[Palaeontology, Vol. 52, Part 4, 2009, pp. 879–931]

TAXONOMY OF QUATERNARY DEEP-SEA OSTRACODS FROM THE WESTERN NORTH ATLANTIC OCEAN

by MORIAKI YASUHARA*, HISAYO OKAHASHI* *and* THOMAS M. CRONIN†

*Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, MRC 121, PO Box 37012, Washington, DC 20013-7012, USA; e-mails: moriakiyasuhara@gmail.com or yasuharam@si.edu (M.Y.), yasuharah@si.edu (H.O.)
†U.S. Geological Survey, 926A National Center, Reston, VA 20192, USA; e-mail: tcronin@usgs.gov

Typescript received 26 June 2008; accepted in revised form 28 October 2008

Abstract: Late Quaternary sediments from Ocean Drilling Program (ODP) Hole 1055B, Carolina Slope, western North Atlantic (32°47.041′ N, 76°17.179′ W; 1798 m water depth) were examined for deep-sea ostracod taxonomy. A total of 13 933 specimens were picked from 207 samples and *c.* 120 species were identified. Among them, 87 species were included and illustrated in this paper. Twenty-eight new species are described. The new species are: *Ambocythere sturgio*, *Argilloecia abba*, *Argilloecia caju*, *Argilloecia keigwini*, *Argilloecia robinwhatleyi*, *Aversovalva carolinensis*, *Bythoceratina willemvandenboldi*, *Bythocythere eugeneschornikovi*, *Chejudocythere tenuis*, *Cytheropteron aielloi*, *Cytheropteron demenocali*, *Cytheropteron didieae*, *Cytheropteron richarddinglei*, *Cytheropteron fugu*, *Cytheropteron guerneti*, *Cytheropteron richardbensoni*, *Eucytherura hazeli*, *Eucytherura mayressi*, *Eucytherura namericana*, *Eucytherura spinicorona*, *Posacythere hunti*, *Paracytherois bondi*, *Pedicythere atroposopetasi*, *Pedicythere kennettopetasi*, *Pedicythere klothopetasi*, *Pedicythere lachesisopetasi*, *Ruggieriella mcmanusi* and *Xestoleberis oppoae*. Taxonomic revisions of several common species were made to reduce taxonomic uncertainty in the literature. This study provides a robust taxonomic baseline for application to palaeoceanographical reconstruction and biodiversity analyses in the deep and intermediate-depth environments of the North Atlantic Ocean.

Key words: Deep-sea Ostracoda, Pleistocene, Holocene, North Atlantic, taxonomy.

THE North Atlantic Ocean is a key region for understanding Quaternary palaeoceanography because the region is climatically sensitive and is the source of North Atlantic Deep Water (NADW), which forms an important part of global deep-water circulation. Orbital–centennial scale climate and palaeoceanographical changes are well known and have been intensively studied using North Atlantic deep-sea sediment records (Bond *et al.* 1997; Oppo *et al.* 1998; Mcmanus *et al.* 1999; Keigwin 2004; Raymo *et al.* 2004). Notably, millennial–centennial scale abrupt climate changes during the late Quaternary are well known during Heinrich Events, the Younger Dryas cooling event and Holocene Bond Events, all of which are characterized by ice rafting and meltwater discharge (Heinrich 1988; Bond and Lotti 1995; Bond *et al.* 2001; Yasuhara *et al.* 2008*a*). Many of these climatic cooling events are known to reduce or shut down NADW formation, and thus influence global climate (Bond *et al.* 1997; Mcmanus *et al.* 1999, 2004; Oppo *et al.* 2003). This region is also one of the most intensively studied regions in terms of micropalaeontology and deep-sea biology (Sanders *et al.* 1965; Whatley and Coles 1987; Coles and Whatley 1989; Rex *et al.* 2000; Gooday and Hughes 2002), and calcareous microfossils such as ostracods are well preserved (Didié and Bauch 2000; Yasuhara *et al.* 2008*a*).

Continental slopes are sometimes characterized by extremely high sedimentation rates in areas characterized by sediment drifts (Bianchi and Mccave 2000; Marchitto and Demenocal 2003; Yasuhara *et al.* 2008*a*). Cores drilled in high sedimentation-rate areas enable us to reconstruct high-resolution palaeoceanography during the late Quaternary using accurate age models developed from oxygen isotope stratigraphy and radiocarbon dates (Mcmanus *et al.* 1999; Oppo *et al.* 2003). Recent palaeoceanographical studies have focused on such mid-depth, high sedimentation-rate sites to reconstruct intermediate-depth water circulation and rapidly changing climate during the latest Pleistocene and Holocene (Marchitto and Demenocal 2003; Oppo *et al.* 2003; Ellison *et al.* 2006; Came *et al.* 2007; Praetorius *et al.* 2008).

Ostracoda are small bivalved Crustacea having an excellent fossil record due to their small size and well-calcified

 doi: 10.1111/j.1475-4983.2009.00888.x

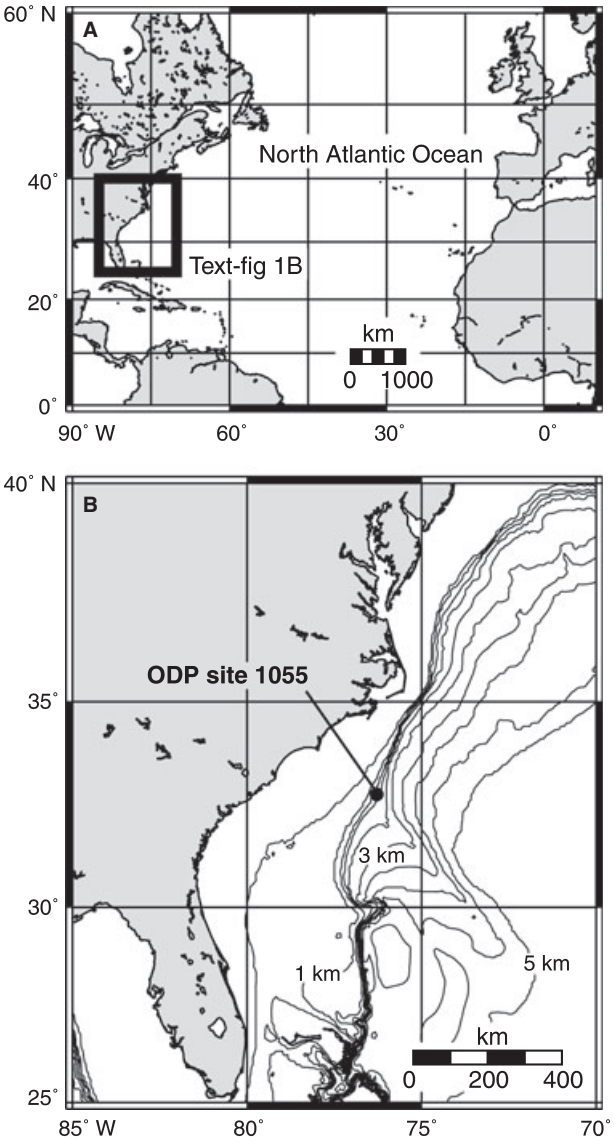
carapace (Schellenberg 2007; Yasuhara and Cronin 2008). In deep-sea sediment cores, they are usually the only benthic fossil group abundantly preserved, along with benthic foraminifera. Ostracods have been applied successfully in palaeoceanography and palaeoecology to understand long-term climate-ecosystem/biodiversity relationships in the deep-sea (Cronin *et al.* 1996; Cronin and Raymo 1997; Didié and Bauch 2000; Didié *et al.* 2002; Yasuhara and Cronin 2008; Yasuhara *et al.* 2008*a*; Alvarez Zarikian *et al.* 2009).

Studies on taxonomy of North Atlantic deep-sea ostracods were started in the 19th century (Brady 1880), and later in studies by Robin C. Whatley and Graham P. Coles (Whatley and Coles 1987; Coles and Whatley 1989). Since their taxonomic works, however, only few taxonomic works have been attempted, and recent palaeoecological (non-taxonomic) studies left many species in open nomenclature, leading to taxonomic confusion. There is also considerable taxonomic confusion for the species described during 19th and early 20th centuries because the specimens were illustrated by sketches and because type specimens were frequently lost, destroyed or not designated. Although many North Atlantic specimens have been assigned to species described by Brady (1880) from material collected during the *Challenger* Expedition, available detailed redescriptions of some of Brady's 'classic' species indicated that Brady's species are not conspecific with North Atlantic specimens in many cases (Mazzini 2005).

Deep-sea ostracods are known from a variety of depths, including the zone of carbonate compensation >4500 m depth (Dingle and Lord 1990; Jellinek *et al.* 2006; Yasuhara *et al.* 2008*a*). However, faunas from the continental slope and intermediate depths are relatively poorly known in the North Atlantic Ocean. For example, in the comprehensive taxonomic revision by Whatley and Coles (1987), emphasis was placed solely on abyssal ostracods from >3000 m water depth. Coles *et al.* (1996) reported deep-sea ostracods from 600 to 800 m water depth of Porcupine Basin, northeastern North Atlantic, but included no formal taxonomy. Other studies on deep-sea ostracods from continental slope also included no formal taxonomy (Cronin 1983; Whatley *et al.* 1996, 1998). Here we describe Quaternary deep-sea ostracods from intermediate-depth western subtropical North Atlantic.

MATERIALS AND METHODS

Ocean Drilling Program (ODP) Hole 1055B was cored at the Carolina Slope in the western North Atlantic (32°47.041′ N, 76°17.179′ W; 1798 m water depth; Text-fig. 1). Core 1H from ODP Hole 1055B was continuously sampled at 2-cm intervals (average sampling resolution = 50–100 years). The >150-μm-size fraction



TEXT-FIG. 1. Index and locality maps showing location of ODP Site 1055.

was examined. The studied interval is equivalent to the past 20 kyr (thousands of years). Further details on samples, methods, chronology, palaeoceanographical setting and ostracod species diversity patterns are found in Yasuhara *et al.* (2008*b*).

In total, 13 933 specimens were picked from 207 samples and more than 122 species were identified (Yasuhara *et al.* 2008*b*). Among them, 87 species are included and illustrated in this paper. Twenty-eight new species are described. Most of other species are represented by very few juvenile specimens or are shallow-water species transported downslope (e.g. *Hulingsina*, *Bensonocythere*, *Loxoconcha*, *Cytheromorpha*, *Cyprideis* and *Proteoconcha*).

More than 200 specimens were digitally imaged with scanning electron microscopy (SEM), using low-vacuum

mode of Philips XL-30 environmental SEM with LaB6 electron source on uncoated specimens. Figured specimens were deposited in the National Museum of Natural History (Washington DC, accession numbers USNM 536979–USNM 537202).

SYSTEMATIC PALAEONTOLOGY

We follow the higher classification scheme of the Integrated Taxonomic Information System (ITIS: http://www.itis.gov/) with certain modification. In the following section, synonymies are abbreviated to conserve space, but usually one of the references given contains a comprehensive synonymy. Three size categories (small, moderate, large) used for ostracod species in this section mean brief, relative size within genus and/or family.

Abbreviations. LV, left valve; RV, right valve; A-1, last juvenile instar (adult minus one); L, length; H, height. Core samples are specified by standard ODP notation (core/section/interval).

Type locality. ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic (32°47.041 N, 76°17.179 W; 1798 m water depth).

Geological age. 20–0 ka (thousands of years ago): Latest Pleistocene–Holocene.

Class OSTRACODA Latreille, 1802
Subclass MYODOCOPA Sars, 1866
Order HALOCYPRIDA Skogsberg, 1920
Suborder CLADOCOPINA Sars, 1866
Superfamily POLYCOPOIDEA Sars, 1866
Family POLYCOPIDAE Sars, 1866

Genus POLYCOPE Sars, 1866

Polycope arcys Joy and Clark, 1977
Plate 1, figure 6

1977 *Polycope*? *arcys* Joy and Clark, p. 144, pl. 2, figs 18–21.
?2001 *Polycope* sp. cf. *P. arcys* Joy and Clark; Didié and Bauch, p. 104, pl. 1, fig. 28; (as erratum for Didié and Bauch 2000).

Dimensions. USNM 537192, L = 0.498 mm, H = 0.460 mm.

Remarks. The specimens in this study are most likely conspecific with *Polycope*? *arcys* Joy and Clark (1977) from the Arctic Ocean. However some of SEM images in Joy and Clark (1977) appear to be deformed, presumably due to technical problems of early SEM photography. So, redescription and taxonomic revision are necessary not only for this species but also for other Arctic deep-sea ostracods.

Occurrence. Few to rare.

Polycope cf. *bireticulata* Joy and Clark, 1977
Plate 1, figures 3–4

Dimensions. USNM 537196, L = 0.259 mm, H = 0.227 mm.

Remarks. This species is closely similar to *Polycope bireticulata* Joy and Clark (1977) from the Arctic Ocean, but differs in having coarser secondary reticulation and different muri alignment. The species also differs from the species identified as *Polycope bireticulata* in recent studies (Whatley *et al.* 1996; Stepanova 2006) in having more prominent muri.

Occurrence. Few to rare.

Polycope cf. *orbicularis* Sars, 1866
Plate 1, figure 5

?1996 *Polycope orbicularis* Sars; Coles *et al.*, p. 142, pl. 6, fig. 17.

Dimensions. USNM 537096, L = 0.459 mm, H = 0.397 mm.

Remarks. This species appears similar to the species identified as *Polycope frequens* Müller 1894 by Bonaduce *et al.* (1976), but the latter has more evenly rounded outline. This species also is similar to the species identified as *Polycope orbicularis* Sars, 1866 in recent works (Stepanova 2006; Stepanova *et al.* 2003; Whatley *et al.* 1996, 1998; non Mackiewicz 2006), but the latter has more evenly rounded outline in lateral view and more extensive anteroventral carinae. Aiello and Szczechura (2004) and Mazzini (2005) also reported similar but slightly different specimens as *Polycope* sp. aff. *p. orbicularis* and *Polycope* sp. A, respectively. *Polycope orbicularis* appear to differ from all of the above species in lacking anteroventral carinae as seen in the original sketch by Sars (1866) and in the sketch of the topotype material in the 'Treatise' (Moore 1961), although holotype and lectotype have not been designated. There are many reports of similar specimens to *Polycope orbicularis sensu* Stepanova (2006) and *Polycope frequens sensu* Bonaduce *et al.* (1976) as mentioned above, but they each have slightly different lateral shapes and levels of development of marginal reticulation and carinae. Thus, we tentatively call these specimens *Polycope orbicularis s.l.*

Occurrence. Few to rare.

Polycope vasfiensis Sissingh, 1972
Plate 1, figures 1–2

1972 *Polycope vasfiensis* Sissingh, p. 68, pl. 1, fig. 6.
1976 *Polycope vasfiensis* Sissingh; Bonaduce *et al.*, p. 18, pl. 1, figs 6–8, text-fig. 6.
2000 *Polycope vasfiensis* Sissingh; Aiello *et al.*, p. 85, pl. 1, fig. 1.

Dimensions. USNM 537194, L = 0.322 mm, H = 0.284 mm.

Remarks. Comprehensive synonymy is found in Aiello *et al.* (2000). This is the first record of this species from North Atlantic. The specimens in this study and Aiello *et al.* (2000) have weaker crenulate anteroventral margin compared to the figured specimens in Sissingh (1972) and Bonaduce *et al.* (1976).

Occurrence. Few to rare.

Subclass PODOCOPA Müller, 1894
Order PLATYCOPIDA Sars, 1866
Suborder PLATYCOPINA Sars, 1866
Superfamily CYTHERELLOIDEA Sars, 1866
Family CYTHERELLIDAE Sars, 1866

Genus CYTHERELLA Jones, 1849

Cytherella robusta s.l. Colalongo and Pasini, 1980
Plate 1, figures 7–12

1980 *Cytherella robusta* Colalongo and Pasini, p. 78, pl. 6, figs 4–10.
1983 *Cytherella* sp. Cronin, p. 112, pl. 6E.
1987 *Cytherella serratula* (Brady); Whatley and Coles, p. 81, pl. 6, figs 30–31.
1996*b* *Cytherella robusta* Colalongo and Pasini; Aiello *et al.*, p. 184, pl. 2, figs 4–5, 8–12.
1996 *Cytherella serratula* (Brady); Coles *et al.*, p. 142, pl. 6, figs 14–15.
1998 *Cytherella* cf. *lata* Brady; Freiwald and Mostafawi, p. 263, pl. 60, fig. 21.
?1998 *Cytherella* cf. *vugatella* Aiello, Barra, Bonaduce and Russo; Freiwald and Mostafawi, p. 259, pl. 58, fig. 3.
1998 *Cytherella serratula* (Brady); Guernet, p. 529, pl. 1, fig. 2.
2001 *Cytherella serratula* (Brady); Didié and Bauch, p. 104, pl. 1, figs 5–6; (as erratum for Didié and Bauch 2000).
2005 *Cytherella* sp. Mazzini, p. 18, figs 10A–E.
2007 *Cytherella serratula* (Brady); Bergue *et al.*, p. 7, fig. 3A.
2008 *Cytherella serratula* (Brady); Bergue and Coimbra, p. 110, pl. 1, fig. 1.

Dimensions. USNM 537150, L = 1.142 mm, H = 0.676 mm.

Remarks. Comprehensive synonymy is found in Aiello *et al.* (1996*b*) and supplemented here. Aiello *et al.* (1996*b*) considered that the species identified as *Cytherella serratula* (Brady 1880) by Whatley and Coles (1987), which is also reported as *Cytherella serratula* by subsequent studies (Coles *et al.* 1996; Guernet 1998; Didié and Bauch 2000, 2001) and as *Cytherella* sp. by Mazzini (2005) and is apparently different from *Cytherella serratula* (see Aiello *et al.* 1996*b* for detailed discussion; also see Brandão 2008), is identical to *Cytherella robusta* Colalongo and Pasini 1980. *Cytherella serratula sensu* Whatley and Coles (1987) and the specimens in this study are similar to *Cytherella robusta*, but the latter has more triangular lateral outline especially in holotype specimen and slightly upturned anterior margin in LV. The specimens in this study may be identical to *Cytherella serratula sensu* Whatley and Coles (1987), but the latter has slightly concave dorsal margin. Tentatively, we prefer to call all specimens listed in synonymy of Aiello *et al.* (1996*b*)

EXPLANATION OF PLATE 1

Figs 1–2. *Polycope vasfiensis* Sissingh, 1972. 1, USNM 537194, 1/3/46–48; LV, lateral view. 2, USNM 537195, 1/3/46–48; RV, lateral view.

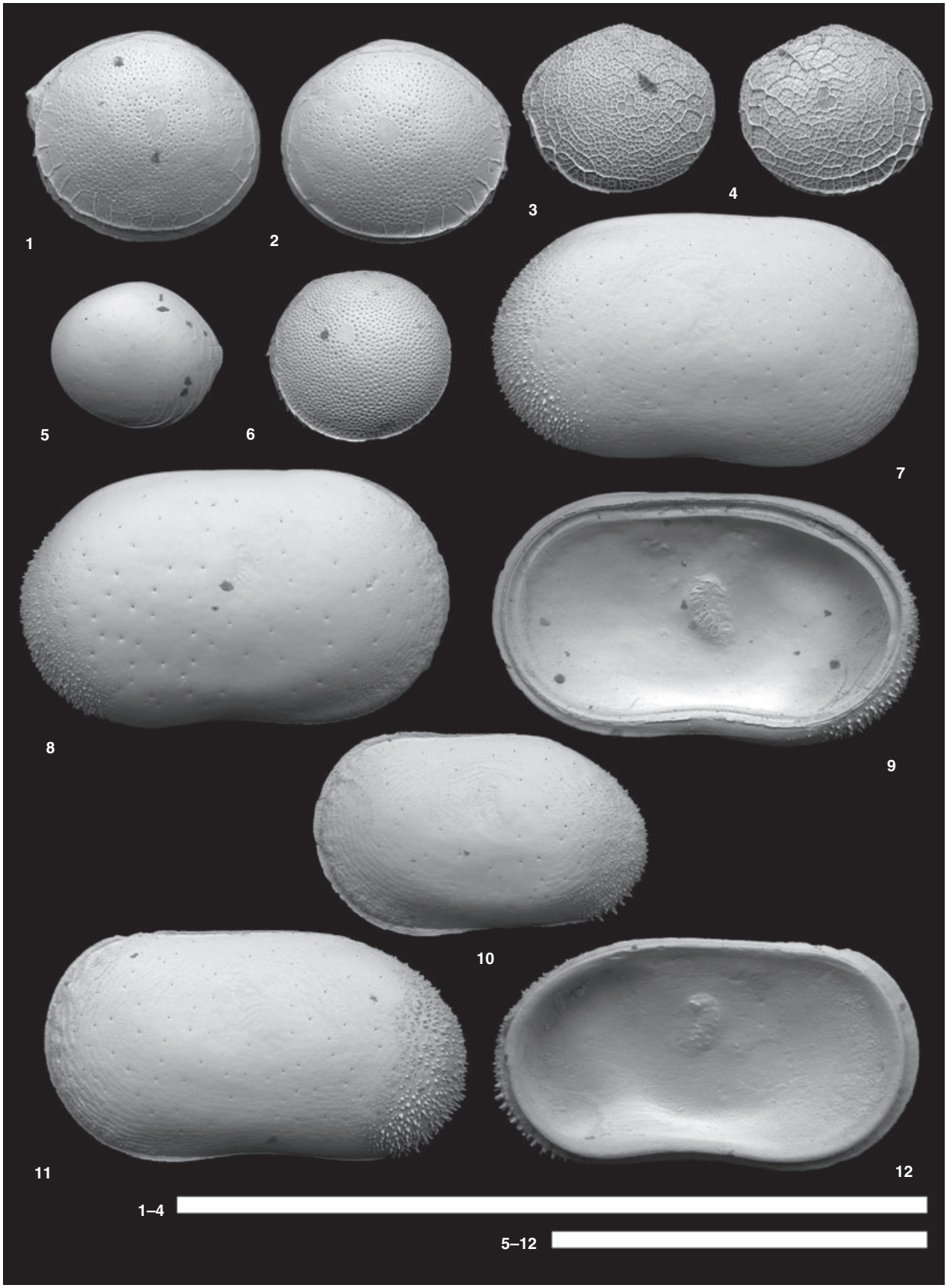
Figs 3–4. *Polycope* cf. *bireticulata* Joy and Clark, 1977. 3, USNM 537196, 1/3/46–48; LV, lateral view. 4, USNM 537193, 1/3/48–50; RV, lateral view.

Fig. 5. *Polycope* cf. *orbicularis* Sars, 1866, USNM 537096, 1/1/120–122; RV, lateral view.

Fig. 6. *Polycope arcys*, Joy and Clark, 1977, USNM 537192, 1/3/48–50; LV, lateral view.

Figs 7–12. *Cytherella robusta s.l.* Colalongo and Pasini, 1980. 7, USNM 537150, 1/3/30–32; adult female RV, lateral view. 8–9, USNM 537200, 1/2/66–68; adult male RV. 8, lateral, and 9, internal views. 10, USNM 537199, 1/2/42–44; A-1 juvenile LV, lateral view. 11–12, USNM 537142, 1/2/124–126; adult male LV. 11, lateral, and 12, internal views.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bars represent 1 mm (upper bar for 1–4, and lower bar for 5–12).



YASUHARA *et al.*, *Polycope, Cytherella*

and this study *Cytherella robusta s.l.* Size variation of *Cytherella robusta* is relatively large according to Aiello *et al.* (1996*b*), but the size of our adult specimens are almost the same as that of the holotype (1.11 mm length). We will describe *Cytherella serratula sensu* Whatley and Coles (1987) as new species elsewhere (Yasuhara *et al.* in prep.). It is widely distributed in the Atlantic Ocean and has an outline distinct from *Cytherella serratula* and *Cytherella robusta*.

Occurrence. Relatively common.

Order PODOCOPIDA Sars, 1866
Suborder BAIRDIOCOPINA Gründel, 1967
Superfamily BAIRDIOIDEA Sars, 1866
Family BAIRDIIDAE Sars, 1866

Genus BYTHOCYPRIS Brady, 1880

Bythocypris affinis (Brady, 1886)
Plate 2, figures 1–4

1886 *Bairdia affinis* Brady, p. 195, pl. 14, figs 6–7.
1889 *Bairdia affinis* Brady; Brady and Norman, p. 242.
1969 *Bythocypris affinis affinis* (Brady); Maddocks, p. 90, figs 45a–d.
non 1983 *Bythocypris cf. B. affinis* (Brady); Cronin, p. 108, pl. 2E, G.

Dimensions. USNM 537007, L = 1.021 mm, H = 0.569 mm.

Remarks. The specimens in this study have slightly more triangular posterior margin in RV compared to the sketches by Brady (1886), Brady and Norman (1889) and Maddocks (1969).

Occurrence. Moderately abundant.

Suborder CYPRIDOCOPINA Jones, 1901
Superfamily PONTOCYPRIDOIDEA Müller, 1894
Family PONTOCYPRIDIDAE Müller, 1894

Genus ARGILLOECIA Sars, 1866

Argilloecia abba sp. nov.
Plate 3, figures 7–8, 10–11

Derivation of name. In honour of Giuseppe Aiello, the late Gioacchino Bonaduce, Diana Barra, and Silvana Abate, Universitá di Napoli Federico II, for work by this research group on deep-sea ostracods including this genus. From combination of their initials.

Holotype. Adult RV, USNM 537159 (Pl. 3, fig. 10).

Paratypes. USNM 537157, 537158, 537160.

Type locality and horizon. ODP 1055, 1/3/60–62.

Dimensions. USNM 537159 (holotype), L = 0.621 mm, H = 0.263 mm.

Diagnosis. A large, thick-shelled *Argilloecia* species, subrectangular to subtriangular in lateral view; posterior margin evenly acuminate.

Description. Carapace robust, large, highest at middle. Outline subrectangular to subtriangular in lateral view; anterior margin rounded, more angular and truncated in LV; posterior margin evenly acuminate; dorsal margin weakly arched; ventral margin slightly sinuous. Anterodorsal and posterodorsal corners rounded. RV strongly overlaps LV. Lateral surface smooth. Internal features as for genus. Anterior and posterior vestibules well developed; marginal pores short.

