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Quaternary equatorial Atlantic deep-sea ostracodes: evidence for a distinct tropical fauna in the deep sea

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Abstract.—Low-latitude, deep-sea faunas remain poorly understood and described. Here, we systematically describe Quaternary deep-sea ostracodes from the Ocean Drilling Program (ODP) Site 925 (Ceara Rise; 4°12.2'N, 43°29.3′W; 3040 m water depth) in the equatorial Atlantic Ocean. Twenty-six genera and 52 species were examined and illustrated with high-resolution scanning electron microscopy images. Six new species are described herein: *Pseudocythere spinae*, *Hemiparacytheridea zarikiani*, *Pedicythere canis*, *Xylocythere denticulata*, *Paracytherois obtusa*, and *Poseidonamicus sculptus*. The results show that deep-sea ostracodes have a tropical faunal element that is distinctive from higher latitude ostracodes, and that is globally distributed in low latitudes. This tropical faunal component is possibly a Tethyan legacy of a fauna that was widely distributed in tropical and extratropical latitudes in deep waters during greenhouse conditions in the Cretaceous and early Cenozoic. Global cooling thereafter shrank its distribution, limiting it to tropical latitudes, perhaps with the relatively warm uppermost bathyal area acting as the source or refuge of this faunal component. Because similar present-day biogeographic patterns (i.e., presence and wide distribution of tropical deep-sea fauna) are known in other deep-sea benthic groups, this scenario might be applicable to the deep-sea benthos more broadly.

UUID: http://zoobank.org/552d4cb2-c0db-463a-ae3f-b2efcc0985df.

Introduction

Large scale biogeographic patterns in deep-sea benthic fauna remain poorly understood (O'Hara et al., 2011; Watling et al., 2013; Ingels et al., 2021; Levin et al., 2021). One of the major unresolved questions is whether there is a distinct tropical fauna in the deep sea, or at least latitudinal zonation at low latitudes. Some studies showed clear zonation and the presence of a tropical fauna at bathyal depths (Zezina, 1997; O'Hara et al., 2011), whereas others did not (UNESCO, 2009; Watling et al., 2013). There tends to be agreement that deeper, abyssal faunas are more homogeneous and lack clear latitudinal zonation (Zezina, 1997; UNESCO, 2009; O'Hara et al., 2011; Watling et al., 2013). However, definition of the bathyal-abyssal boundary varies among studies (3500 m in UNESCO, 2009 and Watling et al., 2013; 3000 m in Zezina, 1997; 2000 m in O'Hara et al., 2011). In addition, these studies exclusively analyze macrobenthos, megabenthos, and oceanographic parameters, and do not include any meiobenthic information.

A latitudinal diversity gradient is present in the deep sea, with higher diversity at lower latitudes (Culver and Buzas, 2000; Rex et al., 2000; Yasuhara et al., 2009b, 2012; Jöst et al., 2019). Bottom temperature and particulate organic carbon flux, the major food source for deep-sea benthos, are commonly used to explain large-scale deep-sea diversity patterns in space and time (Rex and Etter, 2010; Tittensor et al., 2011; Yasuhara et al., 2014b, 2020; Yasuhara and Danovaro, 2016; Jöst et al., 2019; Wei et al., 2020), but neither of them shows substantial change at the transition between the tropics and subtropics, nor do they show clear latitudinal trends in low–mid latitudes (O'Hara et al., 2011; Sweetman et al., 2017). Thus, to better understand high biodiversity in the deep sea, it is important to better understand the identity and affinities of tropical deep-sea faunas.

Ostracoda (Crustacea) is a major group of deep-sea meiobenthos (Yasuhara and Cronin, 2008). They have reasonably good taxonomy, especially in the North Atlantic Ocean (Whatley and Coles, 1987; Yasuhara et al., 2009c; Yasuhara and Okahashi, 2014, 2015), and their small size and calcitic shells mean that they are well preserved in sediments as fossils (Yasuhara et al., 2017). Thus, they are useful to better understand deep-sea biogeography in the present as well as the past (Yasuhara et al., 2019), and can give an insight into the above questions about the nature of the tropical deep-sea fauna from a meiofaunal perspective.

Here, we systematically describe Quaternary deep-sea ostracodes from the Ocean Drilling Program (ODP) Site 925, equatorial Atlantic Ocean, and show that this site has tropical ostracode faunal elements that are distinctive from higher latitude faunas,

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but in common with the tropical ostracodes in distant oceans. We suggest that this globally similar tropical deep-sea fauna may be a Tethyan legacy—the remainder of what was, during warmer climate intervals in the past, a more widely distributed fauna.

