zur Mikrofauna einer Ober-Campan-Scholle von der Halbinsel Wittow (NW Rügen/Ostsee). *Freiberger Forschungshefte*, C 468: 129-169.
- HORNIBROOK, N. de B., 1952. Tertiary and Recent marine Ostracoda of New Zealand. *Palaeontological Bulletin New Zealand Geological Survey*, 18: 1-82.
- HOWE, H.V. & LAW, J., 1936. Louisiana Vicksburg Oligocene Ostracoda. *Department of Conservation Geological Bulletin*, 7: 1-96.
- HOWE, R.C. & HOWE, H.J., 1973. Ostracodes from the Shubuta Clay (Tertiary) of Mississippi. *Journal of Paleontology*, 47(4): 629-657.
- IRIZUKI, T., ISHIZAKI, K., TAKAHASHI, M. & USAMI, M., 1998. Ostracode faunal changes after the Mid-Neogene climatic optimum elucidated after the Middle Miocene Kobana Formation, Central Japan. *Paleontological Research*, 2(1): 20-46.
- ISHIZAKI, K., 1977. Distribution of Ostracoda in the East China Sea - A justification for the existence of the paleo-Kuroshio current in the Late Cenozoic. In: LÖFFLER, H. & DANIELOPOL, D., *Aspects of ecology and zoogeography of recent and fossil Ostracoda*, 425-440, Junk Publishers, The Hague.

- ISHIZAKI, K., 1981. Ostracoda from the East China Sea. *Tihoku University Scientific Report, 2nd Series, Geology*, 51: 37-65.
- JØRGENSEN, N.O., 1979. The ostracod fauna from the Maastrichtian white chalk of Denmark. *Bulletin of the Geological Society of Denmark*, 27: 93-98.
- KAUFMANN, E.G., 1973. Cretaceous Bivalvia. In: HALLAM, A. (Ed.), *Atlas of Paleobiogeography*: 353-383, Elsevier.
- KEIJ, A.J., 1975. Note on three Holocene Indo-Malaysian ostracod species. *Proceedings van de Koninklijke Nederlandse Akademie voor Wetenschappen*, B, 78(3): 231-241.
- MAJORAN, S., 1996. Late Eocene Ostracoda of the Blanche Point Formation, South Australia. *Revista Española de Paleontología*, 11(1): 18-34.
- MAJORAN, S., 1997. Cytheropterine Ostracoda in view of the palaeoecology of the Palaeogene Port Willunga Formation, South Australia and the palaeobathymetrical evolution of the Tasman Basin. *Geobios*, 30(3): 421-435.
- MAZZINI, I., 2004. Quaternary benthic Ostracoda from the Tasman Sea: distribution patterns within circumpolar deepwaters. *Bolletino della Società Paleontologica Italiana*, 43(1-2): 217-224.
- MCKENZIE, K.G., 1973. Cenozoic Ostracoda. In: HALLAM, A. (Ed.), *Atlas of Paleobiogeography*: 477-487, Elsevier.
- MCKENZIE, K.G., 1974. Cenozoic Ostracoda of Southeastern Australia with the description of *Hanaiceratina* new genus. *Geoscience and Man*, 6: 153-182.
- MCKENZIE, K.G. & PEYPOUQUET, J.-P., 1984. Oceanic palaeoenvironment of the Miocene Fyansford Formation from Fossil Beach, near Mornington, Victoria, interpreted on the basis of Ostracoda. *Alcheringa*, 8: 291-303.
- MCKENZIE, K.G., REYMENT, R.A. & REYMENT, E.R., 1991. Eocene-Oligocene Ostracoda from South Australia and Victoria, Australia. *Revista Española de Paleontología*, 6: 135-175.
- MCKENZIE, K.G., REYMENT, R.A. & REYMENT, E.R., 1993. Eocene Ostracoda from the Browns Creek Clays at Browns Creek and Castle Cove, Victoria, Australia. *Revista Española de Paleontología*, 8(1): 75-116.
- MICULAN, P., 1992. Gli Ostracodi del Miocene Superiore di Vigoleno (subappennino piacentino). *Bolletino della Società Paleontologica Italiana*, 31(1): 105-132.
- NAMIOTKO, T., WOUTERS, K., DANIELOPOL, D.L. & HUMPHREYS, W.F., 2004. On the origin and evolution of a new anchialine stygobitic *Microceratina* species (Crustacea, Ostracoda) from Christmas Island (Indian Ocean). *Journal of Micropalaeontology*, 23(1): 49-59.
- NEALE, J., 1975. The ostracod fauna from the Santonian Chalk (Upper Cretaceous) of Gingin, Western Australia. *Special Papers in Palaeontology*, 16: 1-125, Palaeontological Association, London.
- NOHARA, T., 1987. Cenozoic Ostracoda of Okinawa-jima. *Bulletin of the College of Education, University of the Ryukyus*, 30(3): 1-105.
- NOHARA, T. & YABU, S., 1983. Notes on Ostracode genus *Saida* from the Ryukyus. *Bulletin of the College of Education, University of the Ryukyus*, 26: 65-71.
- PIETRZENIUK, E. 1969. Taxonomische und biostratigraphische Untersuchungen an Ostracoden des Eozän 5 im Norden der Deutschen Demokratischen Republik. *Paläontologische Abhandlungen*, A, 4(1): 1-162.
- POKORNY, V., 1981. Paleogeographical and paleoecological testimony of Ostracodes in the Paleogene of Southern Moravia. *Zemni phyn a Nafta*, 26(4): 649-664.
- PURI, H.S. & HULINGS, N.C., 1976. Designation of lectotypes of some ostracods from the Challenger Expedition. *Bulletin of the British Museum (Natural History) Zoology*, 29: 251-315.
- PYNE, R.S., WHATLEY, R.C. & WILKINSON, I.P., 2003. New species of Ostracoda from the Upper Cretaceous Chalk (Coniacian to Lower Maastrichtian) of East Anglia, U.K. *Revista Española de Micropaleontología*, 35(1): 87-118.
- RUAN Pei-hua & HAO Yi-chun, 1988. Systematic description of microfossils, 2. Ostracoda. In: RONG, L. & SHU, Z. (Eds), *Quaternary microbiotas in the Okinawa Through and their geological significance*, p. 227-395. Geological Publishing House, Beijing.
- RUAN Pei-hua & HAO Yi-chun, 1989. Distribution of ostracods in surface sediments of the Okinawa Through. *Acta Micropalaeontologica Sinica*, 6(1): 1-10.
- RUSSO, A., 1964. Ostracodi langhiani del Pescale (Appennino settentrionale modenese). *Bolletino della Società Paleontologica Italiana*, 3: 227-251.
- SISSINGH, W., 1972. Late Cenozoic Ostracoda of the South Aegean Island Arc. *Utrecht Micropaleontological Bulletin*, 6: 1-187.
- SWANSON, K., 1969. Some Lower Miocene Ostracoda from the Middle Waipara District, New Zealand. *Transactions of the Royal Society of New Zealand, Earth Sciences*, 7: 33-48.
- TABUKI, R., 2001. Plio-Pleistocene and Recent subtropical Ostracoda in Okinawa. In: IKEYA, N., *International Symposium on Ostracoda 2001, Field Excursions Guidebook*: 21-44.
- WEAVER, P.P.E., 1982. Ostracoda from the British Lower Chalk and Plenus Marls. *Palaeontographical Society Publication*, 562: 1-127.
- WHATLEY, R.C., 1983. Some aspects of the palaeobiology of Tertiary deep-sea Ostracoda from the SW Pacific. *Journal of Micropalaeontology*, 2: 83-104.
- WHATLEY, R.C. & BOOMER, I., 1995. Upper Oligocene to Pleistocene Ostracoda from guyots in the Western Pacific: holes 871A, 872C, and 873B. In: HAGGERTY, J.A., PREMOLI SILVA, I., RACK, F. & MCNUTT, M.K. (Eds), *Proceedings of the Ocean Drilling Program, Scientific Results*, 144: 87-96.