Remarks. This species is closely similar to *Argilloecia acuminata* Müller 1894, but distinguished by larger, more

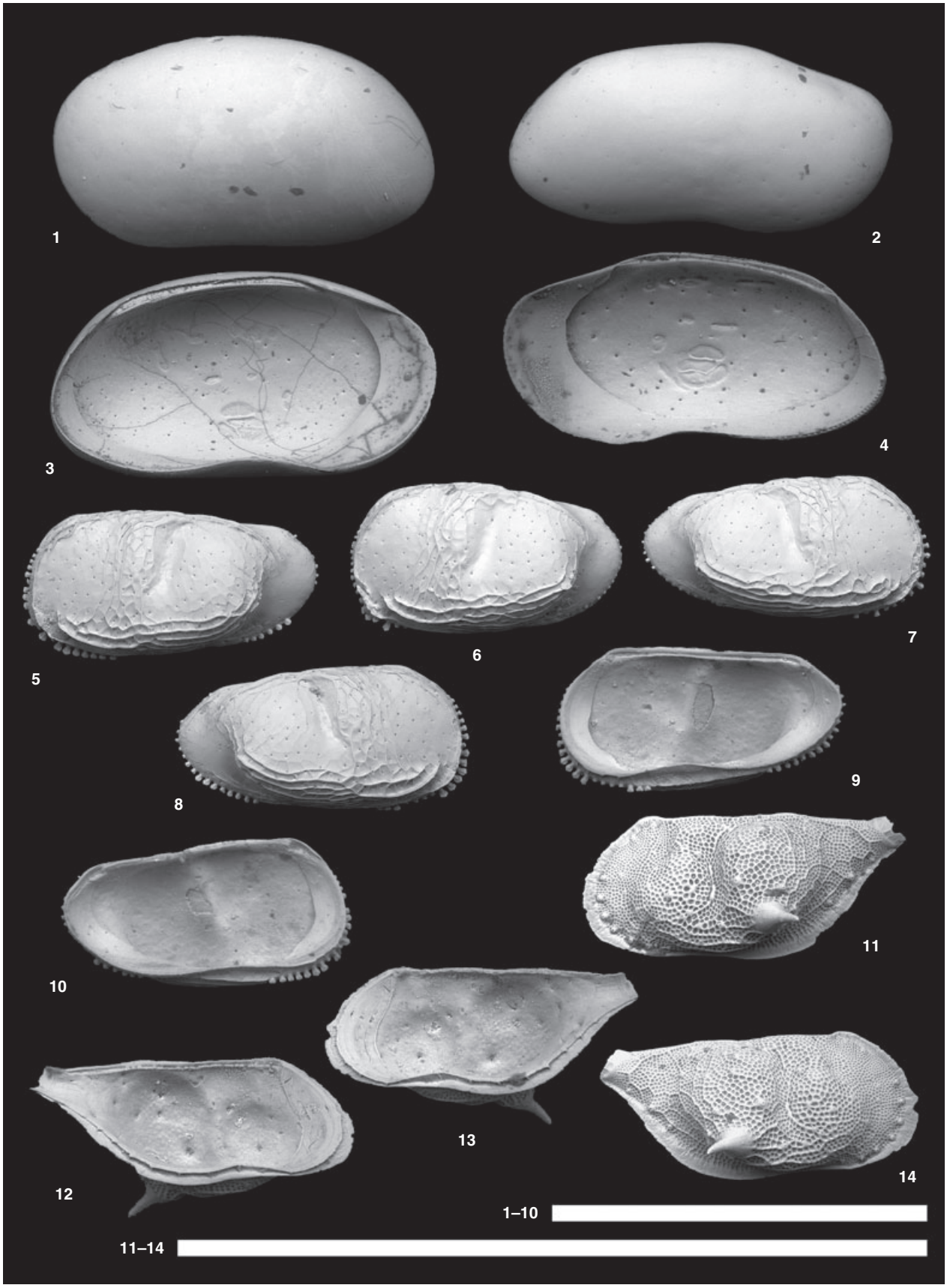
EXPLANATION OF PLATE 2

Figs 1–4. *Bythocypris affinis* (Brady, 1886). 1, 3, USNM 537007, 1/2/42–44; adult LV. 1, lateral, and 3, internal views. 2, 4, USNM 537197, 1/2/34–36; adult RV. 2, lateral, and 4, internal views.

Figs 5–10. *Bythocythere eugeneschornikovi* sp nov. 5, 10, holotype, USNM 537145, 1/2/94–96; adult male LV. 5, lateral, and 10, internal views. 6, USNM 537144, 1/2/62–64; adult female LV, lateral view. 7, USNM 537151, 1/3/36–38; adult male RV, lateral view. 8–9, USNM 537146, 1/2/94–96; adult male RV. 8, lateral, and 9, internal views.

Figs 11–14. *Bythoceratina willemvandenboldi* sp. nov. 11–12, USNM 537155, 1/3/44–46; adult LV. 11, lateral, and 12, internal views. 13–14, holotype, USNM 537156, 1/3/44–46; adult RV. 13, internal, and 14, lateral views.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bars represent 1 mm (upper bar for 1–10, and lower bar for 11–14).



YASUHARA *et al.*, *Bythocypris, Bythocythere, Bythoceratina*

robust carapace, more evenly acuminate posterior margin and lacking interior sinuous carinae.

Occurrence. Relatively common.

Argilloecia acuminata Müller, 1894
Plate 3, figures 1–2, 4–5

1894 *Argilloecia acuminata* Müller, p. 261, pl. 12, figs 1–2, 12–22.
1987 *Argilloecia* sp. 5 Whatley and Coles, p. 87, pl. 1, figs 19–20.
1988 *Cardobairdia* gr. *asymmetrica* van den Bold; Guernet and Fourcade, p.148, pl. 3, fig. 10.
?1996 *Argilloecia acuminata* Müller; Coles *et al.*, p. 133, pl. 1, fig. 12.
2000 *Argilloecia* sp. 1 Didié and Bauch, p. 114, pl. 3, fig. 1 (non fig. 2).
2004 *Argilloecia acuminata* Müller; Aiello and Szczechura, p. 16, pl. 1, fig. 2.

Dimensions. USNM 537083, L = 0.579 mm, H = 0.248 mm.

Remarks. Comprehensive synonymy is found in Aiello and Szczechura (2004). This species is widely reported from North Atlantic and Mediterranean regions.

Occurrence. Abundant.

Argilloecia caju sp. nov.
Plate 3, figures 21–24

Derivation of name. From Portuguese caju = cashew, with reference to its similarity of general shape to cashew nut.

Holotype. Adult RV, USNM 537089 (Pl. 3, fig. 22).

Paratypes. USNM 537086, 537087, 537088.

Type locality and horizon. ODP 1055, 1/2/120–122.

Dimensions. USNM 537089 (holotype), L = 0.454 mm, H = 0.235 mm.

Diagnosis. A small, moderately calcified, cashew-nut-shaped *Argilloecia* species.

Description. Carapace moderately calcified, small, highest at middle. Outline subtrapezoid to subrectangular in lateral view; anterior margin rounded, more angular in LV; posterior margin obliquely truncated; dorsal margin arched; ventral margin sinuous. Anterodorsal and posterodorsal corners generally rounded. RV overlaps LV. Lateral surface smooth. Internal features as for genus. Anterior and posterior vestibules well developed; marginal pores short.

Remarks. This species differs from any other *Argilloecia* species by its distinct cashew-nut shape in lateral view.

Occurrence. Rare.

EXPLANATION OF PLATE 3

Figs 1–2, 4–5. *Argilloecia acuminata* Müller, 1894. 1, USNM 537198, 1/2/52–54; adult LV, lateral view. 2, USNM 537083, 1/2/74–76; adult RV, lateral view. 4, USNM 537085, 1/2/78–80; adult LV, internal view. 5, USNM 537084, 1/2/74–76; adult RV, internal view.

Figs 3, 6, 9, 12. *Australoecia posteroacuta* Coles and Whatley, 1989. 3, USNM 537134, 1/2/36–38; adult RV, lateral view. 6, USNM 537131, 1/2/28–30; adult RV, internal view. 9, USNM 537133, 1/2/36–38; adult LV, lateral view. 12, USNM 537132, 1/2/28–30; adult LV, internal view.

Figs 7–8, 10–11. *Argilloecia abba* sp. nov. 7, USNM 537160, 1/3/60–62; adult LV, lateral view. 8, USNM 537158, 1/3/44–46; adult LV, internal view. 10, holotype, USNM 537159, 1/3/60–62; adult RV, lateral view. 11, USNM 537157, 1/3/44–46; adult RV, internal view.

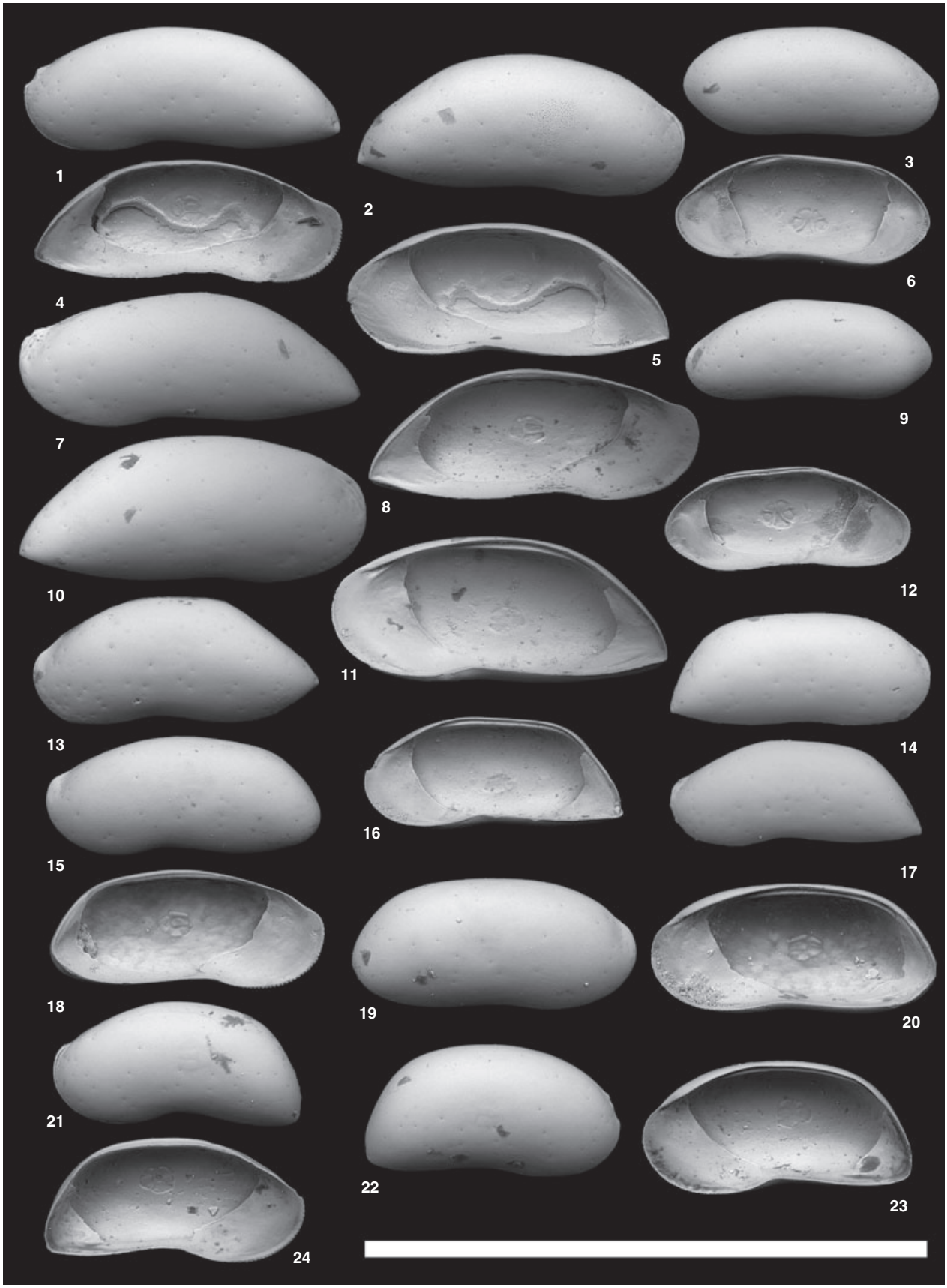
Fig. 13. *Argilloecia* sp., USNM 537090, 1/3/30–32; adult LV, lateral view.

Figs 14, 16–17. *Argilloecia keigwini* sp. nov. 14, holotype, USNM 537081, 1/1/50–52; adult RV, lateral view. 16, USNM 537080, 1/1/50–52; adult RV, internal view. 17, USNM 537082, 1/1/50–52; adult LV, lateral view.

Figs 15, 18–20. *Argilloecia robinwhatleyi* sp. nov. 15, USNM 537126, 1/1/106–108; adult LV, lateral view. 18, USNM 537099, 1/1/74–76; adult LV, internal view. 19, holotype, USNM 537127, 1/1/106–108; adult RV, lateral view. 20, USNM 537098, 1/1/74–76; adult RV, internal view.

Figs 21–24. *Argilloecia caju* sp. nov. 21, USNM 537088, 1/2/120–122; adult LV, lateral view. 22, holotype, USNM 537089, 1/2/120–122; adult RV, lateral view. 23, USNM 537086, 1/3/26–28; adult RV, internal view. 24, USNM 537087, 1/3/26–28; adult LV, internal view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Argilloecia, Australoecia*

Argilloecia keigwini sp. nov.
Plate 3, figures 14, 16–17

Derivation of name. In honour of Lloyd D. Keigwin, Woods Hole Oceanographic Institution, for his work on North Atlantic palaeoceanography.

Holotype. Adult RV, USNM 537081 (Pl. 3, fig. 14).

Paratypes. USNM 537080, 537082.

Type locality and horizon. ODP 1055, 1/1/50–52.

Dimensions. USNM 537081 (holotype), L = 0.464 mm, H = 0.200 mm.

Diagnosis. A small, moderately calcified *Argilloecia* species, subtrapezoid to subrectangular in lateral view; posterior margin truncated and acuminate.

Description. Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subtrapezoid to subrectangular in lateral view; anterior margin rounded, more angular in LV; posterior margin obliquely truncated and acuminate; dorsal margin straight; ventral margin sinuous. Anterodorsal and posterodorsal corners obtuse-angular. RV overlaps LV. Lateral surface smooth. Internal features as for genus. Anterior and posterior vestibules well developed; marginal pores short.

Remarks. This species differs from any other *Argilloecia* species by its acuminate and steeply truncated posterior margin.

Occurrence. Rare.

Argilloecia robinwhatleyi sp. nov.
Plate 3, figures 15, 18–20

1987 *Argilloecia* sp. 1 Whatley and Coles, p. 87, pl. 1, figs 11–12.

Derivation of name. In honour of Robin C. Whatley, ex University College of Wales, Aberystwyth, for his work on North Atlantic deep-sea ostracods. He first recognized this species.

Holotype. Adult RV, USNM 537127 (Pl. 3, fig. 19).

Paratypes. USNM 537098, 537099, 537126.

Type locality and horizon. ODP 1055, 1/1/106–108.

Dimensions. USNM 537127 (holotype), L = 0.508 mm, H = 0.230 mm.

Diagnosis. A moderately calcified *Argilloecia* species, subrectangular in lateral view; posterior margin rounded.

Description. Carapace moderately calcified, moderate in size, highest at anterior cardinal angle. Outline subrectangular in lateral view; anterior margin rounded, more angular in LV; posterior margin rounded, more triangular in LV; dorsal margin slightly arched; ventral margin sinuous. Anterodorsal and posterodorsal corners obtuse-angular. RV strongly overlaps LV. Lateral surface smooth. Internal features as for genus. Anterior and posterior vestibules well developed; marginal pores short.

Remarks. This species differs from *Argilloecia keigwini* sp. nov. by having larger carapace and rounded posterior margin.

Occurrence. Rare.

Argilloecia sp.
Plate 3, figure 13

1987 *Argilloecia* sp. 4 Whatley and Coles, p. 87, pl. 1, figs 17–18.
2000 *Argilloecia* sp. 2 Didié and Bauch, p. 114, pl. 3, figs 3–4.

Dimensions. USNM 537090, L = 0.509 mm, H = 0.225 mm.

Occurrence. Very rare.

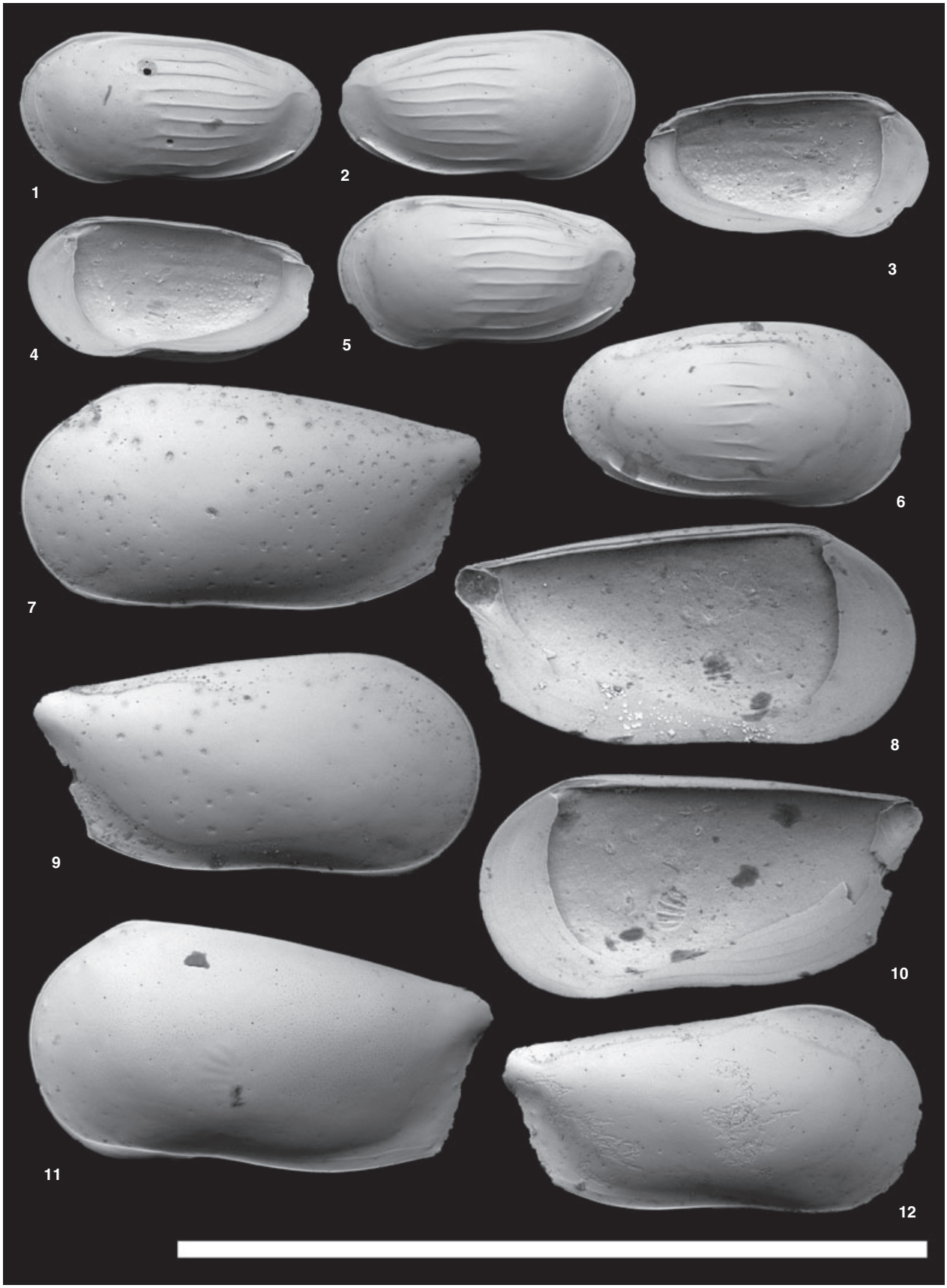
EXPLANATION OF PLATE 4

Figs 1–5. *Ruggieriella mcmanusi* sp. nov. 1, USNM 537136, 1/2/54–56; adult LV, lateral view. 2, holotype, USNM 537137, 1/2/98–100; adult RV, lateral view. 3, USNM 537138, 1/2/102–104; adult LV, internal view. 4, USNM 537139, 1/2/102–104; adult RV, internal view. 5. USNM 537202, 1/2/98–100; adult LV, lateral view.

Fig. 6. *Ruggieriella* sp., USNM 537184, 1/3/102–104; adult RV, lateral view.

Figs 7–12. *Pseudocythere caudata* Sars, 1866. 7–8, USNM 537175, 1/3/90–92; adult female LV. 7, lateral, and 8, internal views. 9–10, USNM 537176, 1/3/90–92; adult female RV. 9, lateral, and 10, internal views. 11, USNM 537183, 1/3/100–102; adult male LV, lateral view. 12, USNM 537168, 1/3/82–84; adult male RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Ruggieriella, Pseudocythere*

Genus AUSTRALOECIA Mckenzie, 1967

Australoecia posteroacuta Coles and Whatley, 1989
Plate 3, figures 3, 6, 9, 12

1989 *Australoecia posteroacuta* Coles and Whatley, p. 108, pl. 6, figs 5–8.

Dimension. USNM 537134, L = 0.458 mm, H = 0.196 mm.

Remarks. This is the youngest record of this species. Coles and Whatley (1989) attributes this species to *Australoecia* Mckenzie (1967) (but also see Barra *et al.* 1996 for detailed discussion on close relative of this species).

Occurrence. Few to rare.

Suborder CYTHEROCOPINA Gründel, 1967
Superfamily CYTHEROIDEA Baird, 1850
Family BYTHOCYTHERIDAE Sars, 1866

Genus BYTHOCERATINA Hornibrook, 1952

Bythoceratina willemvandenboldi sp. nov.
Plate 2, figures 11–14

Derivation of name. In honour of late Willem A. van den Bold, ex Louisiana State University, for his work on deep-sea ostracods.

Holotype. Adult RV, USNM 537156 (Pl. 2, figs 13, 14).

Paratype. USNM 537155.

Type locality and horizon. ODP 1055, 1/3/44–46.

Dimensions. USNM 537156 (holotype), L = 0.424 mm, H = 0.192 mm.

Diagnosis. A small, weakly calcified *Bythoceratina* species, parallelogram-shaped in lateral view; caudal process prominent and upturned; lateral surface ornamented with primary and secondary reticulation and punctation; posteroventral spine well developed.

Description. Carapace thin, small, highest at posterior cardinal angle. Outline parallelogram-shaped in lateral view; anterior margin rounded; caudal process prominent and upturned; dorsal margin straight; ventral margin sinuous. Anterodorsal corner obtuse-angular; posterodorsal corner almost straight. Lateral surface ornamented with primary and secondary reticulation in posterior half and punctation in anterior half. A posteroventral spine well developed. A median sulcus incised. Prominent pore conuli along anterior margin. Internal features as for genus.

Remarks. This species differs from *Bythoceratina monoceros* van den Bold (1988) by having a straight dorsal margin, a well developed posteroventral spine and finer surface ornamentation.

Occurrence. Very rare.

Genus BYTHOCYTHERE Sars, 1866

Bythocythere eugeneschornikovi sp. nov.
Plate 2, figures 5–10

Derivation of name. In honour of Eugene I. Schornikov, Russian Academy of Sciences, for his work on bythocytheridid ostracods.

Holotype. Adult male LV, USNM 537145 (Pl. 2, figs 5, 10).

Paratypes. USNM 537144, 537146, 537151.

Type locality and horizon. ODP 1055, 1/2/94–96.

Dimensions. USNM 537145 (holotype), L = 0.797 mm, H = 0.400 mm.

Diagnosis. A large, moderately calcified *Bythocythere* species, subrectangular in lateral view; anterior and posterior margin bearing clavate spines; lateral surface partially reticulate.

EXPLANATION OF PLATE 5

Figs 1–5. *Cytheropteron lumalatum* Ayress *et al.,* 1996. 1, USNM 537113, 1/2/98–100; adult male LV, lateral view. 2, USNM 537114, 1/2/86–88; adult female LV, lateral view. 3, USNM 537112, 1/2/34–36; adult female LV, internal view. 4, USNM 537128, 1/1/112–114; adult female RV, internal view. 5, USNM 537115, 1/2/56–58; adult female RV, lateral view.

Figs 6–8, 10. *Cytheropteron pherozigzag* Whatley *et al.,* 1986. 6, USNM 537091, 1/2/100–102; adult female LV, lateral view. 7, USNM 537092, 1/2/100–102; adult female RV, lateral view. 8, USNM 537094, 1/1/126–128; adult male RV, lateral view. 10, USNM 537093, 1/1/126–128; adult male LV, lateral view.

Fig. 9. *Cytheropteron* sp. a, USNM 537095, 1/1/96–98; adult RV, lateral view.

Fig. 11. *Cytheropteron* sp. b, USNM 537106, 1/3/24–26; adult RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.

YASUHARA *et al.*, *Cytheropteron*

Description. Carapace moderately calcified, large, highest at anterior cardinal angle. Outline subrectangular in lateral view; anterior margin rounded, bearing clavate spines; posterior margin subtriangular, bearing clavate spines mainly in ventral half; dorsal and ventral margins slightly convex. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface partially ornamented with weak reticulation, concentrated in front of median sulcus. A few carinae running on ventrolateral ridge. A median sulcus obliquely incised. Internal features as for genus.

Remarks. This species differs from *Bythocythere gangamus* Zhao, 1988 (*in* Wang *et al.* 1988), by having stronger reticulation and more elongate caparapace.

Occurrence. Rare.

Genus PSEUDOCYTHERE Sars, 1866

Pseudocythere caudata Sars, 1866
Plate 4, figures 7–12

1866 *Pseudocythere caudata* Sars, p. 88.
1926 *Pseudocythere caudata* Sars; Sars, p. 239, pl. 109, figs 2a–k.
1986 *Pseudocythere caudata* Sars; Horne, p. 119, figs 1m, 2c.
1989 *Pseudocythere caudata* Sars; Athersuch *et al.*, p. 255, figs 108a–d.
cf. 1996 *Pseudocythere* gr. *caudata* Sars; Coles *et al.*, p. 134, pl. 2, figs 3–4.
non 1998 *Pseudocythere caudata* Sars; Freiwald and Mostafawi, p. 263, pl. 60, fig. 5.

Dimensions. USNM 537183, L = 0.618 mm, H = 0.328 mm.

Remarks. The specimens in this study appear identical to the line drawing of the type material by Horne (1986). Relatively few marginal pores found in the specimens are also characteristic of this species. Detailed discussion of taxonomic difficulties with this species is found in Horne (1986) and Malz and Jellinek (1994).

Occurrence. Few to rare.

Genus RUGGIERIELLA Colalongo and Pasini, 1980

Ruggieriella mcmanusi sp. nov.
Plate 4, figures 1–5

Derivation of name. In honour of Jerry F. McManus, Woods Hole Oceanographic Institution, for his work on North Atlantic palaeoceanography.

Holotype. Adult RV, USNM 537137 (Pl. 4, fig. 2).

Paratypes. USNM 537136, 537138, 537139, 537202.

Type locality and horizon. ODP 1055, 1/2/98–100.

Dimensions. USNM 537137 (holotype), L = 0.396 mm, H = 0.200 mm.

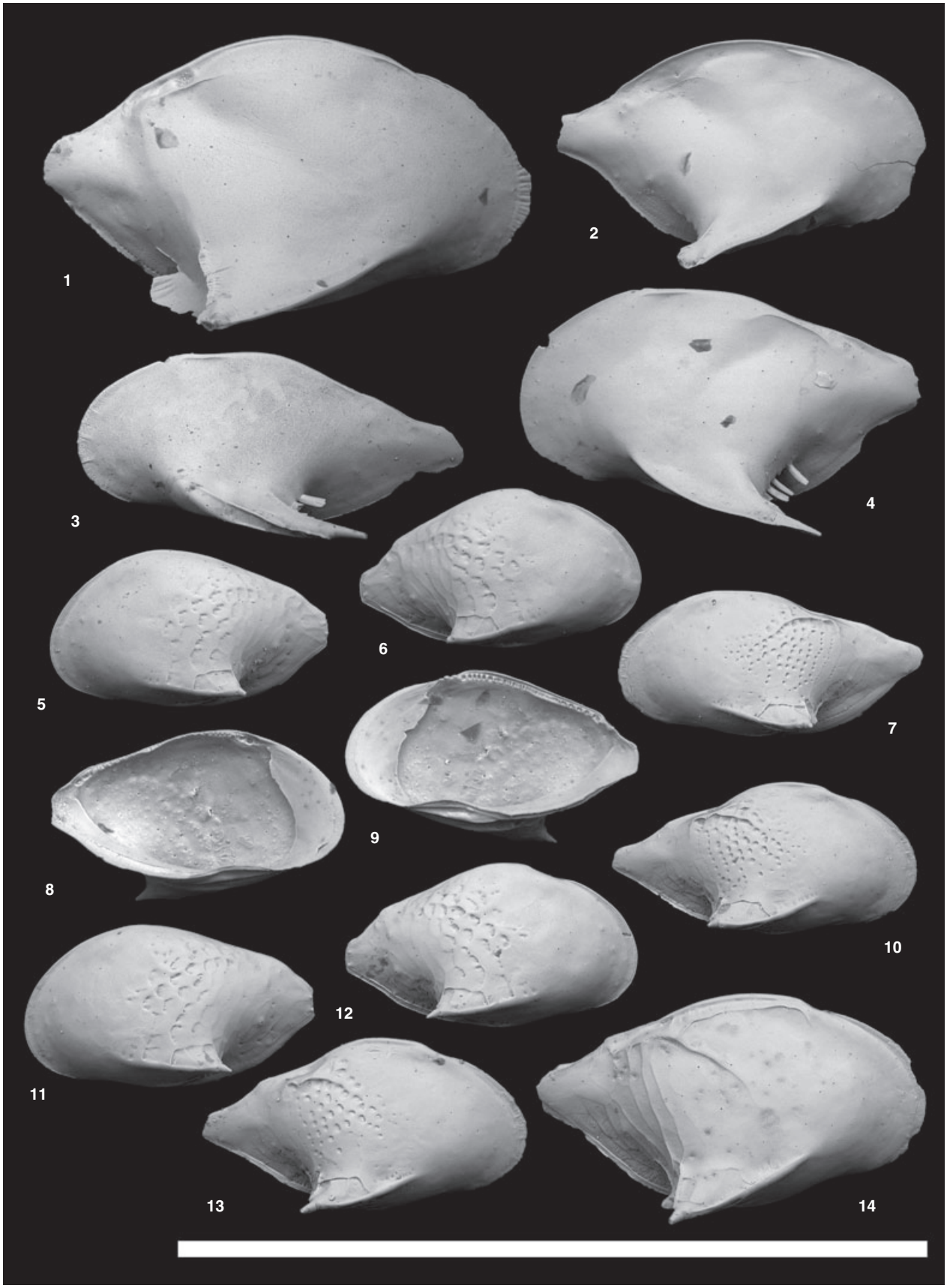
Diagnosis. A moderately calcified *Ruggieriella* species, subrectangular in lateral view; 10 fine carinae extend horizontally.

Description. Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subrectangular in lateral view; anterior and posterior margins evenly rounded; dorsal margin almost straight; ventral margin sinuous. Anterodorsal corner rounded; posterodorsal corner straight. Lateral surface smooth, bearing 10 fine horizontal carinae mainly in posterior half. Internal features as for genus.

Remarks. This species is closely similar to *Ruggieriella decemcostata* Colalongo and Pasini (1980), but the latter has more triangular lateral outline and straight dorsal margin. Part of specimens identified as *Cytherura striatoides* Bonnema 1941 (Bonnema 1941; pl. 5, fig. 28; Herrig 1966,

EXPLANATION OF PLATE 6

Fig. 1. *Cytheropteron* sp. c, USNM 537180, 1/3/94–96; adult RV, lateral view.
Fig. 2. *Cytheropteron* sp. d, USNM 537116, 1/3/72–74; adult RV, lateral view.
Fig. 3. *Cytheropteron* sp. e, USNM 537177, 1/3/92–94; adult LV, lateral view.
Fig. 4. *Cytheropteron* sp. f, USNM 537117, 1/3/46–48; adult LV, lateral view.
Figs 5–6, 8–9, 11–12. *Cytheropteron didieae* sp. nov. 5, USNM 537003, 1/1/120–122; adult female LV, lateral view. 6, USNM 537004, 1/1/120–122; adult female RV, lateral view. 8, 11, USNM 537005, 1/2/94–96; adult male LV. 8, internal, and 11, lateral views. 9, 12, holotype, USNM 537006, 1/2/94–96; adult male RV. 9, internal, and 12, lateral views.
Figs 7, 10, 13. *Cytheropteron massoni* Whatley and Coles, 1987. 7, USNM 536999, 1/2/110–112; adult male? LV, lateral view. 10, USNM 537000, 1/2/110–112; adult male? RV, lateral view. 13, USNM 537001, 1/2/2–4; adult female? RV, lateral view.
Fig. 14. *Cytheropteron* sp. g, USNM 537002, 1/2/94–96; adult RV, lateral view.
All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Cytheropteron*

pl. 28, fig. 21) appear to be *Ruggieriella*, but these specimens are more slender and have longer horizontal carinae than *Ruggieriella mcmanusi* sp. nov.

Occurrence. Rare.

Ruggieriella sp.
Plate 4, figure 6

Dimensions. USNM 537184, L = 0.465 mm, H = 0.251 mm.

Remarks. This species is closely similar to *Ruggieriella mcmanusi* sp. nov., but the latter has smaller, more elongate carapace and better developed carinae.

Occurrence. Very rare.

Family CYTHERIDAE Baird, 1850

Genus POSACYTHERE Gründel, 1976

Posacythere hunti sp. nov.
Plate 14, figures 8, 10–12; Text-fig. 2A–D

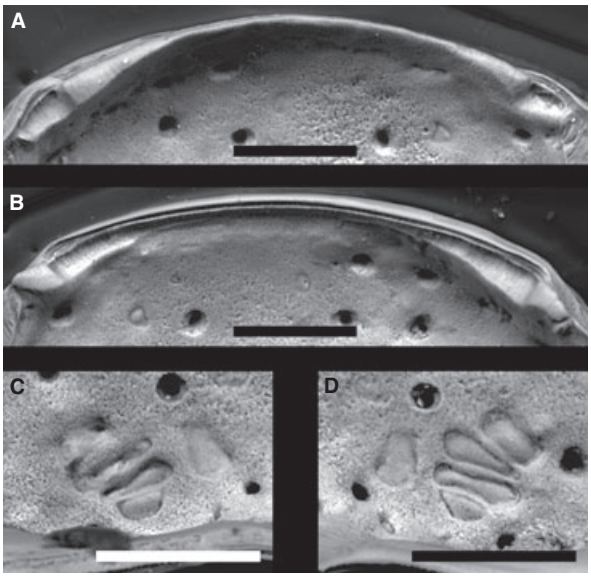
Derivation of name. In honour of Gene Hunt, National Museum of Natural History, Smithsonian Institution, for his work on deep-sea ostracods.

Holotype. Adult LV, USNM 537143 (Pl. 14, figs 8, 12; Text-fig. 2A, 2C).

Paratype. USNM 537149.

Type locality and horizon. ODP 1055, 1/2/56–58.

Dimensions. USNM 537143 (holotype), L = 0.324 mm, H = 0.185 mm.



TEXT-FIG. 2. Internal features of *Posacythere hunti* sp. nov. A, C, holotype, USNM 537143, 1/2/56–58; adult LV. A, hingement, and C, muscle scars. B, D, USNM 537149, 1/3/20–22; adult RV. B, hingement, and D, muscle scars. All SEM images. Scale bars represent 50 μm.

Diagnosis. A moderately calcified *Posacythere* species, subtriangular in lateral view; ventrolateral ridge sinuous; lateral surface ornamented with punctation; three carinae running along ventrolateral ridge but merging in the middle.

Description. Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded; posterior margin subtriangular, pointed at mid-height; dorsal margin arched; ventral margin sinuous. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface punctate; ventrolateral ridge sinuous; three carinae running along ventrolateral ridge but merging in the middle. Normal pores sparse; marginal pores simple, straight, few in number. Inner lamella broad; vestibulum narrow. Hingement

EXPLANATION OF PLATE 7

Figs 1–6. *Cytheropteron fugu* sp. nov. 1, holotype, USNM 537100, 1/2/20–22; adult RV, lateral view. 2, USNM 537101, 1/2/20–22; adult LV, lateral view. 3, USNM 537104, 1/3/22–24; A-1 juvenile LV, lateral view. 4, USNM 537102, 1/3/22–24; adult RV, internal view. 5, USNM 537103, 1/3/22–24; adult LV, internal view. 6, USNM 537105, 1/3/22–24; A-1 juvenile RV, lateral view.

Fig. 7. *Cytheropteron* sp. h, USNM 537109, 1/3/74–76; adult RV, lateral view.

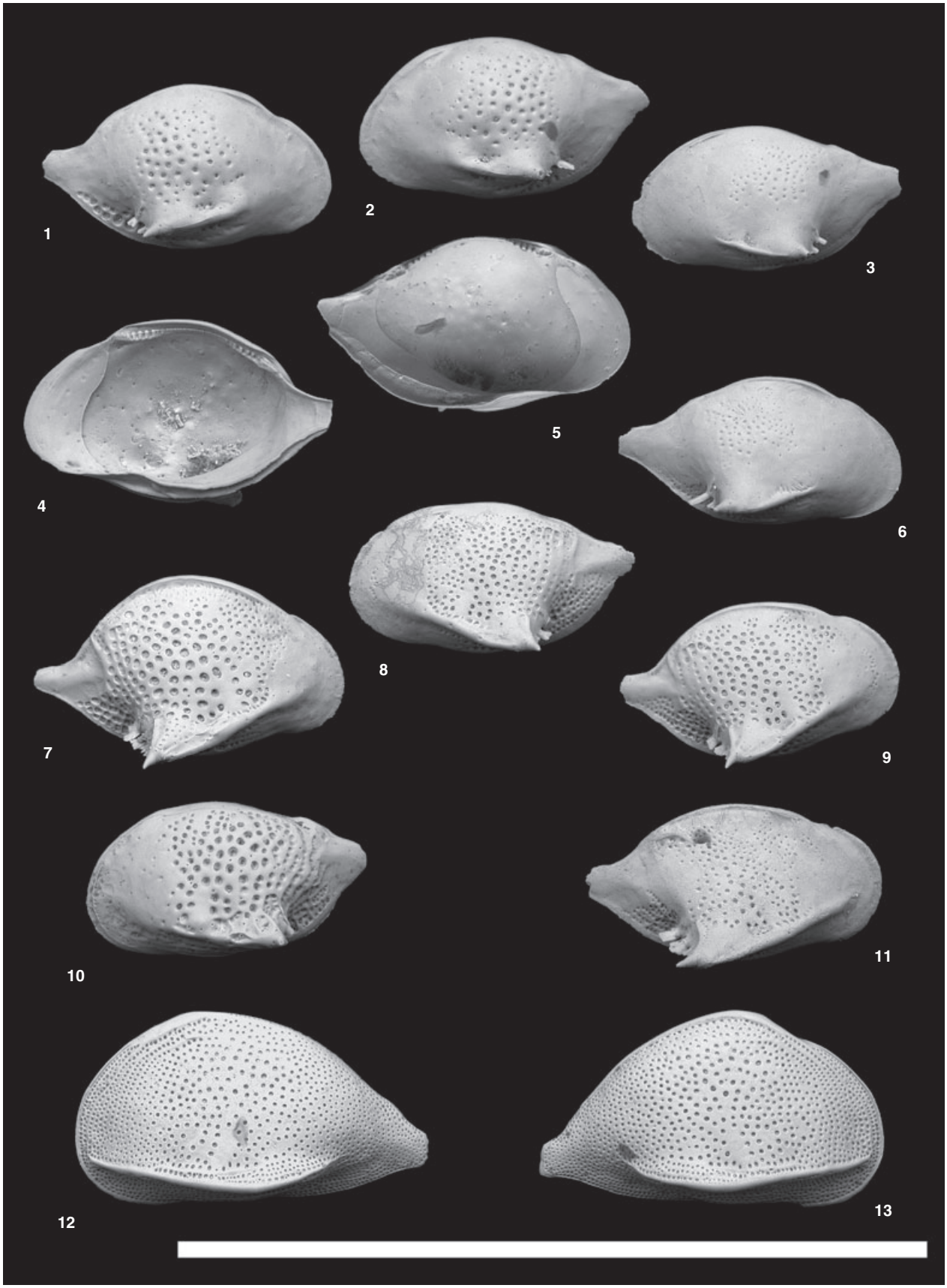
Figs 8–9. *Cytheropteron carolinae* Whatley and Coles 1987. 8, USNM 537110, 1/3/54–56; adult LV, lateral view. 9, USNM 537111, 1/3/64–66; adult RV, lateral view.

Fig. 10. *Cytheropteron* sp. i, USNM 537148, 1/3/20–22; adult LV, lateral view.

Fig. 11. *Cytheropteron* sp. j, USNM 537135, 1/2/36–38; adult RV, lateral view.

Figs 12–13. *Cytheropteron perlaria* Hao, 1988 (in Ruan and Hao 1988). 12, USNM 537107, 1/3/32–34; adult LV, lateral view. 13, USNM 537108, 1/3/22–24; adult RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Cytheropteron*

lophodont, all elements smooth, strongly arched. Frontal scar square-shaped to ovate; adductor muscle scars consisting of oblique row of four scars, median two scars elongate.

Remarks. This species is closely similar to *Posacythere undata* (Colalongo and Pasini 1980), but the latter has a straighter dorsal margin and better developed posteromarginal, subvertical carinae. Species belonging to this genus, which is closely similar to *Posacythere hunti* sp. nov., is also known from the southwestern Pacific Quaternary (Michael A. Ayress, personal communication). Muscle scars of this genus were shown here for the first time.

Occurrence. Very rare.

Genus SAIDA Hornibrook, 1952

Saida ionia Ciampo, 1988
Plate 14, figures 6–7, 9

1988 *Saida ionia* Ciampo, p. 319, pl. 4, fig. 1.
2006 *Saida* sp. Bergue, Costa, Dwyer and Moura, p. 206, fig. 6H.
2008 *Saida minuta* Bergue and Coimbra, p. 119, pl. 3, figs 6–9.

Dimensions. USNM 537141, L = 0.399 mm, H = 0.259 mm.

Occurrence. Very rare.

Family CYTHERURIDAE Müller, 1894

Genus AVERSOVALVA Hornibrook, 1952

Aversovalva carolinensis sp. nov.
Plate 8, figures 7, 10

1983 *Cytheropteron* sp. Cronin, p. 114, pl. 8, fig. A.

Derivation of name. For the type locality, Carolina Slope.

Holotype. Adult RV, USNM 537178 (Pl. 8, fig. 7).

Paratype. USNM 537188.

Type locality and horizon. ODP 1055, 1/3/92–94.

Dimensions. USNM 537178 (holotype), L = 0.404 mm, H = 0.286 mm.

Diagnosis. A moderately calcified *Aversovalva* species, subtrapezoidal in lateral view; alae evenly arched; lateral surface almost smooth, surface ornamentation very weak, restricted to the central part in lateral view.

Description. Carapace moderately calcified, moderate in size, highest at middle. Outline subtrapezoidal in lateral view; anterior margin obliquely truncated; caudal process subtriangular, pointed at mid-height; dorsal margin straight in RV, arched in LV; ala extending below ventral margin, evenly arched, having two carinae in its anterior two-third, having a small spine at its apex. Anterodorsal and posterodorsal corners rounded in LV, obtuse-angular in RV. Lateral surface almost smooth, surface ornamentation very weak and restricted to the central part in lateral view. Internal features as for genus.

Remarks. This species differs from any other *Aversovalva* species by its evenly arched alae and almost smooth carapace.

Occurrence. Very rare.

Aversovalva cf. *hydrodynamica* Whatley and Coles, 1987
Plate 11, figure 9

Dimensions. USNM 537165, L = 0.380 mm, H = 0.226 mm.

Remarks. This species was tentatively separated from *Aversovalva hydrodynamica* Whatley and Coles (1987) and

---

EXPLANATION OF PLATE 8

Figs 1–6. *Cytheropteron richardbensoni* sp. nov. 1, holotype, USNM 537120, 1/3/10–12; adult male? LV, lateral view. 2, USNM 537121, 1/3/10–12; adult male? RV, lateral view. 3, USNM 537124, 1/1/90–92; adult female? LV, lateral view. 4, USNM 537125, 1/1/90–92; adult female? RV, lateral view. 5, USNM 537118, 1/3/26–28; adult male? RV, internal view. 6, USNM 537119, 1/3/26–28; adult male? LV. internal view.

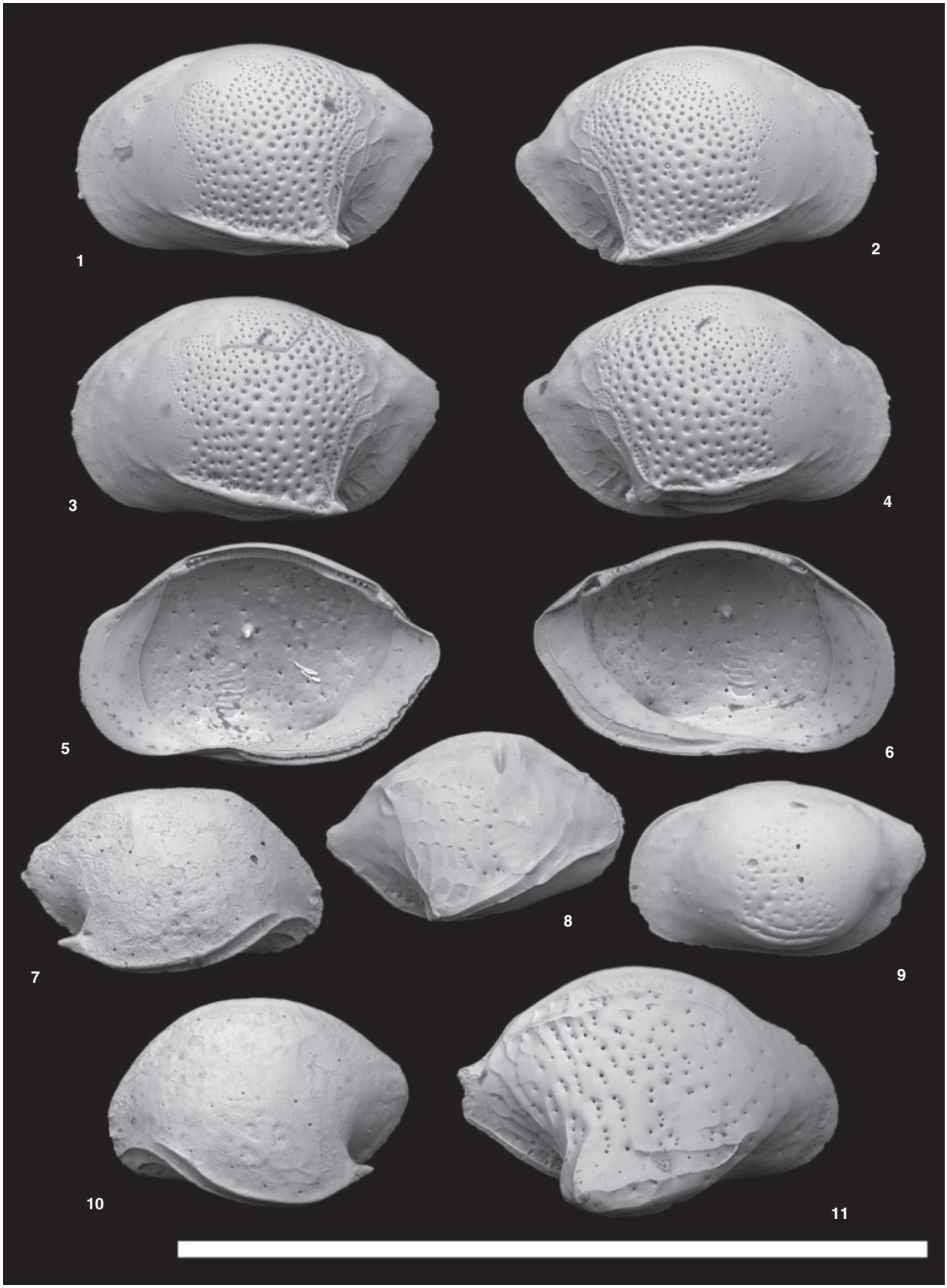
Figs 7, 10. *Aversovalva carolinensis* sp. nov. 7, holotype, USNM 537178, 1/3/92–94; adult RV, lateral view. 10, USNM 537188, 1/3/124–126; adult LV, lateral view.

Fig. 8. *Cytheropteron* sp. k, USNM 537140, 1/2/112–114; adult RV, lateral view.

Fig. 9. *Cytheropteron* sp. l, USNM 537154, 1/3/36–38; adult LV, lateral view.

Fig. 11. *Cytheropteron* sp. m, USNM 537166, 1/3/78–80; adult RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Cytheropteron*

Aversovalva sp. 1, because *Aversovalva hydrodynamica* lacks fine carinae in posterior quarter and *Aversovalva* sp. 1 is larger and has angular reticulation in the central part in lateral view. However, these three species closely similar, and Michael A. Ayress (personal communication) indicated that there is considerable intraspecific variation in the inflation, surface ornamentation and direction of the ventrolateral spine of *Aversovalva*. Furthermore, *Aversovalva* species in this core are very rare and each species include only one or two adult specimens. Considering a number of researchers have reported several species closely similar to *Aversovalva hydrodynamica* from various localities (Herrig 1966; Ruan and Hao 1988; Aiello *et al.* 1996*a*), further specimens are necessary for detailed discussions on this '*Aversovalva hydrodynamica* group'.

Occurrence. Very rare.

Aversovalva sp. 1
Plate 11, figure 8

1983 *Cytheropteron* sp. Cronin, p. 114, pl. 8H.

Dimensions. USNM 537097, L = 0.492 mm, H = 0.279 mm.

Remarks. This species is closely similar to *Aversovalva hydrodynamica* Whatley and Coles 1987, but differ by having arched dorsal margin and angular reticulation in the central part in lateral view.

Occurrence. Very rare.

Aversovalva sp. 2
Plate 11, figure 10

Dimensions. USNM 537173, L = 0.354 mm, H = 0.202 mm.

Remarks. This species is closely similar to *Aversovalva formosa* Coles and Whatley 1989, but the latter has more extensive punctation and a more slender shape in lateral view.

Occurrence. Very rare.

Aversovalva sp. 3
Plate 11, figure 11; Plate 12, figure 1

Dimensions. USNM 537055, L = 0.370 mm, H = 0.214 mm.

Remarks. This species is closely similar to *Aversovalva* sp. 2, but it has more extensive and prominent surface ornamentation. *Aversovalva* sp. 2 may be within intraspecific variation of this species.

Occurrence. Very rare.

Genus CYTHEROPTERON Sars, 1866

Cytheropteron aielloi sp. nov.
Plate 10, figures 3–6

Derivation of name. In honour of Giuseppe Aiello, Universitá di Napoli Federico II, for his work on deep-sea ostracods including this genus.

Holotype. Adult RV, USNM 537153 (Pl. 10, figs 5–6).

Paratype. USNM 537152.

Type locality and horizon. ODP 1055, 1/3/36–38.

Dimensions. USNM 537153 (holotype), L = 0.487 mm, H = 0.281 mm.

Diagnosis. A moderately calcified *Cytheropteron* species, subrhomboidal in lateral view; ala moderately thick, having carinae in its posterior half; surface reticulation restricted to the posterior three-fourths of the carapace.

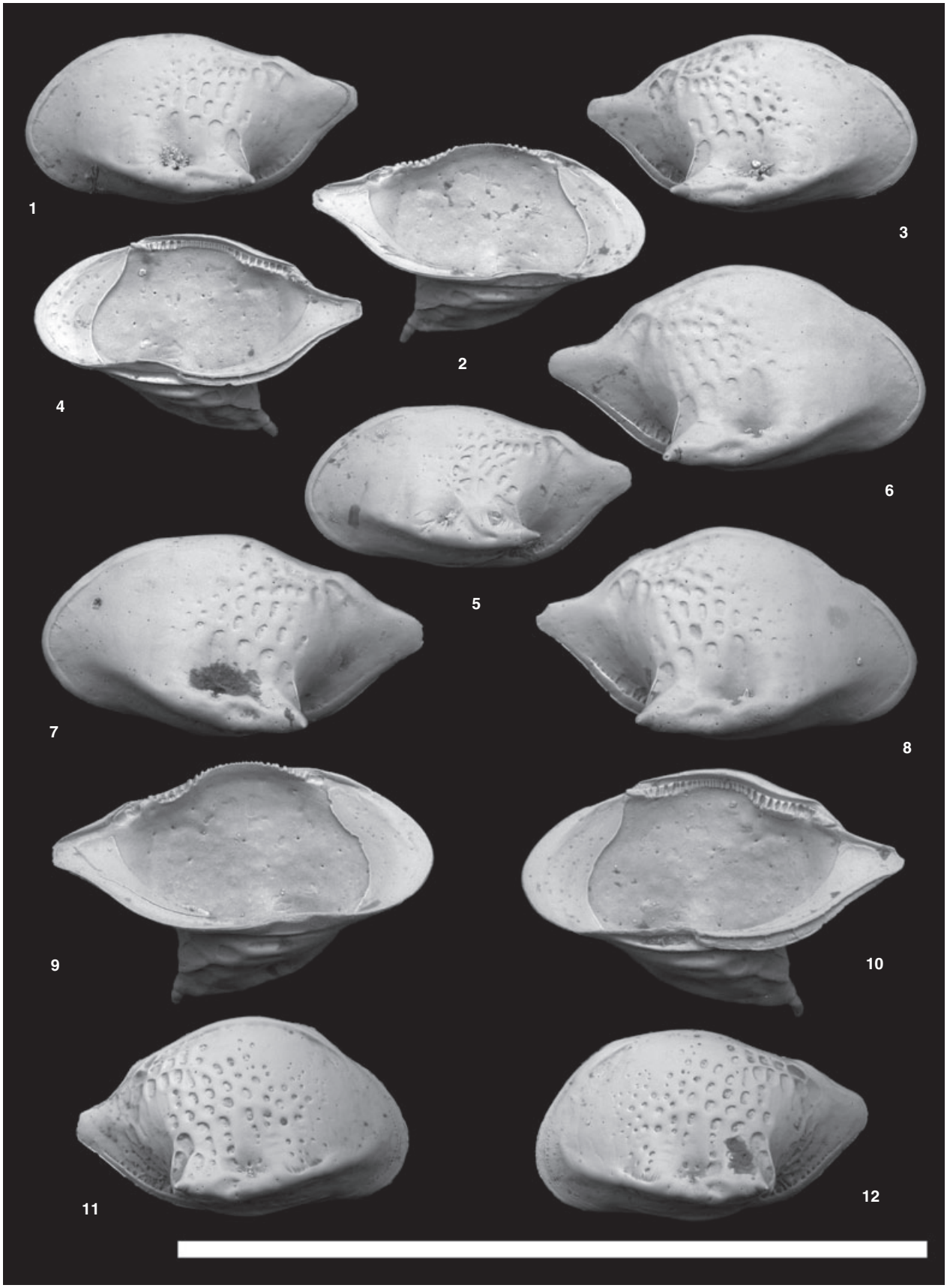
Description. Carapace moderately calcified, moderate in size, highest at middle. Outline subrhomboidal in lateral view; anterior margin rounded; caudal process moderately prominent, pointed at mid-height; dorsal margin arched; ala not extending below ventral margin, moderately thick, having carinae in its

EXPLANATION OF PLATE 9

Figs 1–10. *Cytheropteron demenocali* sp. nov. 1–2, USNM 536983, 1/1/10–12; adult LV. 1, lateral, and 2, internal views. 3–4, holotype, USNM 536984, 1/1/10–12; adult RV. 3, lateral, and 4, internal views. 5, USNM 537123, 1/1/88–90; adult LV, lateral view. 6, USNM 537122, 1/1/82–84; adult RV, lateral view. 7, 9, USNM 537129, 1/1/130–132; adult LV. 7, lateral, and 9, internal views. 8, 10, USNM 537130, 1/1/130–132; adult RV. 8, lateral, and 10, internal views.

Figs 11–12. *Cytheropteron richarddinglei* sp. nov. 11, holotype, USNM 537161, 1/3/60–62; adult RV, lateral view. 12, USNM 537162, 1/3/60–62; adult LV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Cytheropteron*

posterior half. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface ornamented with reticulation and punctation in the posterior three-fourths of the carapace. Internal features as for genus.

Remarks. This species is closely similar to *Cytheropteron richarddinglei* sp. nov., but distinguished by having more strongly reticulate and punctate carapace, shorter alae and fine carinae on ala.

Occurrence. Very rare.

Cytheropteron carolinae Whatley and Coles, 1987
Plate 7, figures 8–9

1987 *Cytheropteron carolinae* Whatley and Coles, p. 88, pl. 2, figs 6–7, 9.