- WHATLEY, R.C. & DOWNING, S., 1983. Middle Miocene Ostracoda from Victoria, Australia. *Revista Española de Micropaleontología*, 15: 347-407.
- WHATLEY, R.C., MOGUILEVSKY, A., RAMOS, M.I.F. & COXILL, D.J., 1998. Recent deep and shallow water Ostracoda from the Antarctic Peninsula and the Scotia Sea. *Revista Española de Micropaleontología*, 30(3): 111-135.
- WHATLEY, R.C. & ROBERTS, R., 1999. Late Quaternary Ostracoda from a core in the Weddell Sea, Antarctica. *Pesquisas*, 26(1): 11-19.
- WHATLEY, R., SIVETER, D.J. & BOOMER, I.D., 1993. Arthropoda (Crustacea: Ostracoda). In: BENTON, M.J. (Ed.), *The fossil Record 2*: 343-356, Chapman & Hall.
- WILKINSON, I., 1990. The biostratigraphical application of Ostracoda in the Albian of eastern England. *Courier Forschungsinstitut Senckenberg*, 123: 239-259.
- WOUTERS, K., 1996. On the discovery of a Cretaceous representative of the extant marine interstitial genus *Iliffeoecia* Maddocks, 1991 (Ostracoda, Pontocyprididae). In: KEEN, M.C. (Ed.), *Proceedings of the 2nd European Ostracodologists Meeting*: 57-62, British Micropalaeontological Society, London.
- WOUTERS, K., 1998. The genus *Liasina*, an ancient low diversity lineage of marine interstitial ostracods. *Proceedings and Abstracts of the 4th International Crustacean Congress, Amsterdam*, p. 122 (abstract).
- YASSINI, I. & JONES, B.G., 1995. Foraminiferida and Ostracoda from estuarine and shelf environments of the southeastern coast of Australia. University of Wollongong Press, 484 pp., Wollongong, New South Wales, Australia.
- ZHAO Quanhong, 2005. Late Cenozoic ostracod faunas and palaeoenvironmental changes at ODP site 1148, South China Sea. *Marine Micropaleontology*, 54: 27-47.
- ZHOU Baochun, 1995. Recent ostracode fauna in the Pacific off Southwest Japan. *Memoirs of the Faculty of Sciences Kyoto University, Series Geology and Mineralogy*, 57 (2): 21-98.

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