Dimensions. USNM 537111, L = 0.374 mm, H = 0.217 mm.

Remarks. Comprehensive synonymy is found in Whatley and Coles (1987). *Cytheropteron* sp. h and *Cytheropteron* sp. j may be within intraspecific variation of this species.

Occurrence. Very rare.

Cytheropteron demenocali sp. nov.
Plate 9, figures 1–10

?2000 *Cytheropteron porterae* Whatley and Coles; Didié and Bauch , p. 113, pl. 2, fig. 20 (non figs 19 and 21).

Derivation of name. In honour of Peter B. deMenocal, Lamont-Doherty Earth Observatory of Columbia University, for his work on North Atlantic paleoceanography.

Holotype. Adult RV, USNM 536984 (Pl. 9, figs 3–4).

Paratypes. USNM 536983, 537122, 537123, 537129, 537130.

Type locality and horizon. ODP 1055, 1/1/10–12.

Dimensions. USNM 536984 (holotype), L = 0.443 mm, H = 0.240 mm; USNM 537130 (paratype), L = 0.512 mm, H = 0.285 mm.

Diagnosis. A moderately calcified *Cytheropteron* species, subrhomboidal in lateral view; alae moderately thick, obliquely arched; surface reticulation restricted to the central part in lateral view.

Description. Carapace moderately calcified, moderate in size, highest at middle. Outline subrhomboidal in lateral view; anterior margin rounded; caudal process prominent, upturned, pointed at mid-height; dorsal margin sinuous, convex; ala extending below ventral margin in RV, moderately thick, obliquely arched, having a small spine at its apex. Anterodorsal and posterodorsal corners obtuse-angular. Surface reticulation weak, restricted to the central part in lateral view. Anterior margin outlined by weak rim. Internal features as for genus.

Remarks. This species is closely similar to *Cytheropteron porterae* Whatley and Coles 1987, but the latter has thicker alae and a more reticulate and punctate carapace.

Occurrence. Few.

Cytheropteron didieae sp. nov.
Plate 6, figures 5–6, 8–9, 11–12

Derivation of name. In honour of Claudia Didié, Alfred Wegener Institute for Polar and Marine Research, for her work on North Atlantic deep-sea ostracods.

Holotype. Adult male RV, USNM 537006 (Pl. 6, figs 9, 12).

Paratypes. USNM 537003, 537004, 537005.

Type locality and horizon. ODP 1055, 1/2/94–96.

Dimensions. USNM 537006 (holotype), L = 0.390 mm, H = 0.219 mm.

Diagnosis. A small, weakly calcified *Cytheropteron* species, subrhomboidal in lateral view; alae short, slightly sinuous;

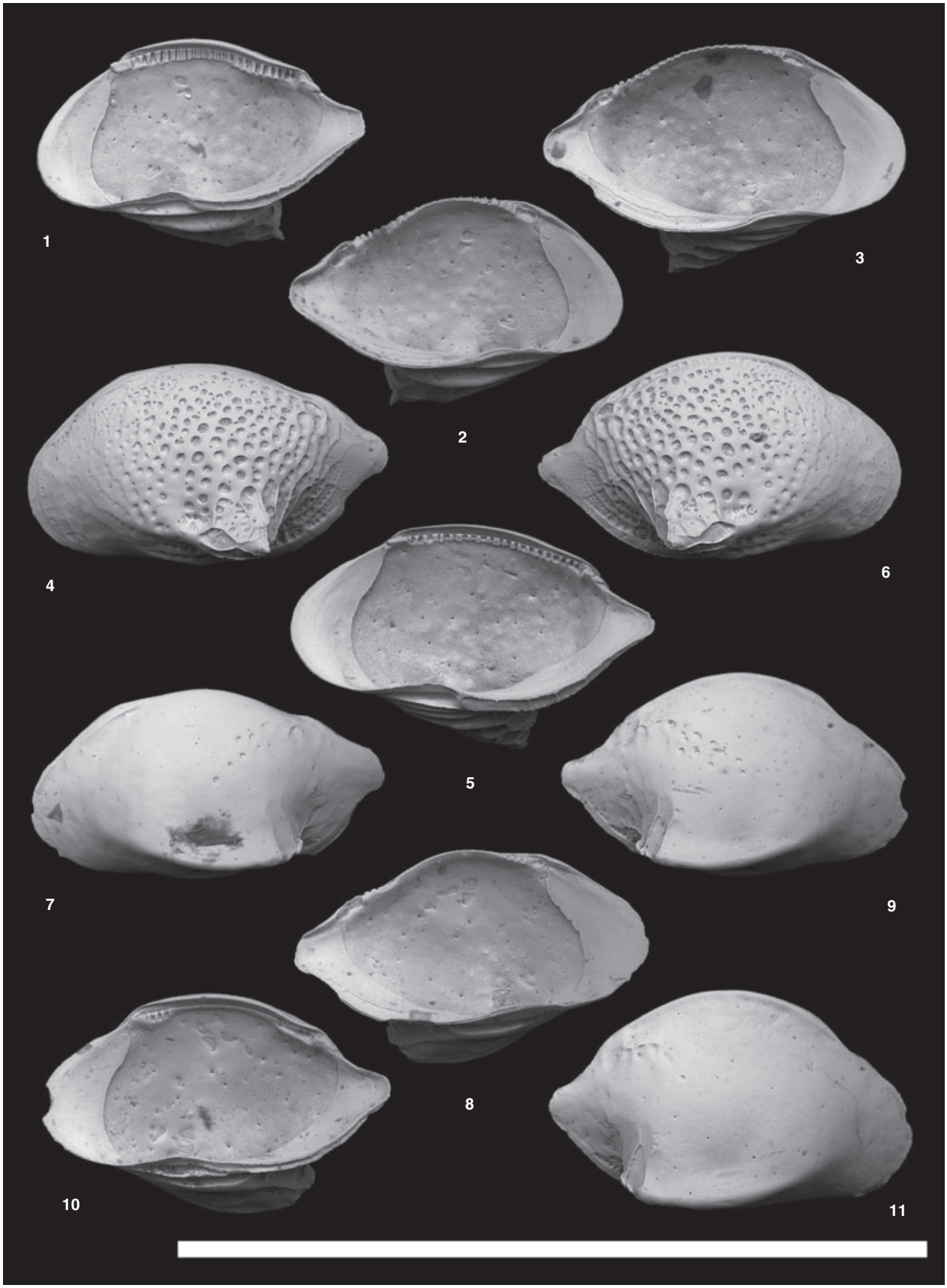
EXPLANATION OF PLATE 10

Figs 1–2. *Cytheropteron richarddinglei* sp. nov. 1, holotype, USNM 537161, 1/3/60–62; adult RV, internal view. 2, USNM 537162, 1/3/60–62; adult LV, internal view.

Figs 3–6. *Cytheropteron aielloi* sp. nov. 3–4, USNM 537152, 1/3/36–38; adult LV. 3, internal, and 4, lateral views. 5–6, holotype, USNM 537153, 1/3/36–38; adult RV. 5, internal, and 6, lateral views.

Figs 7–11. *Cytheropteron guerneti* sp. nov. 7–8, USNM 537179, 1/3/94–96; adult male? LV. 7, lateral, and 8, internal views. 9–10, holotype, USNM 537172, 1/3/88–90; adult male? RV. 9, lateral, and 10, internal views. 11, USNM 537167, 1/3/80–82; adult female? RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Cytheropteron*

surface reticulation weak, restricted to the central part in lateral view.

Description. Carapace weakly calcified, small, highest at anterior cardinal angle. Outline subrhomboidal in lateral view; anterior margin rounded; caudal process subtriangular, pointed at mid-height; dorsal margin arched; ala short, not extending below ventral margin, slightly sinuous, having a small spine at its apex. Anterodorsal corner rounded in LV, obtuse-angular in RV. Posterodorsal corner obtuse-angular. Surface reticulation weak, restricted to the central part in lateral view. Internal features as for genus.

Remarks. This species is closely similar to *Cytheropteron massoni* Whatley and Coles, 1987, but the latter has more elongate carapace, a more prominent caudal process and fine punctation in the central part in lateral view. This species is also similar to *Cytheropteron vanharteni* Aiello, Barra and Bonaduce, 1996, but the latter has more slender lateral outline, straight dorsal margin and sparsely punctate carapace.

Occurrence. Very rare.

Cytheropteron fugu sp. nov.
Plate 7, figures 1–6

Derivation of name. From Japanese fugu = puffer fish, with reference to its inflated carapace in lateral view.

Holotype. Adult RV, Holotype, USNM 537100 (Pl. 7, fig. 1).

Paratypes. USNM 537101, 537102, 537103, 537104, 537105.

Type locality and horizon. ODP 1055, 1/2/20–22.

Dimensions. USNM 537100 (holotype), L = 0.387 mm, H = 0.222 mm.

Diagnosis. A small, moderately calcified *Cytheropteron* species, subrhomboidal in lateral view; ala short, having a small spine at its apex, bearing a few spines in its trailing edge; surface punctation restricted to the central part in lateral view.

Description. Carapace moderately calcified, small, highest at middle. Outline subrhomboidal in lateral view; anterior margin rounded; caudal process prominent, upturned, pointed at mid-height; dorsal margin arched, slightly sinuous; ala short, not extending below ventral margin, moderately thick, having a small spine at its apex, bearing a few spines on its trailing edge. Depression on alae. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface ornamented with punctation in the central part in lateral view. Internal features as for genus.

Remarks. This species is closely similar to *Cytheropteron carolinae* Whatley and Coles 1987, but distinguished by its more inflated and less punctate carapace and shorter alae.

Occurrence. Few to rare.

Cytheropteron guerneti sp. nov.
Plate 10, figures 7–11; Plate 11, figure 2

Derivation of name. In honour of Claude Guernet, Université Pierre et Marie Curie, for his work on western North Atlantic deep-sea ostracods.

Holotype. Adult male? RV, USNM 537172 (Pl. 10, figs 9–10).

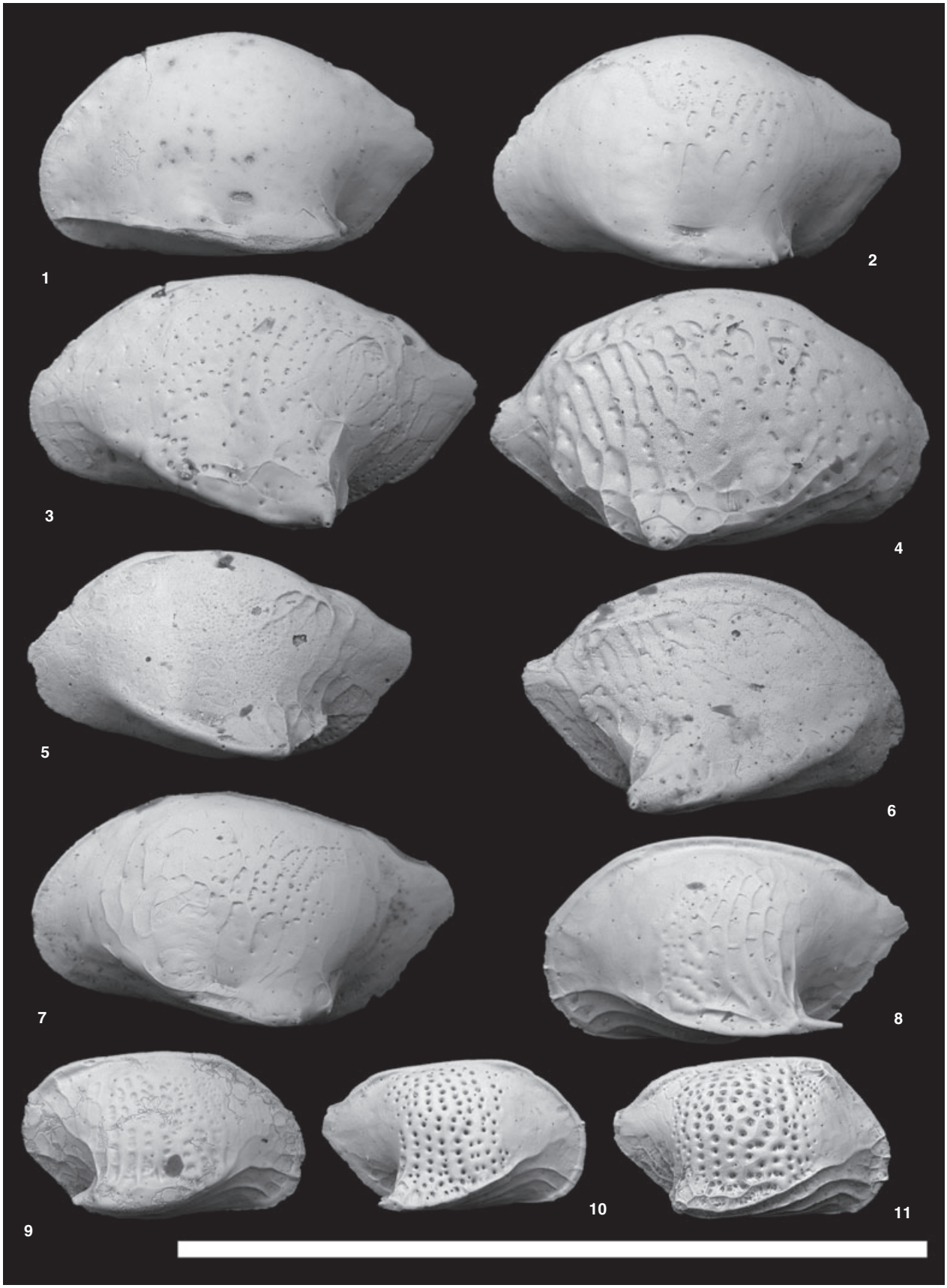
Paratypes. USNM 537167, 537179, 537186.

Type locality and horizon. ODP 1055, 1/3/88–90.

Dimensions. USNM 537172 (holotype), L = 0.463 mm, H = 0.273 mm.

EXPLANATION OF PLATE 11

Fig. 1. *Cytheropteron* sp. n, USNM 537164, 1/3/76–78; adult LV, lateral view.
Fig. 2. *Cytheropteron guerneti* sp. nov., USNM 537186, 1/3/102–104; adult female? LV, lateral view.
Fig. 3. *Cytheropteron* sp. o, USNM 537182, 1/3/100–102; adult LV, lateral view.
Fig. 4. *Cytheropteron* sp. p, USNM 537171, 1/3/88–90; adult RV, lateral view.
Fig. 5. *Cytheropteron* sp. q, USNM 537185, 1/3/102–104; adult LV, lateral view.
Fig. 6. *Cytheropteron* sp. r, USNM 537170, 1/3/82–84; adult RV, lateral view.
Fig. 7. *Cytheropteron* sp. s, USNM 537163, 1/3/76–78; adult LV, lateral view.
Fig. 8. *Aversovalva* sp. 1, USNM 537097, 1/1/66–68; adult LV, lateral view.
Fig. 9. *Aversovalva* cf. *hydrodynamica* Whatley and Coles, 1987, USNM 537165, 1/3/76–78; adult RV, lateral view.
Fig. 10. *Aversovalva* sp. 2, USNM 537173, 1/3/88–90; adult RV, lateral view.
Fig. 11. *Aversovalva* sp. 3, USNM 537055, 1/3/72–74; adult RV, lateral view.
All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Cytheropteron, Aversovalva*

Diagnosis. A moderately calcified *Cytheropteron* species, subrhomboidal in lateral view; alae obliquely arched; lateral surface almost smooth.

Description. Carapace moderately calcified, moderate in size, highest at middle. Outline subrhomboidal in lateral view; anterior margin rounded; caudal process moderately prominent, pointed at mid-height; dorsal margin arched, sinuous; alae obliquely arched. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface almost smooth. Internal features as for genus. Crenulations only at periphery of hinge line.

Remarks. This species is closely similar to *Cytheropteron demenocali* sp. nov., but the latter has more prominent caudal process, stronger surface ornamentation and a small spine at apex of ala.

Occurrence. Very rare.

Cytheropteron lumalatum Ayress *et al.*, 1996
Plate 5, figures 1–5

1974 *Lobosocytheropteron*? sp. A Ishizaki and Gunther, p. 42, pl. 7, figs 9–10.
1996 *Cytheropteron lumalatum* Ayress, Correge, Passlow and Whatley, p. 86, pl. 11, figs 5–13.

Dimensions. USNM 537113, L = 0.780 mm, H = 0.542 mm.

Remarks. This species has been reported from Pacific and Gulf of Panama. Ayress *et al.* (1996) figured one female RV, one broken LV (probably male) and one juvenile RV. Thus, this is the first certain record of male specimens of this species.

Cytheropteron massoni Whatley and Coles, 1987
Plate 6, figures 7, 10, 13

1987 *Cytheropteron massoni* Whatley and Coles , p. 63, pl. 2, figs 15–17.
2000 *Cytheropteron massoni* Whatley and Coles; Didié and Bauch , p. 113, pl. 2, fig. 11.

Dimensions. USNM 537000, L = 0.406 mm, H = 0.204 mm.

Remarks. This species has been reported from the north-eastern North Atlantic.

Occurrence. Few.

Cytheropteron perlaria Hao, 1988
Plate 7, figures 12–13

1987 *Cytheropteron testudo* Sars; Whatley and Coles, p. 90, pl. 3, fig. 1.
1988 *Cytheropteron perlaria* Hao (*in* Ruan and Hao 1988), p. 280, pl. 47, figs 4–9.
1996 *Cytheropteron testudo* Sars; Coles *et al.*, p. 137, pl. 3, figs 10–11.
1996 *Cytheropteron testudo* Sars; Whatley *et al.*, p. 21, pl. 3, figs 2–3.
1998 *Cytheropteron testudo* Sars; Whatley *et al.*, p.20, pl. 2, figs 14–15.
1999 *Cytheropteron perlaria* Hao; Swanson and Ayress, p. 155, pl. 1, figs 7–13; pl. 2, figs 1–3.
2000 *Cytheropteron testudo* Sars; Didié and Bauch, p. 113, pl. 2, fig. 12.
2000 *Cytheropteron testudo* Sars; Zhao *et al.*, p. 266, pl. 1, figs 23–24.
2002 *Cytheropteron testudo* Sars; Cronin *et al.*, p. 102, fig. 2I.
2006 *Cytheropteron perlaria* Hao; Stepanova, p. S163, pl. 3, figs 8–10.
2006 *Cytheropteron perlaria* Hao; Bergue *et al.*, p. 207, fig. 7I.
2008 *Cytheropteron perlaria* Hao; Bergue and Coimbra, p. 130, pl. 6, fig. 15.

Dimensions. USNM 537108, L = 0.460 mm, H = 0.260 mm.

EXPLANATION OF PLATE 12

Fig. 1. *Aversovalva* sp. 3, USNM 537055, 1/3/72–74; adult RV, internal view.

Figs 2–7. *Eucytherura spinicorona* sp. nov. 2, USNM 537045, 1/1/134–136; adult female LV, lateral view. 3, holotype, USNM 537046, 1/1/134–136; adult female RV, lateral view. 4, USNM 537048, 1/2/0–2; adult male LV, lateral view. 5, USNM 537049, 1/2/8–10; adult male RV, lateral view. 6, USNM 537044, 1/1/34–36; adult male LV, internal view. 7, USNM 537047, 1/2/0–2; adult male RV, internal view.

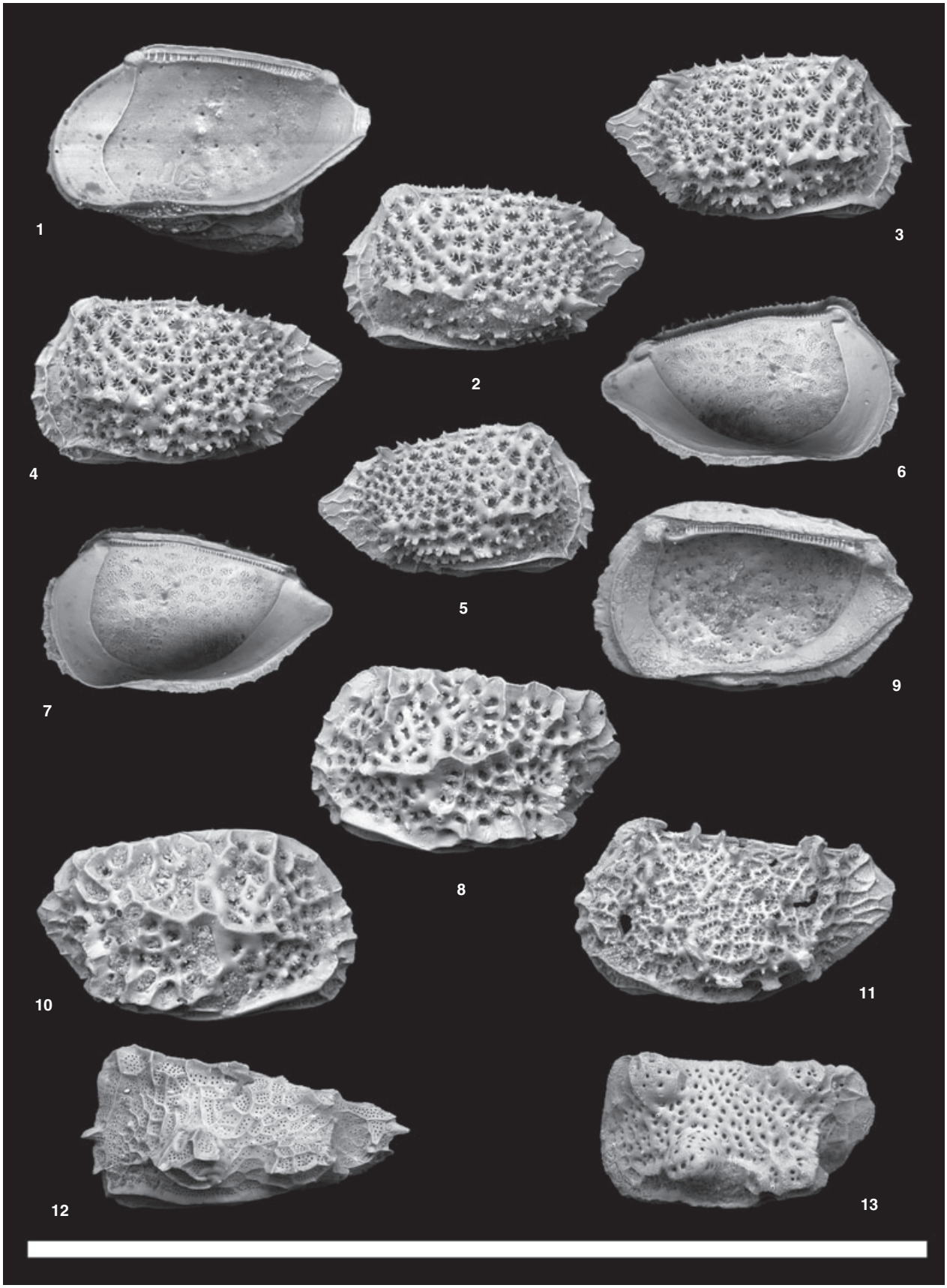
Figs 8–10. *Eucytherura mayressi* sp. nov. 8, holotype, USNM 537059, 1/3/122–124; adult LV, lateral view. 9–10, USNM 537054, 1/3/72–74; adult RV. 9, internal, and 10, lateral views.

Fig. 11. *Eucytherura* sp. 1, USNM 537052, 1/3/40–42; adult LV, lateral view.

Fig. 12. *Parahemingwayella tetrapteron* (Bonaduce *et al.*, 1976), USNM 536997, 1/1/14–16; adult LV, lateral view.

Fig. 13. *Eucytherura* sp. 3, USNM 536998, 1/3/70–72; adult LV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Aversovalva, Eucytherura, Parahemingwayella*

Remarks. Comprehensive synonymy is found in Swanson and Ayress (1999) and Stepanova (2006) and supplemented here. This species has been misidentified as *Cytheropteron testudo* Sars 1869 in the North Atlantic, but the former has more elongate and triangular lateral outline (see Swanson and Ayress 1999 for detail).

Occurrence. Few to rare.

Cytheropteron pherozigzag Whatley *et al.*, 1986
Plate 5, figures 6–8, 10

1986 *Cytheropteron pherozigzag* Whatley, Ayress and Downing, p. 32, pl. 1, figs 6–20.
1987 *Cytheropteron pherozigzag* Whatley, Ayress and Downing; Whatley and Coles, p. 88, pl. 2, fig. 24.
2000 *Cytheropteron pherozigzag* Whatley, Ayress and Downing; Didié and Bauch, p. 113, pl. 2, fig. 5.
?2000 *Cytheropteron pherozigzag* Whatley, Ayress and Downing; Zhao *et al.*, p. 263, pl. 1, fig. 20.

Dimensions. USNM 537094, L = 0.547 mm, H = 0.412 mm.

Remarks. Comprehensive synonymy is found in Zhao *et al.* (2000). This species is known from North Atlantic and Pacific. However, most of Pacific specimens reported and referred in Zhao *et al.* (2000) are likely not conspecific with *Cytheropteron pherozigzag* because they have different lateral outline and number of spines on trailing edge of ala, and further research is needed.

Occurrence. Few to rare.

Cytheropteron richardbensoni sp. nov.
Plate 8, figures 1–6

2006 *Cytheropteron* sp. Bergue *et al.*, p. 207, fig. 7L.
2008 *Cytheropteron* sp. Bergue and Coimbra, p. 133, pl. 7, figs 9–10.

Derivation of name. In honour of the late Richard H. Benson, ex Smithsonian Institution, for his work on deep-sea ostracods.

Holotypes. Adult male? LV, USNM 537120 (Pl. 8, fig. 1).

Paratypes. USNM 537118, 537119, 537121, 537124, 537125.

Type locality and horizon. ODP 1055, 1/3/10–12.

Dimensions. USNM 537120 (holotype), L = 0.480 mm, H = 0.285 mm.

Diagnosis. A large, strongly calcified *Cytheropteron* species, inflated, subovate to subrectangular in lateral view; ala straight, having a small spine at its apex; surface punctation restricted to the central part in lateral view.

Description. Carapace robust, large, highest at middle, inflated in lateral view. Outline subovate to subrectangular in lateral view; anterior margin rounded; caudal process subtriangular, slightly upturned, pointed slightly above mid-height; dorsal margin evenly rounded; ala straight, not extending below ventral margin, having a small spine at its apex. Anterodorsal corner rounded, posterodorsal corner slightly more angular. Lateral surface ornamented with punctation in the central part in lateral view. Internal features as for genus.

Remarks. This species is distinguished from *Cytheropteron fugu* sp. nov. by larger, robust, more extensively punctate carapace, more subrectangular lateral outline and straight alae.

Occurrence. Few to rare.

Cytheropteron richarddinglei sp. nov.
Plate 9, figures 11–12; Plate 10, figures 1–2

Derivation of name. In honour of Richard V. Dingle, ex University of Copenhagen, for his work on Atlantic deep-sea ostracods.

Holotype. Adult RV, USNM 537161 (Pl. 9, fig. 11; Pl. 10, fig. 1).

Paratype. USNM 537162.

Type locality and horizon. ODP 1055, 1/3/60–62.

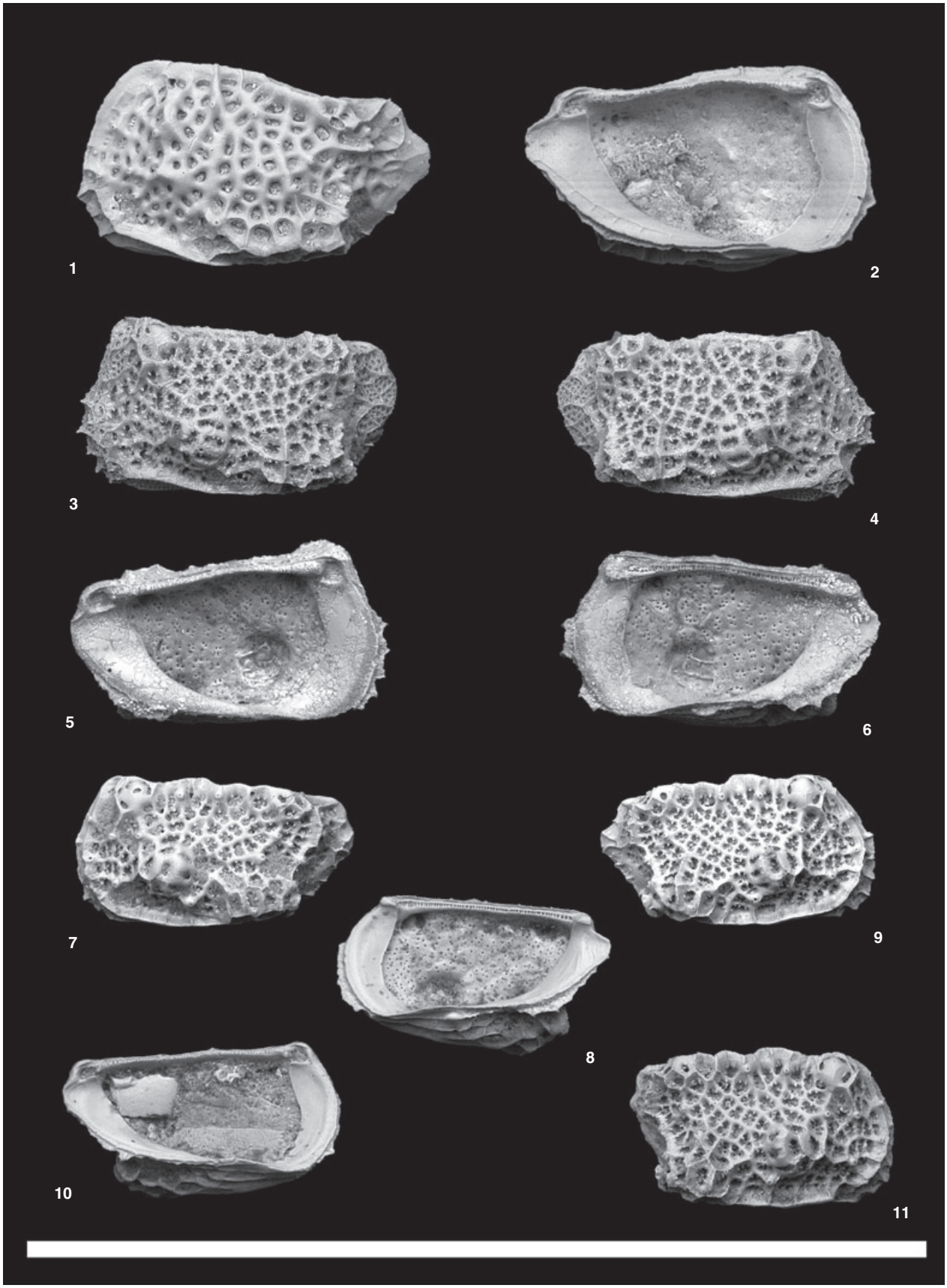
EXPLANATION OF PLATE 13

Figs 1–2. *Eucytherura* sp. 2, USNM 537056, 1/3/78–80; adult LV. 1, lateral, and 2, internal views.

Figs 3–6. *Eucytherura hazeli* sp. nov. 3, 5, holotype, USNM 537050, 1/2/84–86; adult LV. 3, lateral, and 5, internal views. 4, 6, USNM 537051, 1/2/84–86; adult RV. 4, lateral, and 6, internal views.

Figs 7–11. *Eucytherura namericana* sp. nov. 7, 10, USNM 537057, 1/3/86–88; adult male? LV. 7, lateral, and 10, internal views. 8–9, holotype, USNM 537058, 1/3/124–126; adult male? RV. 8, internal, and 9, lateral views. 11, USNM 537053, 1/3/60–62; adult female? RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Eucytherura*

Dimensions. USNM 537161 (holotype), L = 0.444 mm, H = 0.267 mm.

Diagnosis. A moderately calcified *Cytheropteron* species, subrhomboidal in lateral view; ala moderately thick, having a small spine at its apex; surface punctation restricted to the central part in lateral view.

Description. Carapace moderately calcified, moderate in size, highest at middle. Outline subrhomboidal in lateral view; anterior margin rounded; caudal process moderately prominent, pointed at mid-height; dorsal margin arched, sinuous; ala not extending below ventral margin, moderately thick, having a small spine at its apex. Depression on alae. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface ornamented with punctation in the central part in lateral view. Internal features as for genus.

Remarks. This species is closely similar to *Cytheropteron demenocali* sp. nov., but the latter has more elongate carapace, a more prominent caudal process and weaker surface ornamentation.

Occurrence. Very rare.

Cytheropteron sp. a–s
Plate 5, figures 9, 11; Plate 6, figures 1–4, 14; Plate 7, figures 7, 10–11; Plate 8, figures 8–9, 11; Plate 11, figures 1, 3–7

Remarks. In addition to the species discussed above, there are numerous other *Cytheropteron* species present in this core. However, these species are too rare to be discussed in detail. *Cytheropteron* sp. a is similar to *Cytheropteron higashikawai* Ishizaki, 1981; but distinguished by the shape of denticulation on posterior edge of alae and by having two fine carinae along posterodorsal margin. *Cytheropteron* sp. b is similar to *Cytheropteron fraudulentum* Aeillo, Barra and Bonaduce, 1996, but distinguished by having more slender carapace and a fin-like process on posteroproximal edge of ala. *Cytheropteron* sp. e may be conspecific with *Cytheropteron parapulcinella* Ayress *et al.*, 1996; although the latter have slightly straighter alae. *Cytheropteron* sp. f is similar to *Cytheropteron lumalatum* Ayress *et al.*, 1996; but distinguished by having prominent denticulation on posterior edge of alae. *Cytheropteron* sp. g may be conspecific with *Cytheropteron hanaii* Ishizaki, 1981; although the latter have slightly shorter alae. *Cytheropteron* sp. h and *Cytheropteron* sp. j may be within intraspecific variation of *Cytheropteron carolinae* Whatley and Coles, 1987. *Cytheropteron* sp. i is similar to *Cytheropteron carolinae* but distinguished by lacking denticulation on posterior edge of alae. *Cytheropteron* sp. k and *Cytheropteron* sp. r were tentatively included in this genus because of lacking eye tubercle, although the shape and surface ornamentation of these species are closely similar to *Oculocytheropteron* Bate 1972. *Cytheropteron* sp. l was included in this genus because this species has four adductor muscle scars.

Genus EUCYTHERURA Müller, 1894

Eucytherura hazeli sp. nov.
Plate 13, figures 3–6

Derivation of name. In honour of late Joseph E. Hazel, ex U. S. Geological Survey/Louisiana State University, for his work on North American ostracods.

Holotype. Adult LV, USNM 537050 (Pl. 13, figs 3, 5).

Paratype. USNM 537051.

Type locality and horizon. ODP 1055, 1/2/84–86.

Dimensions. USNM 537050 (holotype), L = 0.358 mm, H = 0.200 mm.

Diagnosis. A small, moderately calcified *Eucytherura* species, subrectangular in lateral view; sub-central and eye tubercles prominent; posteroventral and posterodorsal

EXPLANATION OF PLATE 14

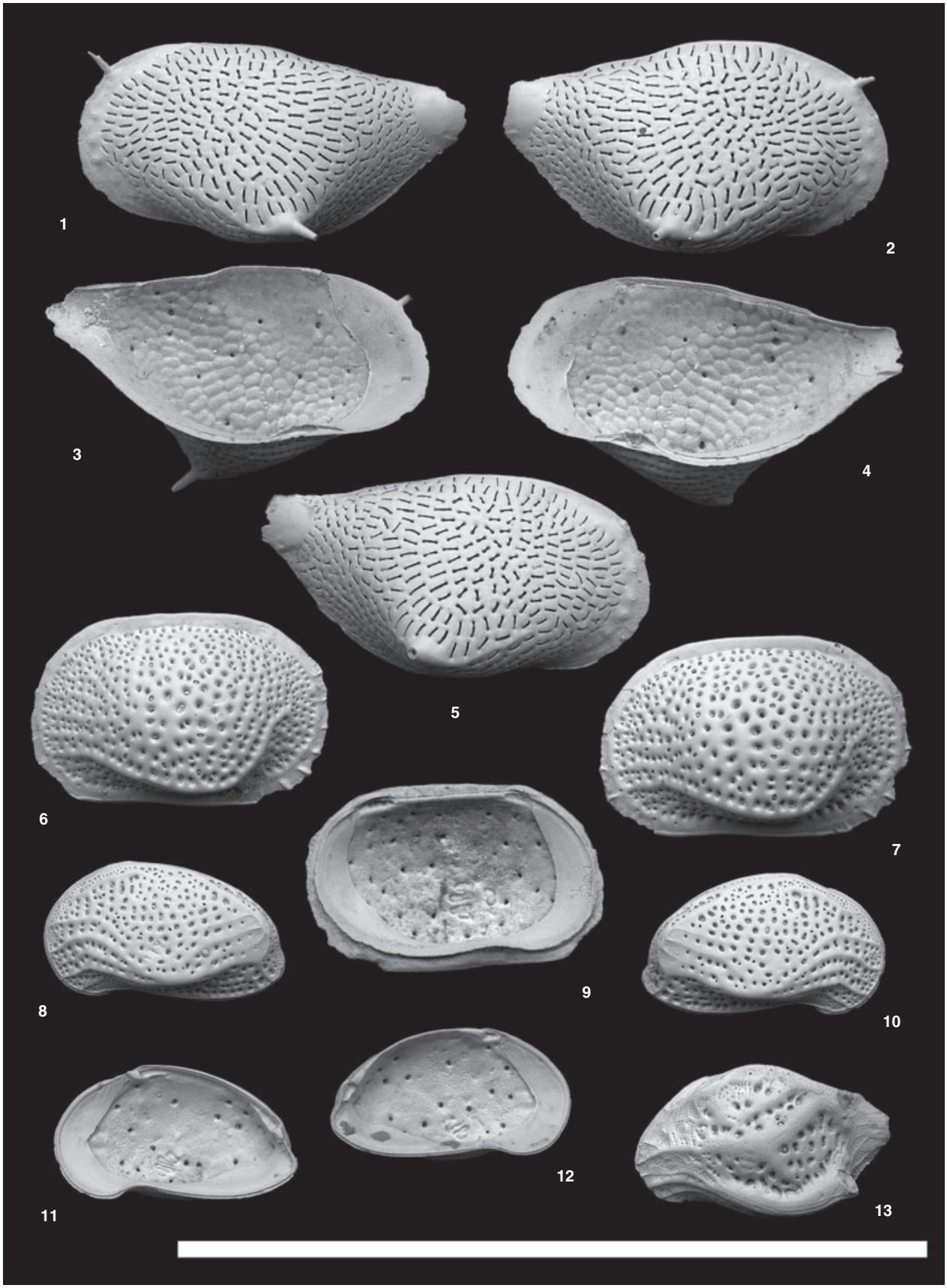
Figs 1–5. *Rimacytheropteron longipunctatum* (Breman, 1976). 1, 3, USNM 537036, 1/2/30–32; adult LV. 1, lateral, and 3, internal views. 2, USNM 537035, 1/2/14–16; adult RV, lateral view. 4–5, USNM 537189, 1/2/16–18; adult RV. 4, internal, and 5, lateral views.

Figs 6–7, 9. *Saida ionia* Ciampo, 1988. 6, 9, USNM 537141, 1/2/116–118; adult LV. 6, lateral, and 9, internal views. 7, USNM 537174, 1/3/88–90; adult LV, lateral view.

Figs 8, 10–12. *Posacythere hunti* sp. nov., 8, 12, holotype, USNM 537143, 1/2/56–58; adult LV. 8, lateral, and 12, internal views. 10–11, USNM 537149, 1/3/20–22; adult RV. 10, lateral, and 11, internal views.

Fig. 13. *Kangarina* cf. *abyssicola* (Müller, 1894), USNM 537181, 1/3/96–98; adult LV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Rimacytheropteron, Posacythere, Saida, Kangarina*

swellings prominent, overreaching margin; lateral surface with strong primary reticulation, muri bearing small spines.

Description. Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subrectangular in lateral view; anterior margin concave in its upper half, roughly rounded in its lower half with crenulate edge bearing four or five thin radial costulae; posterior margin subtriangular; dorsal and ventral margins straight. Anterodorsal and posterodorsal corners angular. Lateral surface ornamented with reticulation, fossae surrounded by small spines; ventrolateral ridge sinuous; sub-central and eye tubercles prominent; posteroventral and posterodorsal swellings prominent, overreaching margin. Internal features as for genus.

Remarks. This species is distinguished from *Eucytherura pseudoantipodum* Coles and Whatley, 1989, by having eye tubercle and more prominent sub-central tubercle. Presence of eye tubercle suggests that *Eucytherura hazeli* sp. nov. is shelf species transported downslope.

Occurrence. Very rare.

Eucytherura mayressi sp. nov.
Plate 12, figures 8–10

Derivation of name. In honour of Michael Ayress, Ichron Limited, for his work on deep-sea cytherurid ostracods.

Holotype. Adult LV, USNM 537059 (Pl. 12, fig. 8).

Paratype. USNM 537054.

Type locality and horizon. ODP 1055, 1/3/122–124.

Dimensions. USNM 537059 (holotype), L = 0.345 mm, H = 0.210 mm.

Diagnosis. A small, strongly calcified *Eucytherura* species, subrectangular in lateral view; ventrolateral and median lateral ridges prominent, sinuous; lateral surface strongly reticulate, muri bearing very small spines.

Description. Carapace robust, small, highest at anterior cardinal angle. Outline subrectangular in lateral view; anterior margin rounded, with crenulate edge bearing seven thin radial costulae; caudal process subtriangular, pointed above mid-height; dorsal margin straight; ventral margin slightly convex. Anterodorsal corner obtuse-angular in LV, rounded in RV; posterodorsal corner straight in LV, angular in RV. Lateral surface ornamented with reticulation, fossae surrounded by sparse, very small spines; ventrolateral and median lateral ridges prominent, sinuous. Internal features as for genus.

Remarks. This species is distinguished from *Eucytherura* sp. 2, by having median lateral ridge and stronger reticulation.

Occurrence. Very rare.

Eucytherura namericana sp. nov.
Plate 13, figures 7–11

Derivation of name. Named for North America.

Holotype. Adult male? RV, USNM 537058 (Pl. 13, figs 8–9).

Paratypes. USNM 537053, 537057.

Type locality and horizon. ODP 1055, 1/3/124–126.

Dimensions. USNM 537058 (holotype), L = 0.306 mm, H = 0.169 mm.

Diagnosis. A small, moderately calcified *Eucytherura* species, subrectangular in lateral view; sub-central and eye tubercles prominent; posteroventral swelling prominent, overreaching ventral margin; lateral surface reticulate, muri bearing small spines.

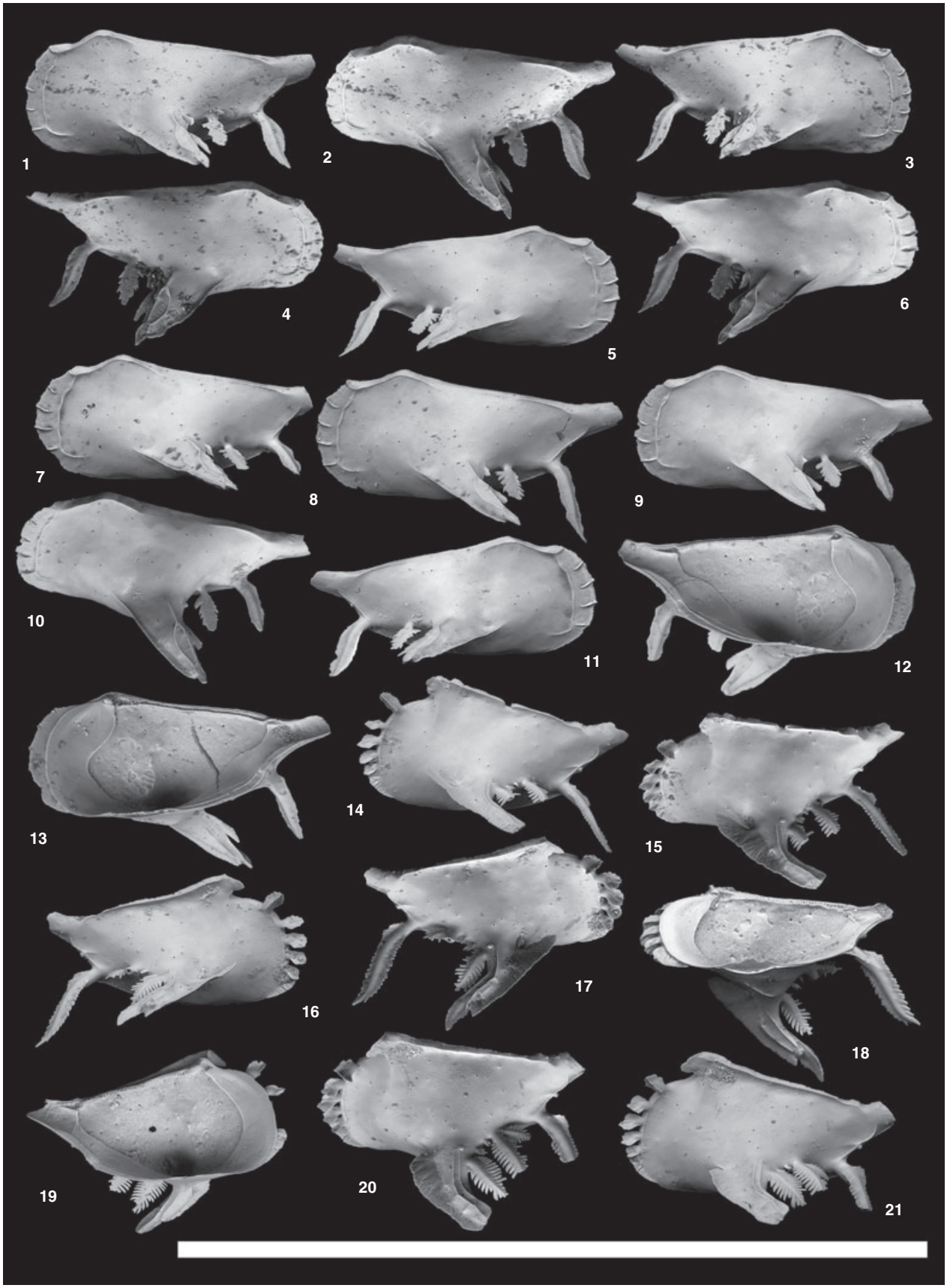
Description. Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subrectangular in lateral view; anterior margin rounded with crenulate edge bearing five or six thin radial costulae in its lower half; caudal process

EXPLANATION OF PLATE 15

Figs 1–13. *Pedicythere atroposopetasi* sp. nov. 1–2, holotype, USNM 537011, 1/1/30–32; adult LV. 1, lateral, and 2, oblique views. 3–4, USNM 537012, 1/1/30–32; adult RV. 3, lateral, and 4, oblique views. 5–6, USNM 537017, 1/1/128–130; adult RV. 5, lateral, and 6, oblique views. 7, USNM 537034, 1/3/38–40; adult LV, lateral view. 8, USNM 537028, 1/2/74–76; adult LV, lateral view. 9–10, USNM 537021, 1/2/26–28; adult LV. 9, lateral, and 10, oblique views. 11, USNM 537032, 1/2/112–114; adult RV, lateral view. 12, USNM 537016, 1/1/82–84; adult LV, internal view. 13, USNM 537015, 1/1/82–84; adult RV, internal view.

Figs 14–21. *Pedicythere klothopetasi* sp. nov. 14–15, USNM 537019, 1/2/22–24; adult LV. 14, lateral, and 15, oblique views. 16–18, holotype, USNM 537018, 1/2/20–22; adult RV. 16, lateral, 17, oblique, and 18, internal views. 19, USNM 537022, 1/2/26–28; adult LV, internal view. 20–21, USNM 537020, 1/2/22–24; adult LV. 20, oblique, and 21, lateral views.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Pedicythere*

subtriangular, pointed above mid-height or at subdorsal; dorsal margin strongly sinuous; ventral margin straight. Anterodorsal and posterodorsal corners angular. Lateral surface ornamented with reticulation, fossae surrounded by small spines; ventrolateral ridge slightly convex; sub-central and eye tubercles prominent; posteroventral swelling prominent, overreaching ventral margin. Internal features as for genus.

Remarks. This species is distinguished from *Eucytherura hazeli* sp. nov., by having smaller carapace and sinuous dorsal margin. Presence of eye tubercle suggests that *Eucytherura namericana* sp. nov. is shelf species transported downslope.

Occurrence. Very rare.

Eucytherura spinicorona sp. nov.
Plate 12, figures 2–7

1987 *Eucytherura calabra* (Colalongo and Pasini); Whatley and Coles, p. 91, pl. 3, figs 14–16.
?1996 *Eucytherura calabra* (Colalongo and Pasini); Coles *et al.*, p. 137, pl. 3, fig. 18.
2001 *Eucytherura calabra* (Colalongo and Pasini); Didié and Bauch, p. 104, pl. 1, figs 9–10; (as erratum for Didié and Bauch 2000).

Derivation of name. Latin combination, spinus = thorn-bush, corona = crown, with reference to its surface ornamentation.

Holotype. Adult female RV, USNM 537046 (Pl. 12, fig. 3).

Paratypes. USNM 537044, 537045, 537047, 537048, 537049.

Type locality and horizon. ODP 1055, 1/1/134–136.

Dimensions. USNM 537046 (holotype), L = 0.342 mm, H = 0.188 mm.

Diagnosis. A small, moderately calcified *Eucytherura* species, subrectangular to subtriangular in lateral view; three discontinuous rows of clavate spines paralleling ventral margin; ventrolateral ridge thin, restricted to anterior half; lateral surface reticulate, muri bearing sharp spines.

Description. Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subrectangular to subtriangular in lateral view; anterior margin rounded, with crenulate edge bearing four thin radial costulae; caudal process moderately prominent, slightly upturned, pointed slightly above mid-height; dorsal and ventral margins straight. Anterodorsal and posterodorsal corners angular. Lateral surface ornamented with reticulation, fossae surrounded by sharp spines; three discontinuous rows of clavate spines parallel ventral margin; ventrolateral ridge thin, restricted to anterior half. Internal features as for genus.

Remarks. The new species is distinguished from *Eucytherura calabra* (Colalongo and Pasini 1980), by having more slender and triangular lateral outline and weaker calcified carapace. *Eucytherura spinicorona* sp. nov. is closely similar to *Eucytherura* sp. 1 of Ayress *et al.* (1995), but differs by having three discontinuous rows of clavate spines and better developed ventrolateral ridge.

Occurrence. Very rare.

Eucytherura sp. 1
Plate 12, figure 11

Dimensions. USNM 537052, L = 0.358 mm, H = 0.208 mm.

Remarks. This species is similar to ?*Eucytherura* sp. Cronin 1983, but the latter has prominent spines on dorsal margins.

Occurrence. Very rare.

Eucytherura sp. 2
Plate 13, figures 1–2

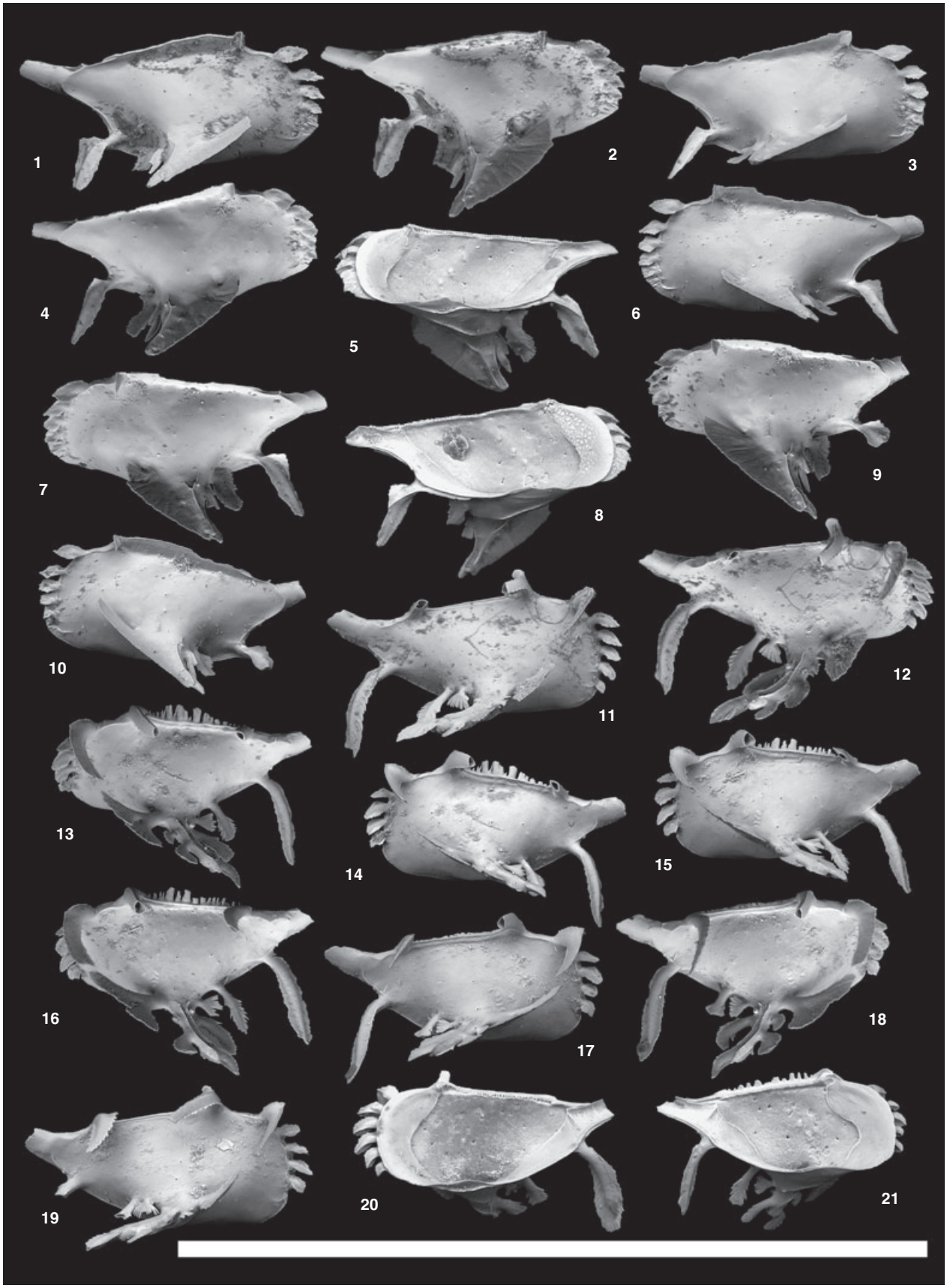
Dimensions. USNM 537056, L = 0.395 mm, H = 0.230 mm.

EXPLANATION OF PLATE 16

Figs 1–10. *Pedicythere kennettopetasi* sp. nov. 1–2, USNM 537013, 1/1/32–34; adult RV. 1, lateral, and 2, oblique views. 3–5, holotype, USNM 537023, 1/2/28–30; adult RV. 3, lateral, 4, oblique, and 5, internal views. 6–8, USNM 537024, 1/2/28–30; adult LV. 6, lateral, 7, oblique, and 8, internal views. 9–10, USNM 537030, 1/2/98–100; adult LV. 9, oblique, and 10, lateral views.

Figs 11–21. *Pedicythere lachesisopetasi* sp. nov. 11–12, USNM 537014, 1/1/48–50; adult RV. 11, lateral, and 12, oblique views. 13–14, holotype, USNM 537025, 1/2/30–32; adult LV. 13, oblique, and 14, lateral views. 15–16, USNM 537027, 1/2/72–74; adult LV. 15, lateral, and 16, oblique views. 17–18, USNM 537031, 1/2/98–100; adult RV. 17, lateral, and 18, oblique views. 19, USNM 537029, 1/2/80–82; adult RV, lateral view. 20, USNM 537033, 1/2/128–130; adult RV, internal view. 21, USNM 537026, 1/2/62–64; adult LV, internal view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Pedicythere*

Remarks. This species is distinguished from *Eucytherura mayressi* sp. nov., by having much weaker reticulation and lacking spines on muri.

Occurrence. Very rare.

Eucytherura sp. 3
Plate 12, figure 13

Dimensions. USNM 536998, L = 0.307 mm, H = 0.178 mm.

Remarks. This species is closely similar to *Eucytherura multituberculata* Ayress *et al.* 1995; but the latter has a more spinous carapace. *Eucytherura* sp. 3 is also similar to *Eucytherura* sp. 2 Whatley and Coles 1987, but the latter has finer secondary reticulation.

Occurrence. Very rare.

Genus KANGARINA Coryell and Fields, 1937

Kangarina cf. *abyssicola* (Müller, 1894)
Plate 14, figure 13

Dimensions. USNM 537181, L = 0.343 mm, H = 0.208 mm.

Remarks. This species closely similar to *Kangarina abyssicola* (Müller 1894), but the latter has finer ventrolateral and median lateral ridges and more elongate lateral outline as seen in Bonaduce *et al.* (1976) and Colalongo and Pasini (1980).

Occurrence. Very rare.

Genus PARAHEMINGWAYELLA Dingle, 1984

Parahemingwayella tetrapteron (Bonaduce *et al.*, 1976)
Plate 12, figure 12

1976 ?*Cytheropteron tetrapteron* Bonaduce, Ciampo and Masoli, p. 99, pl. 47, figs 1–7.

2000 *Parahemingwayella tetrapteron* (Bonaduce, Ciampo and Masoli); Aiello *et al.*, p. 94, pl. 3, fig. 9.

?2001 *Eucytherura* sp. Didié and Bauch , p. 104, pl. 1, fig. 11; (as erratum for Didié and Bauch 2000).

Dimensions. USNM 536997, L = 0.368 mm, H = 0.189 mm.

Remarks. This is first certain record of the species in the Atlantic. Comprehensive synonymy is found in Aiello *et al.* (2000).

Occurrence. Very rare.

Genus PEDICYTHERE Eagar, 1965

Remarks. Terminology for this genus follows that of Schornikov (2005).

Pedicythere atroposopetasi sp. nov.
Plate 15, figures 1–13

?2000 *Pedicythere* sp. B Guernet and Bellier, p. 270, pl. 5, fig. 3.

Derivation of name. Greek and Latin combination, Atropos's hat, one of Moirae.

Holotype. Adult LV, USNM 537011 (Pl. 15, figs 1–2).

Paratypes. USNM 537012, 537015, 537016, 537017, 537021, 537028, 537032, 537034.

Type locality and horizon. ODP 1055, 1/1/30–32.

Dimensions. USNM 537011 (holotype), L = 0.388 mm, H = 0.187 mm.

Diagnosis. A small, weakly calcified *Pedicythere* species, subtriangular in lateral view; anterior margin rounded with weakly crenulate edge bearing five fine radial costulae; caudal process bears a caudal spur; alae simple, bearing

---

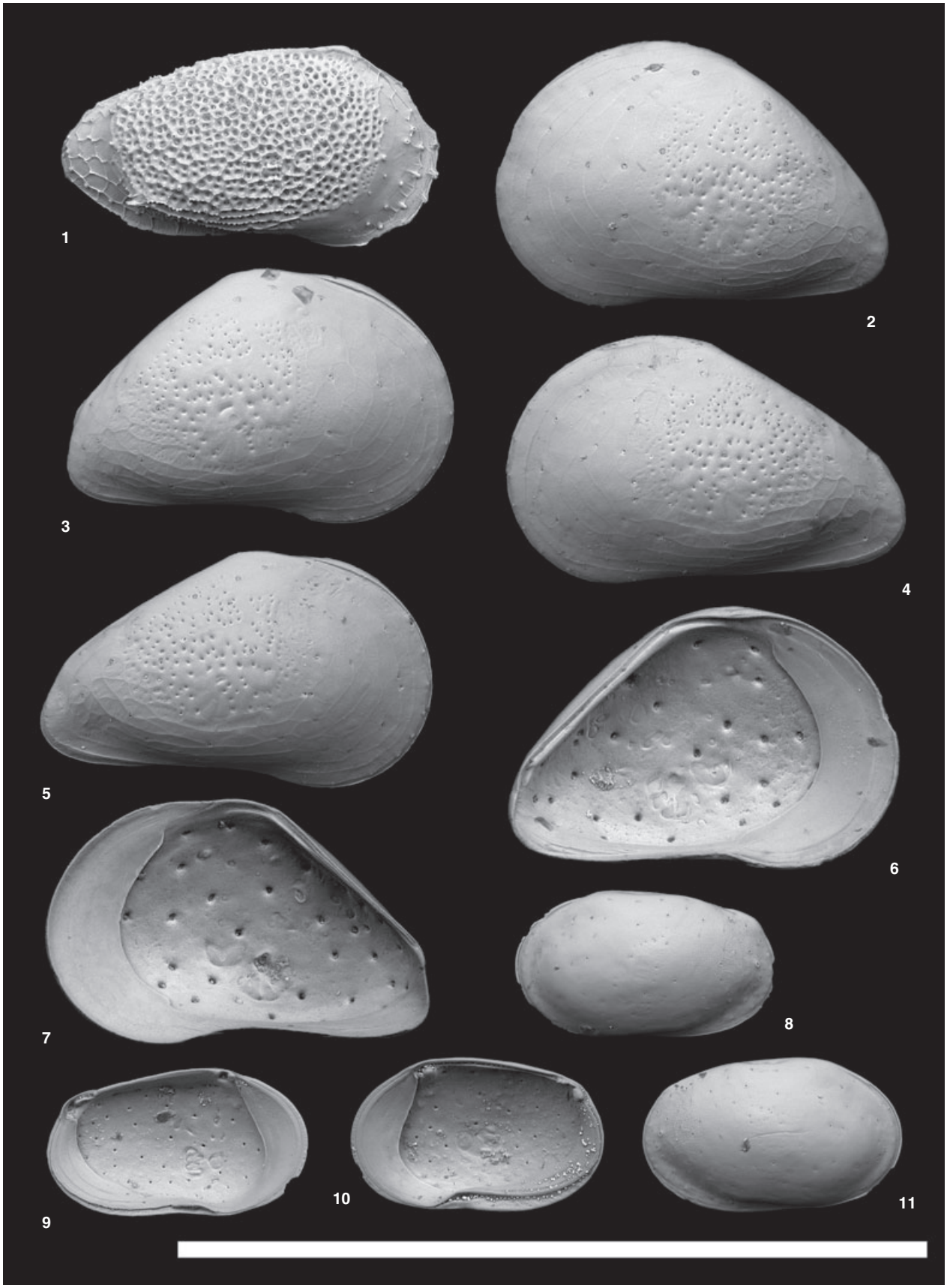
EXPLANATION OF PLATE 17

Fig. 1. *Xylocythere* sp., USNM 537010, 1/3/20–22; adult RV, lateral view.

Figs 2–7. *Eucythere triangula* Whatley and Coles, 1987. 2, 6, USNM 537038, 1/2/8–10; adult female LV. 2, lateral, and 6, internal views. 3, 7, USNM 537037, 1/2/30–32; adult female RV. 3, lateral, and 7, internal views. 4, USNM 537039, 1/2/28–30; adult male LV, lateral view. 5, USNM 537040, 1/2/28–30; adult male RV, lateral view.

Figs 8–11. *Loxoconchidea minima* Bonaduce *et al.*, 1976. 8, USNM 537076, 1/3/48–50; adult LV, lateral view. 9, USNM 537078, 1/3/48–50; adult LV, internal view. 10, USNM 537079, 1/3/48–50; adult RV, internal view. 11, USNM 537077, 1/3/48–50; adult RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Xylocythere, Eucythere, Loxoconchidea*

only one process posteriorly, fine carinae running along ala; dorsal marginal ridge pronounced only in posterior and anterior one third, absent in the middle.

Description. Carapace thin, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded with weakly crenulate edge bearing five fine radial costulae; caudal process prominent and upturned, bearing a feather-like caudal spur; dorsal margin slightly concave. Alae extending below ventral margin, bearing one posterior process; posteroproximal edge of ala bearing one feather-like process; two fine, imperfectly divided carinae running along ala. Anterodorsal corner obtuse-angular; posterodorsal corner straight. Lateral surface smooth. Dorsal marginal ridge pronounced only in posterior and anterior one third, absent in the middle. Internal features as for genus.

Remarks. This species is closely similar to *Pedicythere*? *polita* Colalongo and Pasini 1980, but distinguished by lacking a dorsal marginal ridge in the middle and having fine carinae on ala. The latter species has more concave anterior edge of alae and higher angle of attack of alae.

Occurrence. Rare.

Pedicythere kennettopetasi sp. nov.
Plate 16, figures 1–10

?2000 *Pedicythere* sp. Guernet and Bellier, p. 270, pl. 5, fig. 2 (non fig. 1).

Derivation of name. In honour of James P. Kennett, University of California, Santa Barbara, for his contribution to palaeoceanography, Kennett's hat.

Holotype. Adult RV, USNM 537023 (Pl. 16, figs 3–5).

Paratypes. USNM 537013, 537024, 537030.

Type locality and horizon. ODP 1055, 1/2/28–30.

Dimensions. USNM 537023 (holotype), L = 0.389 mm, H = 0.200 mm.

Diagnosis. A small, weakly calcified *Pedicythere* species, subtriangular in lateral view; anterior margin rounded, bearing four short feather-like spines; caudal process bears a caudal spur; ala simple, its anterior edge consisting a blade-like carina, a fine carina running on dorsal surface of ala; anterodorsal corner prominent.

Description. Carapace thin, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded, bearing four short feather-like spines; caudal process prominent and upturned, bearing a feather-like caudal spur; dorsal margin straight to slightly concave. Alae extending below ventral margin, its anterior edge consisting a blade-like carina, a fine carina running on dorsal surface of ala, posteroproximal edge of ala bearing two processes; Anterodorsal corner prominent; posterodorsal corner straight. Lateral surface smooth. Internal features as for genus.

Remarks. This species is closely similar to *Pedicythere phryne* Bonaduce *et al.*, 1976, but shapes and positions of posteroproximal processes of alae and shape of uppermost spine in anterior margin are different.

Occurrence. Very rare.

Pedicythere klothopetasi sp. nov.
Plate 15, figures 14–21

Derivation of name. Greek and Latin combination, Klotho's hat, one of Moirae.

Holotype. Adult RV, USNM 537018 (Pl. 15, figs 16–18).

Paratypes. USNM 537019, 537020, 537022.

Type locality and horizon. ODP 1055, 1/2/20–22.

Dimensions. USNM 537018 (holotype), L = 0.362 mm, H = 0.234 mm.

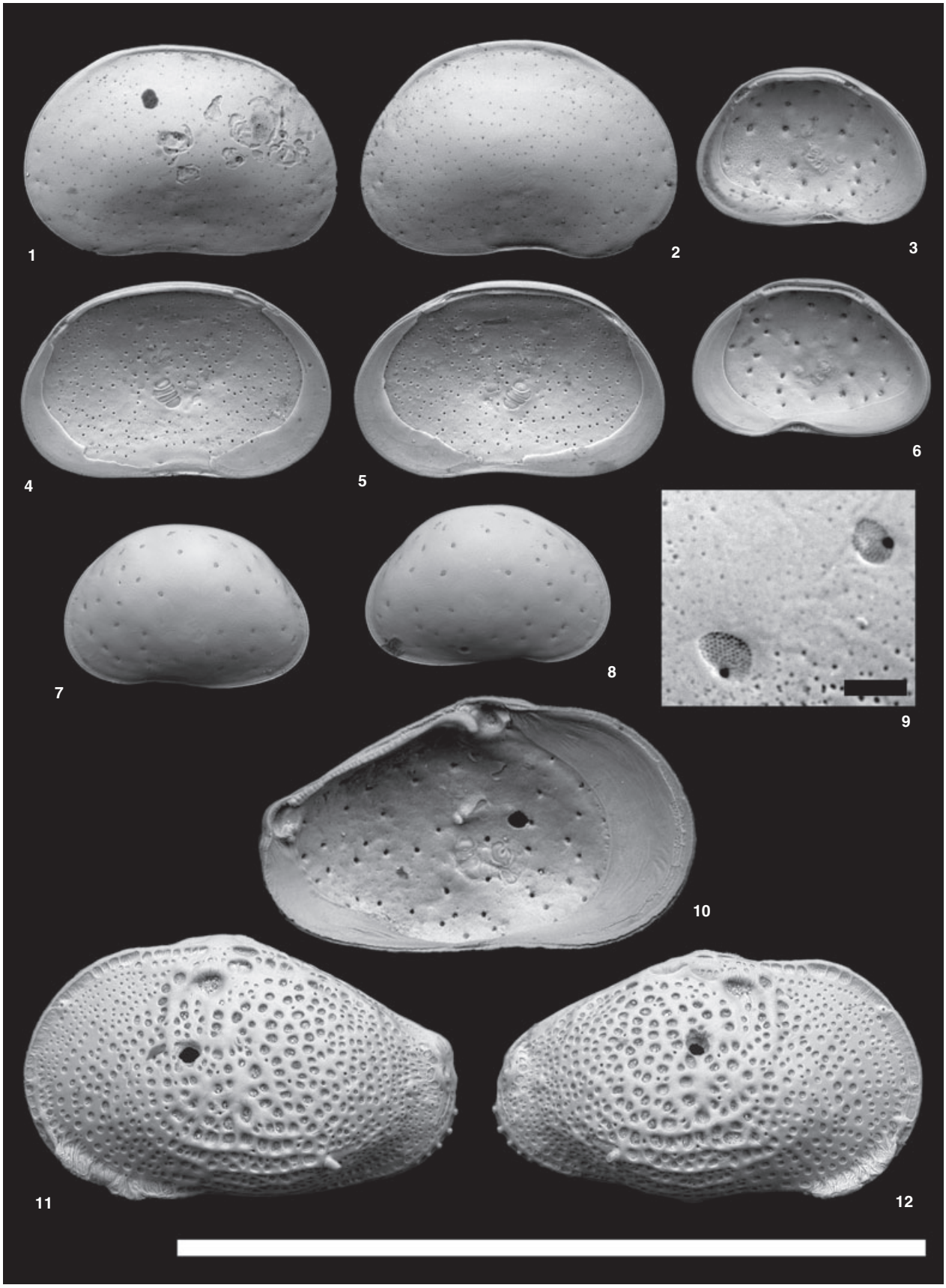
EXPLANATION OF PLATE 18

Figs 1–2, 4–5. *Chejudocythere tenuis* sp. nov. 1, USNM 537072, 1/2/32–34; adult LV, lateral view. 2, holotype, USNM 537074, 1/2/70–72; adult RV, lateral view. 4, USNM 537073, 1/2/32–34; adult LV, internal view. 5, USNM 537075, 1/2/60–62; adult RV, internal view.

Figs 3, 6–9. *Chejudocythere vandenboldi* (Aiello and Szczechura, 2001). 3, USNM 536981, 1/2/86–88; adult LV, internal view. 6, 8, USNM 536980, 1/2/86–88; adult RV. 6, internal, and 8, lateral views. 7, USNM 536979, 1/2/86–88; adult LV, lateral view. 9, USNM 536982, 1/2/86–88; adult RV, detail of lateral view.

Figs 10–12. *Buntonia textilis* Bonaduce *et al.*, 1976. 10–11, USNM 537008, 1/1/28–30; adult LV. 10, internal, and 11, lateral views. 12, USNM 537009, 1/1/28–30; adult RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bars represent 1 mm for 1–8, 10–12; 10 μm for 9.



YASUHARA *et al.*, *Chejudocythere, Buntonia*

Diagnosis. A small, weakly calcified *Pedicythere* species, subtriangular in lateral view; anterior margin rounded, bearing five short feather-like spines; caudal process bears a caudal spur; ala simple, its anterior edge consisting a blade-like carina; a fine carina running along ala; anterodorsal corner strongly prominent.

Description. Carapace thin, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded, bearing five short feather-like spines; caudal process prominent and upturned, bearing a feather-like caudal spur; dorsal margin straight. Ala extending below ventral margin, its anterior edge consisting a blade-like carina; posteroproximal edge of ala bearing two feather-like processes; a fine carina running along ala. Anterodorsal corner strongly prominent; posterodorsal corner straight. Lateral surface smooth. Internal features as for genus.

Remarks. This species is closely similar to *Pedicythere phryne* Bonaduce *et al.* 1976, but distinguished by having more prominent and angular anterodorsal corner and finer dorsal marginal ridge.

Occurrence. Very rare.

Pedicythere lachesisopetasi sp. nov.
Plate 16, figures 11–21

1983 *Pedicythere* sp. A Cronin, p.110, pl. 4H.
2008 *Pedicythere* sp. Bergue and Coimbra, p. 130, pl. 6, fig. 13.

Derivation of name. Greek and Latin combination, Lachesis's hat, one of Moirae.

Holotype. Adult LV, USNM 537025 (Pl. 16, figs 13–14).

Paratypes. USNM 537014, 537026, 537027, 537029, 537031, 537033.

Type locality and horizon. ODP 1055, 1/2/30–32.

Dimensions. USNM 537025 (holotype), L = 0.351 mm, H = 0.238 mm.

Diagnosis. A small, weakly calcified *Pedicythere* species, subtriangular in lateral view; dorsal and anterior margins bear spines; caudal process bears a caudal spur; alae extending below ventral margin and has many fin-like and feather-like processes.

Description. Carapace thin, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded, bearing a long horn-like anterodorsal spine and five short feather-like spines; caudal process prominent and upturned, bearing a feather-like caudal spur; dorsal margin straight, bearing short spines in the middle in LV. Alae extending below ventral margin, bearing two fin-like anterior processes, and one feather-like posterior process; anteroproximal edge of ala bearing a large fin-like process; posteroproximal edge of ala bearing two feather-like processes; two fine carinae running along ala. Anterodorsal and posterodorsal corners bearing a long horn-like spine. Lateral surface smooth. Internal features as for genus.

Remarks. This species is closely similar to *Pedicythere variabilis* van den Bold (1988), but alae of the latter more strongly extending below ventral margin and have higher angle of attack. Detailed shape of alae is also different.

Occurrence. Very rare.

Genus RIMACYTHEROPTERON Whatley and Coles, 1987

Rimacytheropteron longipunctatum (Breman, 1976)
Plate 14, figures 1–5

1976 *Monoceratina longipunctata* Breman, p. 15, pl. 1, figs 4a–b; pl. 2, figs 4c–i.
1976 '*Pedicythere*' *tessellata* Bonaduce *et al.*, p. 88, pl. 36, figs 12–15.
1987 *Rimacytheropteron longipunctata* (Breman); Whatley and Coles, p. 70, pl. 3, figs 12–13.

EXPLANATION OF PLATE 19

Figs 1–4. *Paracytherois productum* (Brady and Norman, 1889). 1, 3, USNM 537065, 1/1/134–136; adult LV. 1, internal, and 3, lateral views. 2, 4, USNM 537064, 1/1/134–136; adult RV. 2, internal, and 4, lateral views.

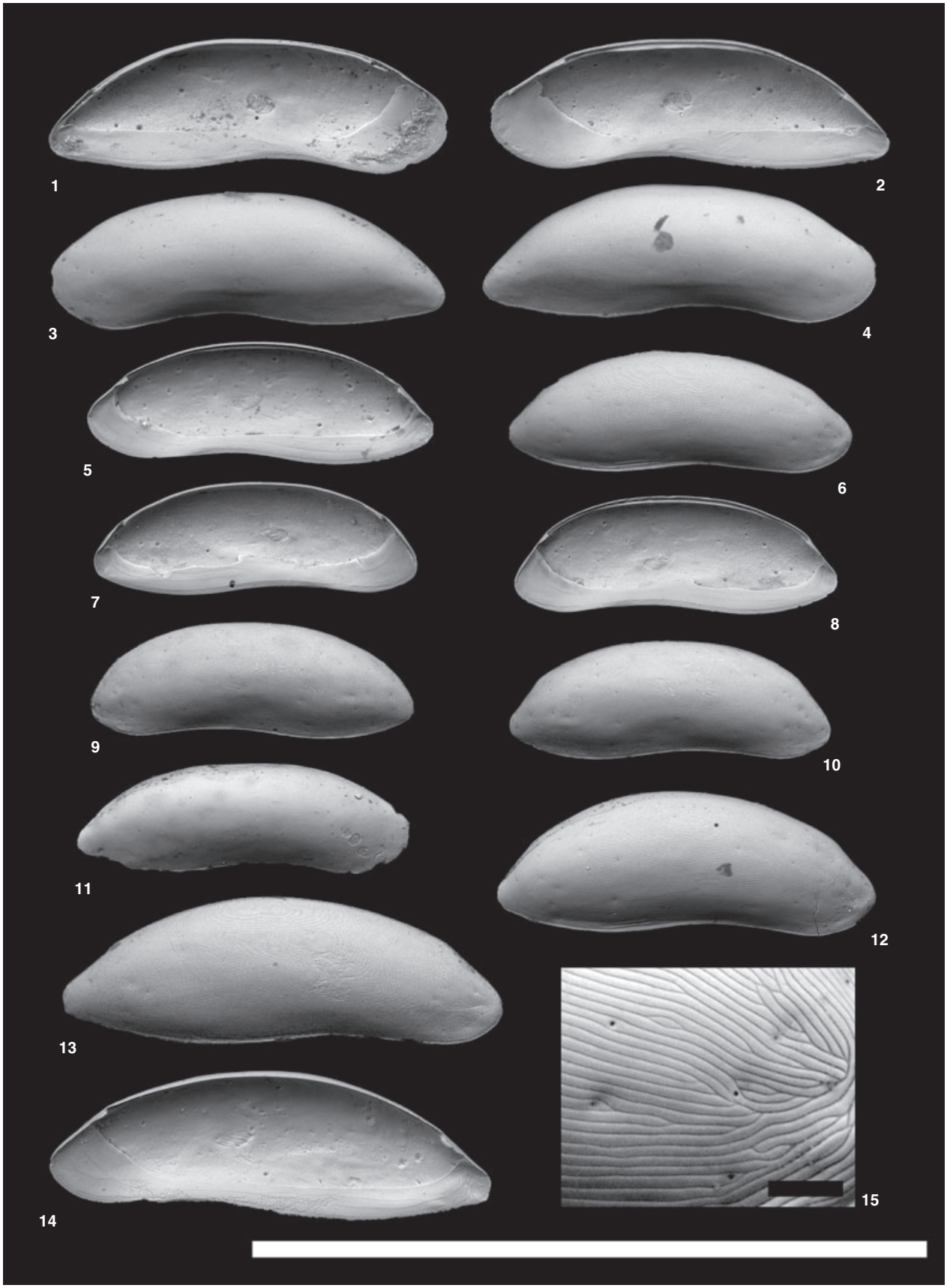
Figs 5–10, 15. *Paracytherois bondi* sp. nov. 5–6, 15, holotype, USNM 537066, 1/1/108–110; adult RV. 5, internal, and 6, 15, lateral views. 7, 9, USNM 537068, 1/2/10–12; adult LV. 7, internal, and 9, lateral views. 8, 10, USNM 537069, 1/2/10–12; adult RV. 8, internal, and 10, lateral views.

Fig. 11. *Paracytherois productum*? (Brady and Norman, 1889), USNM 537071, 1/2/90–92; adult RV, lateral view.

Fig. 12. *Paracytherois* cf. *bondi*, USNM 537070, 1/2/90–92; adult RV, lateral view.

Figs 13–14. *Paracytherois* sp., USNM 537067, 1/1/108–110; adult RV. 13, lateral, and 14, internal views.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bars represent 1 mm for 1–14; 20 μm for 15.



YASUHARA *et al.*, *Paracytherois*

2000 *Rimacytheropteron longipunctatum* (Breman); Aiello *et al.*, p. 97, pl. 3, fig. 11.
2000 *Rimacytheropteron longipunctata* (Breman); Didié and Bauch, p. 115, pl. 4, fig. 26.
2004 *Rimacytheropteron longipunctatum* (Breman); Aiello and Szczechura, p. 56, pl. 14, fig. 7–8.
2006 *Rimacytheropteron longipunctatum* (Breman); Bergue *et al.*, p. 207, fig. 7M.
2008 *Rimacytheropteron longipunctatum* (Breman); Bergue and Coimbra, p. 133, pl. 7, fig. 12.

Dimensions. USNM 537036, L = 0.519 mm, H = 0.269 mm.

Remarks. Comprehensive synonymy is found in Aiello *et al.* (2000). Mediterranean specimens have more straight dorsal margin in LV.

Occurrence. Few to rare.

Genus XYLOCYTHERE Maddocks and Steineck, 1987

Xylocythere sp.
Plate 17, figure 1

Dimensions. USNM 537010, L = 0.505 mm, H = 0.270 mm.

Remarks. This species is closely similar to *Xylocythere* sp. 7 of Steineck *et al.*(1990) but distinguished by having more reticulate ornamentation.

Occurrence. Very rare.

Family EUCYTHERIDAE Puri, 1954

Genus EUCYTHERE Brady, 1866

Eucythere triangula Whatley and Coles, 1987
Plate 17, figures 2–7

non 1983 *Eucythere* sp. Cronin, p. 115, pl. 9H.
1987 *Eucythere triangula* Whatley and Coles, p. 74, pl. 4, figs 16–18.
2000 *Eucythere triangula* Whatley and Coles; Didié and Bauch, p. 114, pl. 3, fig. 21.

Dimensions. USNM 537039, L = 0.534 mm, H = 0.334 mm.

Occurrence. Relatively common.

Family Krithidae Mandelstam, 1958 (*in* Bubikyan 1958)

Genus Krithe Brady *et al.*, 1874

Remarks. Krithe is one of the most dominant genera in this core. Detailed taxonomy of North Atlantic species of this genus including those from this core will be discussed in a separate paper to address the taxonomic confusion in this genus. *Krithe* in this core are mainly composed of *Krithe aequabilis* Ciampo 1986; *Krithe ayressi* Coles *et al.* 1994; *Krithe dolichodeira* van den Bold 1946 *sensu* Coles *et al.* (1994), *Krithe minima* Coles *et al.* 1994 and *Krithe pernoides sinuosa* Ciampo 1986.

Family LOXOCONCHIDAE Sars, 1926

Genus LOXOCONCHIDEA Bonaduce *et al.*, 1976

Loxoconchidea minima Bonaduce *et al.*, 1976
Plate 17, figures 8–11

1976 *Loxoconchidea minima* Bonaduce *et al.* 1976, p. 112, pl. 59, figs 1–7; text-fig. 43.
2004 *Loxoconchidea minima* Bonaduce, Ciampo and Masoli; Aiello and Szczechura, p. 35, pl. 7, figs 1–3.
2006 *Loxoconchidea minima* Bonaduce, Ciampo and Masoli; Bergue *et al.*, p. 206, fig. 6E.
2008 *Loxoconchidea minima* Bonaduce, Ciampo and Masoli; Bergue and Coimbra, p. 115, pl. 1, fig. 16.

Dimensions. USNM 537077, L = 0.347 mm, H = 0.208 mm.

Remarks. Comprehensive synonymy is found in Aiello and Szczechura (2004).

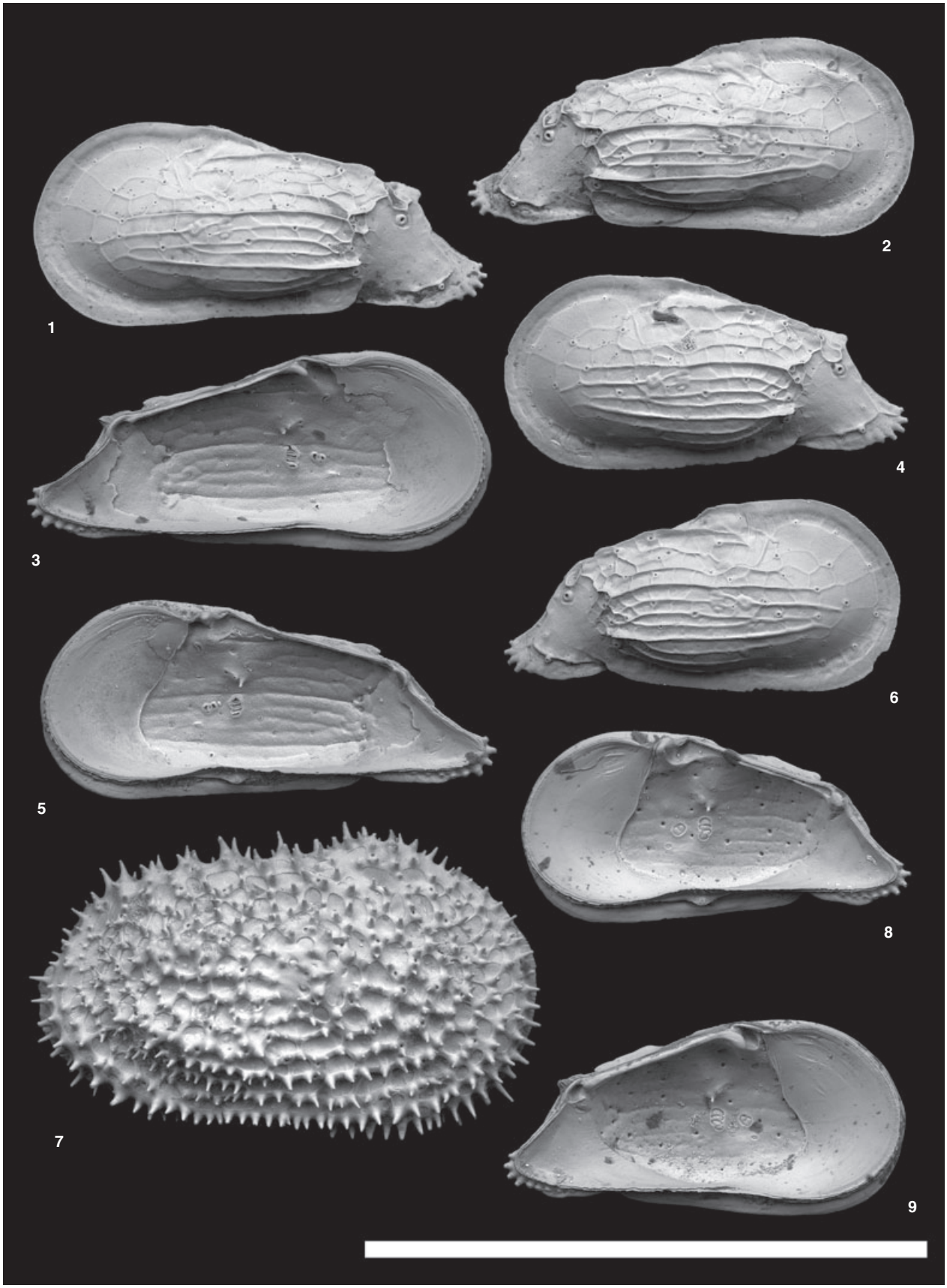
Occurrence. Rare.

EXPLANATION OF PLATE 20

Figs 1–6, 8–9. *Ambocythere sturgio* sp. nov. 1, holotype, USNM 537190, 1/2/32–34; adult male LV, lateral view. 2, USNM 537191, 1/2/32–34; adult male RV, lateral view. 3, USNM 536995, 1/1/110–112; adult male LV, internal view. 4, USNM 536992, 1/1/124–126; adult female LV, lateral view. 5, USNM 536996, 1/1/110–112; adult male RV, internal views. 6, USNM 536991, 1/1/124–126; adult female RV, lateral view. 8, USNM 536994, 1/1/12–14; adult female RV, internal view. 9, USNM 536993, 1/1/12–14; adult female LV, internal view.

Fig. 7. *Henryhowella* cf. *asperrima* (Reuss 1850), USNM 537201, 1/2/70–72; adult female RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Ambocythere, Henryhowella*

Family PARACYTHERIDAE Puri, 1974

Genus CHEJUDOCYTHERE Ishizaki, 1981

Remarks. According to Aiello and Szczechura (2001), *Nunana* Mckenzie *et al.* 1993 is distinguished from *Chejudocythere* Ishizaki 1981 by having anterior and posterior vestibules and the denticulation of median hinge element. However, two *Chejudocythere* species in this study, *Chejudocythere vandenboldi* (Aiello and Szczechura 2001) and *Chejudocythere tenuis* sp. nov., show intermediate features between these two genera. In other words, *Chejudocythere vandenboldi* has very narrow anterior and posterior vestibules but the denticulation of median hinge element is restricted in its anrerior and posterior ends, and *Chejudocythere tenuis* has moderately developed anterior and posterior vestibules but lack the denticulation of median hinge element. Aiello and Szczechura (2001) suggested that *Chejudocythere*, has reversed hinge structure between right and left valves compared to *Nunana*. However, it seems to be their misunderstanding, and the hinge structure of *Chejudocythere* does not reversed in fact, judging from Ishizaki's (1981) plates (i.e. SEM and light microscope images) of *Chejudocythere higashikawai* Ishizaki 1981; type species of *Chejudocythere*. Thus, in our opinion, *Nunana* is junior synonym of *Chejudocythere*. *Loxocythere? subtrigonalis* Herrig 1963 is also included in *Chejudocythere*.

Chejudocythere vandenboldi (Aiello and Szczechura, 2001)
Plate 18, figures 3, 6–9

1966 *Paracythere* sp. van den Bold, p. 37, pl. 1, figs 6a–b; pl. 5, fig. 5.
1983 indet. gen. Cronin, p. 111, pl. 5, fig. F (non figs G–H).
1988 *Paracythere* sp. van den Bold, p. 67, pl. 12, figs 1–2.
2001 *Nunana vandenboldi* Aiello and Szczechura, p. 73.
2008 *Nunana vandenboldi* Aiello and Szczechura; Bergue and Coimbra, p. 117, pl. 2, fig. 12.

Dimensions. USNM 536979, L = 0.329 mm, H = 0.220 mm.

Remarks. Chejudocythere vandenboldi (Aiello and Szczechura, 2001) has very narrow anterior and posterior vestibules. Internal features of this species was shown here for the first time.

Occurrence. Rare.

Chejudocythere tenuis sp. nov.
Plate 18, figures 1–2, 4–5

Derivation of name. From Latin tenuis = thin, delicate.

Holotype. Adult RV, USNM 537074 (Pl. 18, fig. 2).

Paratypes. USNM 537072, 537073, 537075.

Type locality and horizon. ODP 1055, 1/2/70–72.

Dimensions (mm). USNM 537074 (holotype), L = 0.424, H = 0.294.

Diagnosis. A very weakly calcified *Chejudocythere* species, subtrapezoidal to subrectangular in lateral view; lateral surface smooth with numerous normal pores.

Description. Carapace very weakly calcified, moderate in size, highest at the middle. Outline subtrapezoidal to subrectangular in lateral view; anterior margin rounded, posterior margin slightly more triangular; dorsal margin slightly arched; ventral margin sinuous. Anterodorsal and posterodorsal corners obtuse-angular. Lateral surface smooth. Normal pores numerous. Internal features as for genus.

Remarks. This species is closely similar to *Paracythere minima* Müller 1894; but internal features of the former belong to *Chejudocythere*. Although *Chejudocythere tenuis* sp. nov. lacks sunken sieve-type normal pore in contrast with other *Chejudocythere* species, we do not consider that this difference is important enough to separate this species from *Chejudocythere*, because such interspecific difference is commonly seen within a genus (e.g. *Krithe*; see Coles *et al.* 1994).

Occurrence. Rare.

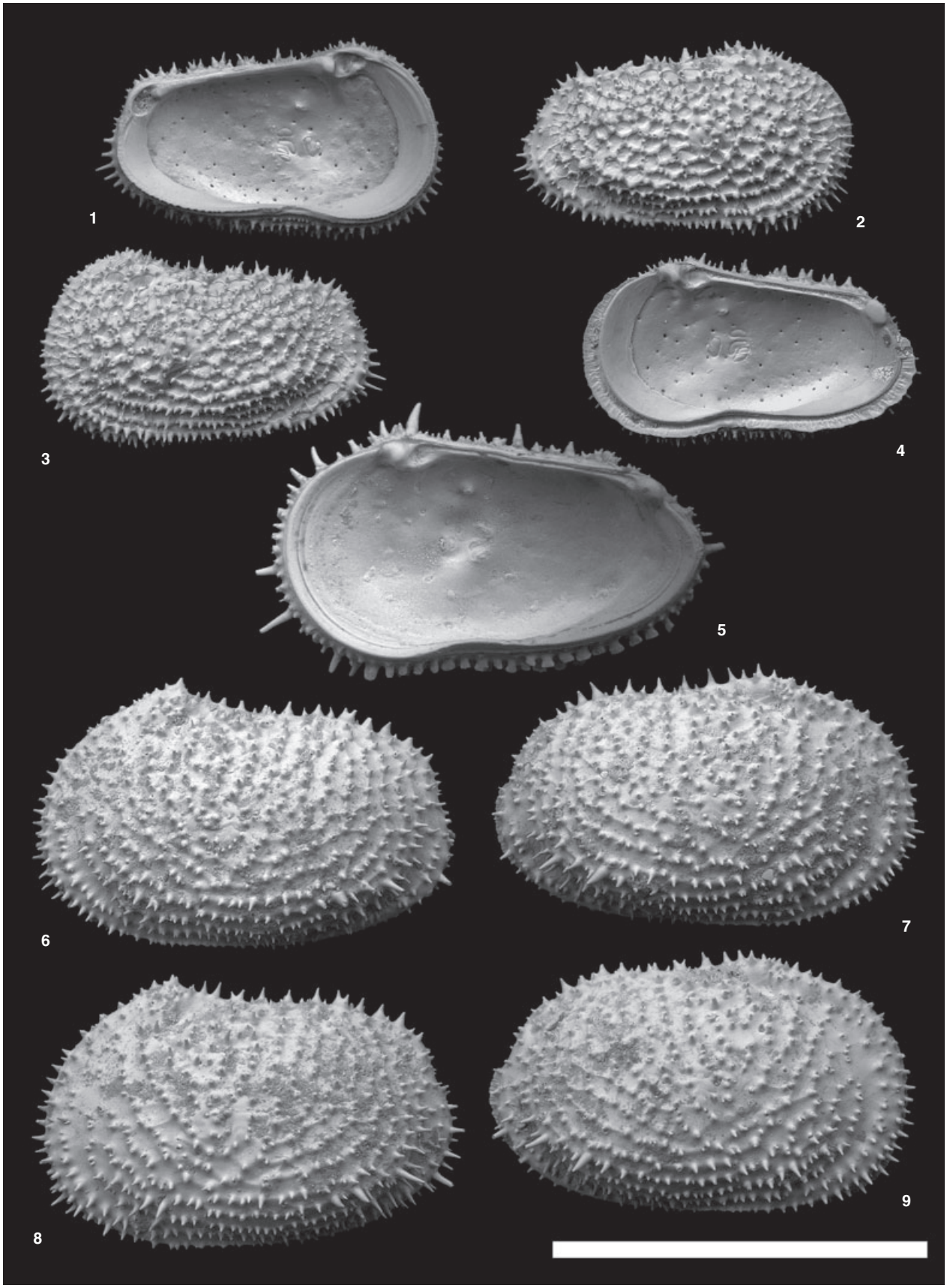
EXPLANATION OF PLATE 21

Figs 1–4. *Henryhowella* cf. *asperrima* (Reuss, 1850). 1, 3, USNM 537042, 1/2/130–132; adult male LV. 1, internal, and 3, lateral views. 2, USNM 537041, 1/1/32–34; adult male RV, lateral view. 4, USNM 537043, 1/1/132–134; adult male RV, internal view.

Fig. 5. *Legitimocythere* sp., USNM 537187, 1/3/122–124; adult male RV, internal view.

Figs 6–9. *Echinocythereis echinata* (Sars, 1866). 6, USNM 537060, 1/2/126–128; adult male LV, lateral view. 7, USNM 537063, 1/2/126–128; adult male RV, lateral view. 8, USNM 537061, 1/2/126–128; adult female LV, lateral view. 9, USNM 537062, 1/2/126–128; adult female RV, lateral view.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bar represents 1 mm.



YASUHARA *et al.*, *Henryhowella, Legitimocythere, Echinocythereis*

Family PARADOXOSTOMATIDAE Brady and Norman, 1889

Genus PARACYTHEROIS Müller, 1894

Paracytherois productum (Brady and Norman, 1889)
Plate 19, figures 1–4 (?figure 11)

1889 *Paradoxostoma productum* Brady and Norman, p. 236, pl. 21, figs 9–10.
2000 *Paracytherois* sp. Didié and Bauch, p. 115, pl. 4, fig. 14.

Dimensions. USNM 537064, L = 0.584 mm, H = 0.205 mm.

Remarks. The lateral outline is exactly identical to the sketch by Brady and Norman (1889).

Occurrence. Rare.

Paracytherois bondi sp. nov.
Plate 19, figures 5–10, 15 (cf. figure 12)

Derivation of name. In honour of late Gerard C. Bond, Lamont-Doherty Earth Observatory, for his contribution to palaeoceanography.

Holotype. Adult RV, USNM 537066 (Pl. 19, figs 5–6, 15).

Paratypes. USNM 537068, 537069.

Type locality and horizon. ODP 1055, 1/1/108–110.

Dimensions. USNM 537066 (holotype), L = 0.508 mm, H = 0.182 mm.

Diagnosis. A small, weakly calcified *Paracytherois* species, elongate in lateral view; lateral surface covered with horizontal striations.

Description. Carapace weakly calcified, small, highest at posterior cardinal angle. Outline elongate in lateral view; anterior margin acutely rounded; posterior margin subtriangular, pointed at mid-height; dorsal margin slightly arched; ventral margin sinuous. Anterodorsal and posterodorsal corners rounded. Lateral surface covered with very fine, horizontal striations. Internal features as for genus.

Remarks. This species is closely similar to *Paracytherois strata* Müller 1894, but distinguished by having more elongate lateral outline.

Occurrence. Rare.

Paracytherois sp.
Plate 19, figures 13–14

Dimensions. USNM 537067, L = 0.655 mm, H = 0.220 mm.

Remarks. This species is closely similar to *Paracytherois bondi* sp. nov., but distinguished by having larger carapace and more acuminate posterior margin.

Occurrence. Very rare.

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Genus AMBOCYTHERE van den Bold, 1957

Ambocythere sturgio sp. nov.
Plate 20, figures 1–6, 8–9

Derivation of name. From Latin sturgio = sturgeon, with reference to its overall impression.

Holotype. Adult male LV, USNM 537190 (Pl. 20, fig. 1).

Paratypes. USNM 537191, 536991, 536992, 536993, 536994, 536995, 536996.

Type locality and horizon. ODP 1055, 1/2/32–34.

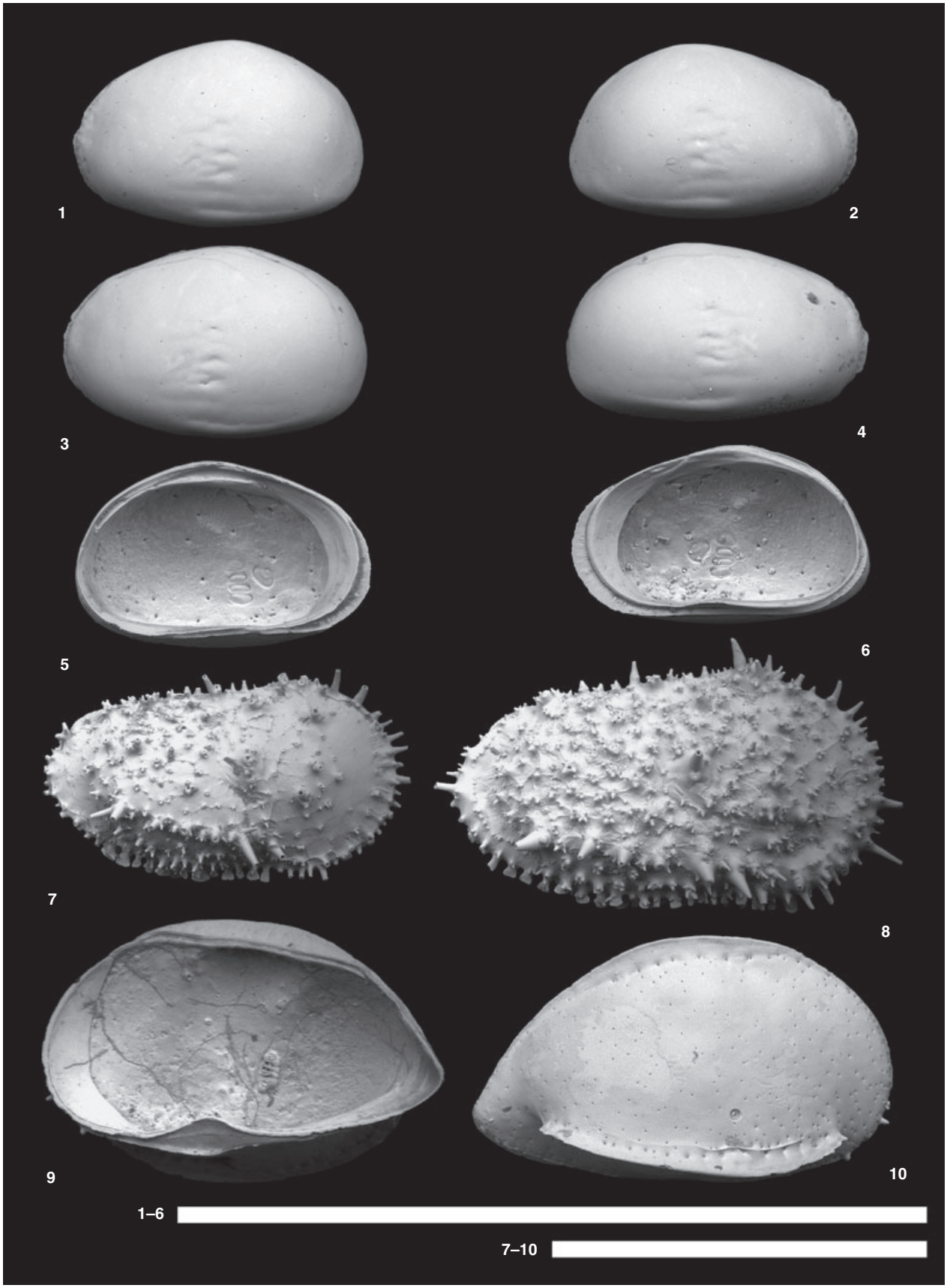
EXPLANATION OF PLATE 22

Figs 1–6. *Xestoleberis oppoae* sp. nov. 1, holotype, USNM 536985, 1/2/88–90; adult female LV, lateral view. 2, USNM 536986, 1/2/88–90; adult female RV, lateral view. 3, USNM 536987, 1/2/88–90; adult male LV, lateral view. 4, USNM 536988, 1/2/88–90; adult male RV, lateral view. 5, USNM 536989, 1/2/80–82; adult male LV, internal view. 6, USNM 536990, 1/2/80–82; adult male RV, internal view.

Figs 7–8. *Legitimocythere* sp. 7, USNM 537169, 1/3/82–84; juvenile RV, lateral view. 8, USNM 537187, 1/3/122–124; adult male RV, lateral view.

Figs 9–10. *Pseudobosquetina* sp., USNM 537147, 1/2/66–68; adult RV. 9, internal, and 10, lateral views.

All SEM images. All specimens from latest Quaternary section of ODP Hole 1055B, Carolina Slope, western subtropical North Atlantic. Scale bars represent 1 mm (upper bar for 1–6; lower bar for 7–10).



YASUHARA *et al.*, *Xestoleberis, Legitimocythere*

Dimensions. USNM 537190 (holotype), L = 0.811 mm, H = 0.367 mm.

Diagnosis. A large, moderately calcified *Ambocythere* species, subtriangular in lateral view; lateral surface weakly reticulate, seven carinae running horizontally; dorsal ridge slightly convex and restricted to posterior half.

Description. Carapace moderately calcified, large, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin evenly rounded; caudal process prominent, pointed at subventral, bearing four short spines; dorsal and ventral margins almost straight. Anterodorsal corner slightly angular; posterodorsal corner angular in LV, obtuse-angular in RV. Lateral surface ornamented with weak reticulation, which is absent in posterior-most quarter; seven carinae running horizontally; dorsal ridge slightly convex and restricted to posterior half; anterior marginal rim developed. Internal features as for genus.

Remarks. This species is closely similar to *Ambocythere caudata* van den Bold (1965), but distinguished by having more triangular lateral outline, weaker, restricted surface reticulation and better developed caudal process.

Occurrence. Few to rare.

Genus BUNTONIA Howe, 1935 (*in* Howe and Chambers 1935)

Buntonia textilis Bonaduce *et al.*, 1976
Plate 18, figures 10–12

1976 *Buntonia textilis* Bonaduce *et al.*, p. 55, pl. 33, figs 1–5.
non 1983 *Quasibuntonia* sp. Cronin, p. 115, pl. 9, fig. G.
1987 *Buntonia textilis* Bonaduce, Ciampo and Masoli; Whatley and Coles, p. 81, pl. 5, fig. 6 (non fig. 5).
1996 *Buntonia textilis* Bonaduce, Ciampo and Masoli; Coles *et al.*, p. 141, pl. 5, figs 16–17.
2000 *Buntonia textilis* Bonaduce, Ciampo and Masoli; Aiello *et al.*, p. 100, pl. 4, figs 6–9; pl. 6, fig. 8.

Dimensions. USNM 537008, L = 0.585 mm, H = 0.359 mm.

Remarks. Comprehensive synonymy is found in Aiello *et al.* (2000).

Occurrence. Very rare.

Genus ECHINOCYTHEREIS Puri, 1954

Echinocythereis echinata (Sars, 1866)
Plate 21, figures 6–9

1866 *Cythereis echinata* Sars, p. 44.
1880 *Cythere irpex* Brady, p. 107, pl. 17, figs 2a–d.
1925 *Cythereis echinata* Sars; Sars, p. 194, pl. 90, figs 1–11.
?1967 *Echinocythereis echinata* (Sars); Hazel, p. 37, pl. 6, figs 10–11.
1969 *Cythereis echinata* (Sars); Elofson, p. 71.
1976 *Cythere irpex* Brady; Puri and Hulings, p. 278, pl. 11, figs 1–9.
?1983 *Echinocythereis echinata* (Sars); Benson *et al.*, p. 449, pl. 2, fig. 8.
1987 *Echinocythereis echinata* (Sars); Whatley and Coles, p. 95, pl. 5, figs 7–8.
?1988 *Echinocythereis echinata* (Sars); Guernet and Fourcade, p.142, pl. 6, fig. 1 (juvenile?).
?1988 *Echinocythereis* sp. 1; Guernet and Fourcade, p.142, pl. 2, fig. 2.
?1996 *Echinocythereis echinata* (Sars); Coles *et al.*, p. 141, pl. 5, fig. 18 (juvenile?).
2000 *Echinocythereis echinata* (Sars); Barra and Bonaduce, p. 214, pl. 1, figs 1–10; text-fig. 1.
2001 *Echinocythereis echinata* (Sars); Didié and Bauch, p. 104, pl. 1, fig. 3; (as erratum for Didié and Bauch 2000).

Dimensions. USNM 537060, L = 1.133 mm, H = 0.727 mm.

Remarks. Comprehensive synonymy is found in Barra and Bonaduce (2000), Hazel (1967), Elofson (1969) and this study. In spite of detailed redescription by Barra and Bonaduce (2000), some taxonomic uncertainty still remains because the holotype and lectotype have not been designated and the topotype material from off Norway has not been studied. The specimens in this study are slightly more spinous than specimens shown by Barra and Bonaduce (2000), Whatley and Coles (1987) and many of others.

Occurrence. Few.

Genus HENRYHOWELLA Puri, 1957

Henryhowella cf. *asperrima* (Reuss, 1850)
Plate 20, figure 7; Plate 21, figures 1–4

?2000 *Henryhowella* sp. Guernet and Bellier, p. 267, pl. 4, fig. 12, 15.

Dimensions. USNM 537042, L = 0.929 mm, H = 0.538 mm.

Remarks. Detailed taxonomy of North Atlantic species of *Henryhowella* including this species will be discussed in separate paper to address the taxonomic confusion surrounding this taxon.

Occurrence. Common.

Genus LEGITIMOCYTHERE Coles and Whatley, 1989

Legitimocythere sp.
Plate 21, figure 5; Plate 22, figures 7–8

Dimensions. USNM 537187, L = 1.254 mm, H = 0.737 mm.

Remarks. This species is closely similar to *Legitimocythere acanthoderma* (Brady 1880), but distinguished by having larger carapace, more slender and triangular lateral outline and less spinous lateral surface [this comparison is based on the SEM images of adult specimens, including a topotype specimen, shown in Mazzini (2005)].

Occurrence. Very rare.

Genus PSEUDOBOSQUETINA Guernet and Moullade, 1994

Pseudobosquetina sp.
Plate 22, figures 9–10

Dimensions. USNM 537147, L = 1.124 mm, H = 0.660 mm.

Remarks. This species is distinguished from *Pseudobosquetina mucronalatum* (Brady 1880) by having more triangular lateral outline. This comparison is based on the SEM images of hololectotype specimen shown in Mazzini (2005).

Occurrence. Very rare.

Family XESTOLEBERIDIDAE Sars, 1928

Genus XESTOLEBERIS Sars, 1866

Xestoleberis oppoae sp. nov.
Plate 22, figures 1–6

Derivation of name. In honour of Delia Oppo, Woods Hole Oceanographic Institution, for her work on North Atlantic palaeoceanography.

Holotype. Adult female LV, USNM 536985 (Pl. 22, fig. 1).

Paratypes. USNM 536986, 536987, 536988, 536989, 536990.

Type locality and horizon. ODP 1055, 1/2/88–90.

Dimensions. USNM 536985 (holotype), L = 0.389 mm, H = 0.252 mm.

Diagnosis. A small, robust *Xestoleberis* species, ovate to subrectangular in lateral view; lateral surface smooth with weak plication at the middle in lateral view.

Description. Carapace strongly calcified, small, highest at the middle. Outline ovate to subrectangular in lateral view; anterior margin evenly rounded; posterior margin truncated; dorsal margin arched; ventral margin slightly convex. Anterodorsal corner straight; posterodorsal corner rounded. Lateral surface smooth with weak plication at the middle in lateral view. Internal features as for genus.

Remarks. This species is closely similar to *Xestoleberis profundis* Whatley and Coles, 1987; but the latter has a more evenly rounded posterior margin. This species is distinguished from *Xestoleberis profunda* (Breman, 1975) by having plication in lateral view.

Occurrence. Moderately abundant.

Acknowledgements. We thank the staff of the U.S. Geological Survey Eastern Earth Surface Processes Team and the Department of Paleobiology, National Museum of Natural History, Smithsonian Institution, especially Carlita Sanford, for their support throughout this project. We thank Peter B. deMenocal for kindly loaning us ODP core samples, Scott Whittaker for help in SEM imaging, Giuseppe Aiello for taxonomic input, and Mark Florence for help in depositing type and figured specimens. Gene Hunt and John Repetski deserve special thanks for valuable comments and discussion. This paper benefited from reviews by Michael A. Ayress and anonymous referee and editing by Paul Smith, David Batten, and Svend Stouge. This research used samples provided by the Ocean Drilling Program. The Ocean Drilling Program is sponsored by the National Science Foundation and participating countries under the management of Joint Oceanographic Institutions. This work was supported by Japan Society for the Promotion of Science Postdoctoral Fellowships for Research Abroad and Smithsonian Postdoctoral Fellowship (to M.Y.).

REFERENCES

AIELLO, G., BARRA, D. and BONADUCE, G. 1996*a*. The genus *Cytheropteron* Sars, 1866 (Crustacea: Ostracoda) in the Pliocene–Early Pleistocene of the Mount San Nicola Section (Gela, Sicily). *Micropaleontology*, **42**, 167–178.

—— —— —— and RUSSO, A. 1996*b*. The genus *Cytherella* Jones, 1849 (Ostracoda) in the Italian Tortonian–recent. *Revue de Micropaléontologie*, **39**, 171–190.

—— 2000. Systematics and biostratigraphy of the Ostracoda of the Plio–Pleistocene Monte S. Nicola section (Gela, Sicily). *Bollettino della Societá Paleontologica Italiana*, **39**, 83–112.

—— and SZCZECHURA, J. 2001. First finding of the genus Nunana McKenzie, Reyment & Reyment, 1993 (Paracytheridae: Ostracoda) from the middle Miocene of central Paratethys. *Revista Española de Micropaleontología*, **33**, 71–78.

—— 2004. Middle Miocene ostracods of the Fore-Carpathian Depression (Central Paratethys, southwestern Poland). *Bollettino della Societá Paleontologica Italiana*, **43**, 11–70.

ALVAREZ ZARIKIAN, C. A., STEPANOVA, A. Y. and GRÜTZNER, J. 2009. Glacial–interglacial variability in deep sea ostracod assemblage composition at IODP Site U1314 in the subpolar North Atlantic. *Marine Geology*, **258**, 69–87.

ATHERSUCH, J., HORNE, D. J. and WHITTAKER, J. E. 1989. Synopses of the British Fauna (New Series) No. 43. *Marine and brackish water ostracods*. The Linnean Society of London and the Estuarine and Brackish-Water Science Association, London, 343 pp.

AYRESS, M., CORRÉGE, T., PASSLOW, V. and WHATLEY, R. C. 1996. New Bythocytherid and Cytherurid ostracode species from the deep-sea Australia, with enigmatic dorsal expansion. *Geobios*, **29**, 73–90.

AYRESS, M. A., WHATLEY, R. C., DOWNING, S. E. and MILLSON, K. J. 1995. Cainozoic and recent deep sea Cytherurid Ostracoda from the south western Pacific and eastern Indian Oceans, part I: Cytherurinae. *Records of the Australian Museum*, **47**, 203–223.

BAIRD, W. 1850. *The natural history of the British Entomostraca*. Ray Society, London, 364 pp.

BARRA, D., AIELLO, G. and BONADUCE, G. 1996. The genus *Argilloecia* Sars, 1866 (Crustacea: Ostracoda) in the Pliocene–Early Pleistocene of the M. San Nicola Section (Gela, Sicily). *Proceedings of the 2nd European Ostracodologists Meeting*, Glasgow, UK, 129–134.

—— and BONADUCE, G. 2000. Some species of *Echinocythereis* Puri, 1954 (Crustacea, Ostracoda) from the Torronian and to recent. *Revista Española de Micropaleontología*, **32**, 213–224.

BATE, R. H. 1972. Upper Cretaceous Ostracoda from the Carnarvon Basin, western Australia. *Special Papers in Palaeontology*, **10**, 1–148.

BENSON, R. H., DELGROSSO, R. M. and STEINECK, P. L. 1983. Ostracode distribution and biofacies, Newfoundland continental slope and rise. *Micropaleontology*, **29**, 430–453.

BERGUE, C. T. and COIMBRA, J. C. 2008. Late Pleistocene and Holocene bathyal ostracodes from the Santos Basin, southeastern Brazil. *Palaeontographica Abteilung A*, **285**, 101–144.

—— —— and CRONIN, T. M. 2007. Cytherellid species (Ostracoda) and their significance to the Late Quaternary events in the Santos Basin, Brazil. *Senckenbergiana Maritima*, **37**, 5–12.

—— COSTA, K. B., DWYER, G. and MOURA, C. A. V. 2006. Bathyal ostracode diversity in the Santos Basin, Brazilian southeast margin: response to Late Quaternary climate changes. *Revista Brasileira de Paleontologia*, **9**, 201–210.

BIANCHI, G. G. and MCCAVE, I. N. 2000. Hydrography and sedimentation under the deep western boundary current on Björn and Gardar Drifts, Iceland Basin. *Marine Geology*, **165**, 137–169.

BOLD, W. A. VAN DEN 1946. *Contribution to the study of Ostracoda with special reference to the Tertiary and Cretaceous microfauna of the Caribbean region [Proefschrift, Rijks-Universiteit te Utrecht]*. J. H. De Bussy, Amsterdam, 167 pp. [reprinted in 1970 by Antiquriaat Junk, Lochem].

—— 1957. *Ambocythere*, a new genus of Ostracoda. *The Annals and Magazine of Natural History, 12th series*, **10**, 801–813.

—— 1965. New species of the ostracod genus *Ambocythere*. *The Annals and Magazine of Natural History, 13th series*, **8**, 1–18.

—— 1966. Miocene and Pliocene Ostracoda from northeastern Venezuela. *Verhandelingen der Koninklijke Nederlandse Akademie van Wetenschappen, Afdeling Natuurkunde, 1. Reeks*, **23**, 1–43.

—— 1988. Neogene paleontology in the northern Dominican Republic: 7. The subclass Ostracoda (Arthropoda: Crustacea). *Bulletins of American Paleontology*, **94**, 1–105.

BONADUCE, G., CIAMPO, G. and MASOLI, M. 1976. Distribution of Ostracoda in the Adriatic Sea. *Pubblicazioni della Stazione Zoologica di Napoli*, **40**, 1–154.

BOND, G. C., KROMER, B., BEER, J., MUSCHELER, R., EVANS, M. N., SHOWERS, W., HOFFMANN, S., LOTTI-BOND, R., HAJDAS, I. and BONANI, G. 2001. Persistent Solar Influence on North Atlantic Climate during the Holocene. *Science*, **294**, 2130–2136.

—— and LOTTI, R. 1995. Iceberg discharges into the North Atlantic on millennial time scales during the last glaciation. *Science*, **267**, 1005–1010.

—— SHOWERS, W., CHESEBY, M., LOTTI, R., ALMASI, P., DEMENOCAL, P., PRIORE, P., CULLEN, H., HAJDAS, I. and BONANI, G. 1997. A pervasive millennial-scale cycle in North Atlantic Holocene and glacial climates. *Science*, **278**, 1257–1266.

BONNEMA, J. H. 1941. Ostracoden aus der Kreide des Untergrundes der nordöstlichen Niederlande. *Natuurhistorisch Maanblad, Maastricht*, **30**, 1–6, 8–10, 21–24, 26–29, 40–41, 56–60, 70–72.

BRADY, G. S. 1866. On new or imperfectly known species of marine Ostracoda. *Transactions of the Zoological Society of London*, **5**, 359–393.

—— 1880. Report on the Ostracoda dredged by H.M.S. Challenger, during the years 1873–1876. *Report on the Scientific Results of the Exploring Voyage of H.M.S. Challenger, Zoology*, **1**, 1–184.

—— 1886. Chapitre 4: Les Crustaces-Ostracodes des expeditions du Travailleur et du Talisman de 1881 a 1883; Chapitre 7: Les Ostracodes nouveaux des explorations du Travailleur et du Talisman. *Les Fonds de la Mer*, **4**, 164–166, 194–200.

—— CROSSKEY, H. W. and ROBERTSON, D. 1874. A monograph of the post-Tertiary Entomostraca of Scotland including species from England and Ireland. *Annual Volumes (Monographs) of the Palaeontographical Society, London*, **28**, 1–232.

—— and NORMAN, A. M. 1889. A monograph of the marine and fresh-water Ostracoda of the North Atlantic and of northwestern Europe. Section I: Podocopa. *Scientific Transactions of the Royal Dublin Society*, **4**, 63–270.

BRANDÃO, S. N. 2008. First Record of a living Platycopida (Crustacea, Ostracoda) from Antarctic waters and a Discussion on *Cytherella serratula* (Brady, 1880). *Zootaxa*, **1866**, 349–372.

BREMAN, E. 1975. Ostracodes in a bottom core from the deep southeastern basin of the Adriatic sea. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen, Series B*, **78**, 197–218.

—— 1976. Five ostracode species from Adriatic deep-sea sediments. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen, Series B*, **79**, 9–17.

BUBIKYAN, S. A. 1958. Ostracoda from Paleogene deposits of the Erevan Basin. *Izvestiya Akademii Nuak Armyanskoy SSR, Seriya Geologicheskii i Geograficheskii Nauk*, **11**, 3–16. [In Russian].

CAME, R. E., OPPO, D. W. and MCMANUS, J. F. 2007. Amplitude and timing of temperature and salinity variability in the subpolar North Atlantic over the past 10 k.y. *Geology*, **35**, 315–318.

CIAMPO, G. 1986. Ostracodi del limite Tortoniano/Messiniano in alcune sezioni italiane. *Bollettino della Societá Paleontologica Italiana*, **24**, 29–110.

—— 1988. Nuove specie di ostracodi pliocenici della Calabria ionica. *Bollettino della Societá Paleontologica Italiana*, **27**, 307–321.

COLALONGO, M. L. and PASINI, G. 1980. La ostracofauna plio-pleistocenica della Sezione Vrica in Calabria (con considerazioni sul limite Neogene/Quaternario). *Bollettino della Societá Paleontologica Italiana*, **19**, 44–126.

COLES, G. P., AINSWORTH, N. R., WHATLEY, R. C. and JONES, R. W. 1996. Foraminifera and Ostracoda from Quaternary carbonate mounds associated with gas seepage in the Porcupine Basin, offshore western Ireland. *Revista Española de Micropaleontología*, **28**, 113–151.

—— and WHATLEY, R. C. 1989. New Palaeocene to Miocene genera and species of Ostracoda from DSDP sites in the North Atlantic. *Revista Española de Micropaleontología*, **21**, 81–124.

———— and MOGUILEVSKY, A. 1994. The ostracod genus *Krithe* from the Tertiary and Quaternary of the North Atlantic. *Palaeontology*, **37**, 71–120.

CORYELL, H. N. and FIELDS, S. 1937. A Gatun ostracode fauna from Cativa, Panama. *American Museum Novitates*, **956**, 1–18.

CRONIN, T. M. 1983. Bathyal ostracodes from the Florida–Hatteras slope, the Straits of Florida, and the Blake Plateau. *Marine Micropaleontology*, **8**, 89–119.

—— BOOMER, I., DWYER, G. S. and RODRIGUEZ-LAZARO, J. 2002. Ostracoda and Paleoceanography. 99–119. *In* HOLMES, J. A. and CHIVAS, A. R. (eds). *The Ostracoda: applications in Quaternary research*. American Geophysical Union, Washington, DC, 313 pp.

—— and RAYMO, M. E. 1997. Orbital forcing of deep-sea benthic species diversity. *Nature*, **385**, 624–627.

———— and KYLE, K. P. 1996. Pliocene (3.2–2.4 Ma) ostracode faunal cycles and deep ocean circulation, North Atlantic Ocean. *Geology*, **24**, 695–698.

DIDIÉ, C. and BAUCH, H. A. 2000. Species composition and glacial-interglacial variations in the ostracode fauna of the northeast Atlantic during the past 200,000 years. *Marine Micropaleontology*, **40**, 105–129.

—— 2001. Erratum to "Species composition and glacial–interglacial variations in the ostracode fauna of the northeast Atlantic during the past 200,000 years" [Marine Micropaleontology 40 (2000) 105–129]. *Marine Micropaleontology*, **41**, 103–108.

—— BAUCH, H. A. and HELMKE, J. P. 2002. Late Quaternary deep-sea ostracodes in the polar and subpolar North Atlantic: paleoecological and paleoenvironmental implications. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **184**, 195–212.

DINGLE, R. V. 1984. Mid-Cretaceous Ostracoda from Southern Africa and the Falkland Plateau. *Annals of the South African Museum*, **93**, 97–211.

—— and LORD, A. R. 1990. Benthic ostracods and deep water-masses in the Atlantic Ocean. *Palaeogeography, Palaeoclimatology, Palaeoecology*, **80**, 213–235.

EAGAR, S. H. 1965. Ostracoda of the London Clay (Ypresian) in the London Basin, 1. Reading District. *Revue de Micropaléontologie*, **8**, 15–32.

ELLISON, C. R. W., CHAPMAN, M. R. and HALL, I. R. 2006. Surface and deep ocean interactions during the cold climate event 8200 years ago. *Science*, **312**, 1929–1932.

ELOFSON, O. 1969. *Marine Ostracoda of Sweden with special consideration of the Skagerrak*. Israel Program for Scientific Translations, Jerusalem, 286 pp. Translated from German. Published for the Smithsonian Institution and the National Science Foundation, Washington, DC [ELOFSON, O. 1941. Zur Kenntnis der marinen Ostracoden Schwedens mit besonderer Berücksichtigung des Skageraks. *Zoologiska Bidrag från Uppsala*, 19, 215–534].

FREIWALD, A. and MOSTAFAWI, N. 1998. Ostracods in a cold-temperate coastal environment, western Troms, northern Norway: Sedimentary aspects and assemblages. *Facies*, **38**, 255–274.

GOODAY, A. J. and HUGHES, J. A. 2002. Foraminifera associated with phytodetritus deposits at a bathyal site in the northern Rockall Trough (NE Atlantic): seasonal contrasts and a comparison of stained and dead assemblages. *Marine Micropaleontology*, **46**, 83–110.

GRÜNDEL, J. 1967. Zur Grossgliederung der Ordnung Podocopida G. W. Müller, 1894 (Ostracoda). *Neues Jahrbuch für Geologie und Paläontologie, Monatshefte*, **6**, 321–332.

—— 1976. Neue taxonomische Einheiten der Cytherocopina Gründel, 1967 (Ostracoda). *Zeitschrift für geologische Wissenschaften*, **4**, 1295–1304.

GUERNET, C. 1998. Neogene and Pleistocene ostracodes, sites 959 and 960, Gulf of Guinea. *Proceedings of the Ocean Drilling Program, Scientific Results*, **159**, 525–531.

—— and BELLIER, J.-P. 2000. Ostracodes Paléocènes et Éocènes du Blake Nose (Leg ODP 171B) et évolution des environnements bathyaux au large de la Floride. *Revue de Micropaléontologie*, **43**, 249–279.

—— and FOURCADE, E. 1988. Cenozoic ostracodes from Hole 628A, ODP Leg 101, Bahamas. *Proceedings of the Ocean Drilling Program, Scientific Results*, **101**, 139–151.

—— and MOULLADE, M. 1994. Ostracodes en milieu océanique profond (Atlantique central) au passage Miocéne–Pliocéne. *Revue de Micropaléontologie*, **37**, 257–274.

HAZEL, J. E. 1967. Classification and distribution of the recent Hemicytheridae and Trachyleberididae (Ostracoda) off northeastern North America. *U. S. Geological Survey Professional Paper*, **564**, 1–49.

HEINRICH, H. 1988. Origin and consequences of cyclic ice rafting in the northeast Atlantic Ocean during the past 130,000 years. *Quaternary Research*, **29**, 142–152.

HERRIG, E. 1963. Neue Ostracoden-Arten aus der Weißen Schreibkreide der Insel Rügen (Unter-Maastricht). *Wissenschaftliche Zeitschrift der Ernst-Moritz-Arndt-Universität Greifswald (Mathematisch-naturwissenschaftliche Reihe)*, **12**, 289–325.

—— 1966. Ostracoden aus der Weißen Schreibkreide (Unter-Maastricht) der Insel Rügen. *Paläontologische Abhandlungen (A: Paläozoologie)*, **2**, 693–1024.

HORNE, D. J. 1986. Two new species of *Pseudocythere* Sars (Crustacea, Ostracoda) from Britain and Norway. *Hydrobiologia*, **139**, 119–122.

HORNIBROOK, N. B. 1952. Tertiary and recent marine Ostracoda of New Zealand–their origin, affinities and distribution. *New Zealand Geological Survey, Paleontological Bulletin*, **18**, 5–82.

HOWE, H. V. and CHAMBERS, J. 1935. Louisiana Jackson Eocene Ostracoda. *Geological Bulletin, State of Louisiana Department of Conservation, Louisiana Geological Survey*, **5**, 1–65.

ISHIZAKI, K. 1981. Ostracoda from the East China Sea. *Science Reports of the Tohoku University, 2nd Series (Geology)*, **51**, 37–65.

—— and GUNTHER, F. 1974. Ostracoda of the family Cytheruridae from the Gulf of Panama. *Science Reports of the Tohoku University, 2nd Series (Geology)*, **45**, 1–50.

JELLINEK, T., SWANSON, K. and MAZZINI, I. 2006. Is the cosmopolitan model still valid for deep-sea podocopid ostracods? With the discussion of two new species of the genus *Pseudobosquetina* Guernet & Moullade 1994 and *Cytheropteron testudo* (Ostracoda) as case studies *Senckenbergiana Maritima*, **36**, 29–50.

JONES, T. R. 1849. A monograph of the Entomostraca of the Cretaceous formation of England. *Annual Volumes (Monographs) of the Palaeontographical Society, London*, **3**, 1–40.

——1901. On some Carboniferous shale from Siberia. *Geological Magazine* (*Decade 4*), **8**, 433–436.

JOY, J. A. and CLARK, D. L. 1977. The distribution, ecology and systematics of the benthic Ostracoda of the central Arctic Ocean. *Micropaleontology*, **23**, 129–154.

KEIGWIN, L. D. 2004. Radiocarbon and stable isotope constraints on Last Glacial Maximum and Younger Dryas ventilation in the western North Atlantic. *Paleoceanography*, **19**, PA4012, doi: 10.1029/2004PA001029.

LATREILLE, P. A. 1802. *Genera crustaceorum et insectorum, Tomus I*. Amand Koenig, Paris, 303 pp.

MACKIEWICZ, A. 2006. Recent benthic Ostracoda from Hornsund, south Spitsbergen, Svalbard Archipelago. *Polish Polar Research*, **27**, 71–90.

MADDOCKS, R. F. 1969. Revision of recent Bairdiidae (Ostracoda). *United States National Museum Bulletin*, **295**, 1–126.

—— and STEINECK, P. L. 1987. Ostracoda from experimental wood-island habitats in the deep sea. *Micropaleontology*, **33**, 318–355.

MALZ, H. and JELLINEK, T. 1994. Podocopide Tiefsee-Ostracoden aus Kastengreifer-Proben im östlichen Mittelmeer ('Meteor'-Fahrt 25/leg 1: Ionisches bis Levantinisches Becken). *Senckenbergiana Lethaea*, **74**, 9–32.

MARCHITTO, T. M. and DEMENOCAL, P. B. 2003. Late Holocene variability of upper North Atlantic Deep Water temperature and salinity. *Geochemistry, Geophysics, Geosystems*, **4**, 1100, doi: 10.1029/2003GC000598.

MAZZINI, I. 2005. Taxonomy, biogeography and ecology of Quaternary benthic Ostracoda (Crustacea) from circumpolar deep water of the Emerald Basin (Southern Ocean) and the S Tasman Rise (Tasman Sea). *Senckenbergiana Maritima*, **35**, 1–119.

MCKENZIE, K. G. 1967. Recent Ostracoda from Port Phillip Bay, Victoria. *Proceedings of the Royal Society of Victoria, New Series*, **80**, 61–106.

—— REYMENT, R. A. and REYMENT, E. R. 1993. Eocene Ostracoda from the Browns Creek Clays at Browns Creek and Castle Cove, Victoria, Australia. *Revista Española de Micropaleontología*, **8**, 75–116.

MCMANUS, J. F., FRANCOIS, R., GHERARDI, J.-M., KEIGWIN, L. D. and BROWN-LEGER, S. 2004. Collapse and rapid resumption of Atlantic meridional circulation linked to deglacial climate changes. *Nature*, **428**, 834–837.

—— OPPO, D. W. and CULLEN, J. L. 1999. A 0.5-million-year record of millennial-scale climate variability in the North Atlantic. *Science*, **283**, 971–975.

MOORE, R. C. (ed.) 1961. *Treatise on invertebrate paleontology, part Q, Arthropoda 3*. Geological Society of America, Boulder, and University of Kansas Press, Lawrence, 442 pp.

MÜLLER, G. W. 1894. Die Ostracoden des Golfes von Neapel und der angrenzenden Meeres-Abschnitte. *Fauna und Flora des Golfes von Neapel*, **21**, 1–404.

OPPO, D. W., MCMANUS, J. F. and CULLEN, J. L. 1998. Abrupt climate events 500,000 to 340,000 years ago: Evidence from subpolar north Atlantic sediments. *Science*, **279**, 1335–1338.

—— —— —— 2003. Deepwater variability in the Holocene epoch. *Nature*, **422**, 277–278.

PRAETORIUS, S. K., MCMANUS, J. F., OPPO, D. W. and CURRY, W. B. 2008. Episodic reductions in bottom-water currents since the last ice age. *Nature Geoscience*, **1**, 449–452.

PURI, H. S. 1954. Contribution to the study of the Miocene of the Florida Panhandle, Pt. 3, Ostracoda. *Geological Bulletin, State Board of Conservation, Florida Geological Survey*, **36**, 217–309.

—— 1957. *Henryhowella*, new name for *Howella* Puri, 1956. *Journal of Paleontology*, **31**, 982.

—— 1974. Normal pores and the phylogeny of Ostracoda. *Geoscience and Man*, **6**, 137–151.

—— and 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.

RAYMO, M. E., OPPO, D. W., FLOWER, B. P., HODELL, D. A., MCMANUS, J. F., VENZ, K. A., KLEIVEN, K. F. and MCINTYRE, K. 2004. Stability of North Atlantic water masses in face of pronounced climate variability during the Pleistocene. *Paleoceanography*, **19**, PA2008, doi: 10.1029/2003PA000921.

REUSS, A. M. 1850. Die fossilen Entomostraceen des öesterreichischen Tertiärbeckens. *Haidingers Naturwissenschaftliche Abhandlungen*, **3**, 41–92.

REX, M. A., STUART, C. T. and COYNE, G. 2000. Latitudinal gradients of species richness in the deep-sea benthos of the North Atlantic. *Proceedings of the National Academy of Sciences of the United States of America*, **97**, 4082–4085.

RUAN, P. and HAO, Y. 1988. Systematic description of microfossils. 2. Ostracoda. 227–395. *In* Research Party of Marine

Geology, Ministry of Geology and Mineral Resources, Chinese University of Geosciences (Beijing) (ed.). *Quaternary microbiotas in the Okinawa Trough and their geological significance*. Geological Publishing House, Beijing, 510 pp. [In Chinese with English summary].

SANDERS, H. L., HESSLER, R. R. and HAMPSON, G. R. 1965. An introduction to the study of deep-sea benthic faunal assemblages along the Gay Head-Bermuda transect. *Deep-Sea Research*, **12**, 845–867.

SARS, G. O. 1866 [Preprint, 1865]. Oversigt af Norges marine Ostracoder. *Förhandlinger i Videnskabs-Selskabet i Christiania*, **7**, 1–130.

—— 1869. Nye dybvands crustacéer fra Lofoten. *Forhandlinger i Videnskabs – Selskabet i Christiania*, **8**, 170–174.

—— 1925. Ostracoda, parts 5–12. *An Account of the Crustacea of Norway with Short Description and Figures of All the Species*, **9**, 73–208.

—— 1926. Ostracoda, parts 13 and 14. *An Account of the Crustacea of Norway with Short Description and Figures of All the Species*, **9**, 209–240.

—— 1928. Ostracoda, parts 15 and 16. *An Account of the Crustacea of Norway with Short Description and Figures of All the Species*, **9**, 241–277.

SCHELLENBERG, S. A. 2007. Marine ostracods. 2046–2062. *In* ELIAS, S. A. (ed.). *Encyclopedia of quaternary science*. Elsevier, Amsterdam.

SCHORNIKOV, E. I. 2005. The question of cosmopolitanism in the deep-sea ostracod fauna: the example of the genus *Pedicythere*. *Hydrobiologia*, **538**, 193–215.

SISSINGH, W. 1972. Late Cenozoic Ostracoda of the South Agean Island Arc. *Utrecht Micropaleontological Bulletins*, **7**, 1–187.

SKOGSBERG, T. 1920. Studies on marine ostracods. Part 1 (cypridinids, halocyprids and polycopids). *Zoologiska Bidrag fran Uppsala, Supplment*, **1**, 1–784.

STEINECK, P. L., MADDOCKS, R. F., COLES, G. P. and WHATLEY, R. C. 1990. Xylophile Ostracoda in the deep sea. 307–319. *In* WHATLEY, R. C. and MAYBURY, C. (eds). *Ostracoda and global events*. Chapman and Hall, London, 621 pp.

STEPANOVA, A. 2006. Late Pleistocene-Holocene and Recent Ostracoda of the Laptev Sea and their importance for paleoenvironmental reconstructions. *Paleontological Journal*, **40**, S91–S204.

STEPANOVA, A., TALDENKOVA, E. and BAUCH, H. A. 2003. Recent Ostracoda from the Laptev Sea (Arctic Siberia): species assemblages and some environmental relationships. *Marine Micropaleontology*, **48**, 23–48.

SWANSON, K. M. and AYRESS, M. A. 1999. *Cytheropteron testudo* and related species from the SW Pacific – with analyses of their soft anatomies, relationships and distribution. *Senckenbergiana Biologica*, **79**, 151–193.

SYLVESTER-BRADLEY, P. C. 1948. The ostracode genus *Cythereis*. *Journal of Paleontology*, **22**, 792–797.

WANG, P., ZHANG, J., ZHAO, Q., MIN, Q., BIAN, Y., ZHENG, L., CHENG, X. and CHEN, R. 1988. *Foraminifera and Ostracoda in bottom sediments of the East China Sea*. Ocean Press, Beijing, 438 pp.

WHATLEY, R. C., AYRESS, M. and DOWNING, S. 1986. Two unusual new species of the ostracod genus *Cytheropteron* from the late Cainozoic of the deep sea. *Journal of Micropalaeontology*, **5**, 31–36.

—— and COLES, G. P. 1987. The late Miocene to Quaternary Ostracoda of Leg 94, Deep Sea Drilling Project. *Revista Española de Micropaleontología*, **19**, 33–97.

—— EYNON, M. and MOGUILEVSKY, A. 1996. Recent Ostracoda of the Scoresby Sund fjord system, East Greenland. *Revista Española de Micropaleontología*, **28**, 5–23.

—— —— —— 1998. The depth distribution of Ostracoda from the Greenland Sea. *Journal of Micropalaeontology*, **17**, 15–32.

YASUHARA, M. and CRONIN, T. M. 2008. Climatic influences on deep-sea ostracode (Crustacea) diversity for the last three million years. *Ecology*, **89**, S52–S65.

—— —— DEMENOCAL, P. B., OKAHASHI, H. and LINSLEY, B. K. 2008*b*. Abrupt climate change and collapse of deep-sea ecosystems. *Proceedings of the National Academy of Sciences of the United States of America*, **105**, 1556–1560.

—— —— and MARTÍNEZ ARBIZU, P. 2008*a*. Abyssal ostracods from the South and Equatorial Atlantic Ocean: Biological and paleoceanographic implications. *Deep-Sea Research I*, **55**, 490–497.

ZHAO, Q., WHATLEY, R. and ZHOU, B. 2000. The taxonomy and distribution of recent species of the ostracod genus *Cytheropteron* in the South China Sea. *Revista Española de Micropaleontología*, **32**, 259–281.