Materials and methods

Detailed information for the specimens used for the present study is shown in Appendix 1. All specimens are from the late Quaternary sediments of ODP Site 925 (Ceara Rise, western equatorial Atlantic; 4°12.2′N, 43°29.3′W; 3040 m water depth; Fig. 1), covering the last ca. 500 ka. Further details on samples, methods, chronology, paleoceanographical setting, and ostracode species diversity patterns are found in Yasuhara et al. (2009b). Uncoated specimens were digitally imaged with a Philips XL-30 environmental scanning electron microscope (SEM) (at the Scanning Electron Microscope Lab, National Museum of Natural History, Smithsonian Institution) and a Hitachi S-3400N Variable Pressure SEM (at the Electron Microscope Unit, University of Hong Kong) in low-vacuum mode. High-resolution figures of ostracode SEM images (Figs. 2–13, 15–17) are available at Dryad (http://datadryad.org/; https://doi.org/10.5061/dryad.ns1rn8psq). For higher classification, we mainly referred to Whatley et al. (1993), Horne et al. (2002), and the World Ostracoda Database (Brandão and Karanovic, 2019).

Repository and institutional abbreviation.—Figured specimens are deposited in the National Museum of Natural History (Washington DC, catalogue numbers USNM PAL 527091 and 771616–771785). MY's personal catalogue numbers are also shown.

Systematic paleontology

Abbreviations.—LV, left valve; RV, right valve; L, length; H, height.

Class Ostracoda Latreille, 1802
Subclass Myodocopa Sars, 1866
Order Halocyprida Dana, 1853
Suborder Cladocopina Sars, 1866
Superfamily Polycopoidea Sars, 1866
Family Polycopidae Sars, 1866
Genus *Polycope* Sars, 1866

Type species.—*Polycope orbicularis* Sars, 1866.

Polycope orbicularis s.l. Sars, 1866
Figure 2.1–2.9

1996 *Polycope* sp. 4 Zhao and Zheng, pl. 4, fig. 12.
2009c *Polycope* cf. *orbicularis* Sars; Yasuhara et al., p. 881, pl. 1, fig. 5.
2009c *Polycope orbicularis* s.l. Sars; Yasuhara et al., p. 881.
2009 *Polycope orbicularis* Sars; Alvarez Zarikian, p. 3, pl. P1, fig. 7.
2015 *Polycope orbicularis* s.l.; Yasuhara and Okahashi, p. 25, fig. 2F, G.

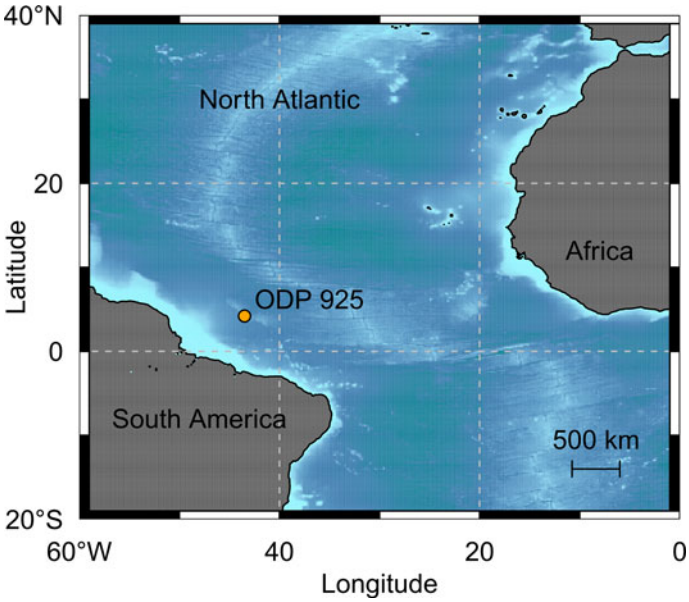

Figure 1. Locality map indicating ODP Site 925 (4°12.2′N, 43°29.3′W). This map was generated with R package "marmap" by using the NOAA's ETOPO1 bathymetric data (Pante and Simon-Bouhet, 2013).

Remarks.—See Yasuhara et al. (2009c) for details of this species and its '*sensu lato*' status.

Polycope vasfiensis Sissingh, 1972
Figure 2.10

1972 *Polycope vasfiensis* Sissingh; p. 68, pl. 1, fig. 6.
1976 *Polycope vasfiensis*; Bonaduce et al., p. 18, text-fig. 6, pl. 1, figs. 6–8.
1988 *Polycope vasfiensis*; Ruan and Hao, p. 393, pl. 74, figs. 2–5.
?1996 *Polycope* sp. 3 Zhao and Zheng, pl. 4, fig. 11.
2000 *Polycope vasfiensis*; Aiello et al., p. 85, pl. 1, fig. 1.
2009c *Polycope vasfiensis*; Yasuhara et al., p. 882, pl. 1, figs. 1, 2.
2015 *Polycope vasfiensis*; Yasuhara and Okahashi, p. 25, fig. 2H, I.

Holotype.—LV (Utrecht Micropaleontological Collection, Netherlands; catalog number not shown) from Vasfi Formation, Rhodos, Aegean Sea, Pleistocene.

Remarks.—This species is widely known from the Mediterranean, North Atlantic, and North Pacific.

Subclass Podocopa Sars, 1866
Order Podocopida Sars, 1866
Suborder Bairdiocopina Gründel, 1967
Superfamily Bairdioidea Sars, 1866
Family Bythocyprididae Maddocks, 1969
Genus *Bythocypris* Brady, 1880

Type species.—*Bythocypris reniformis* Brady, 1880.

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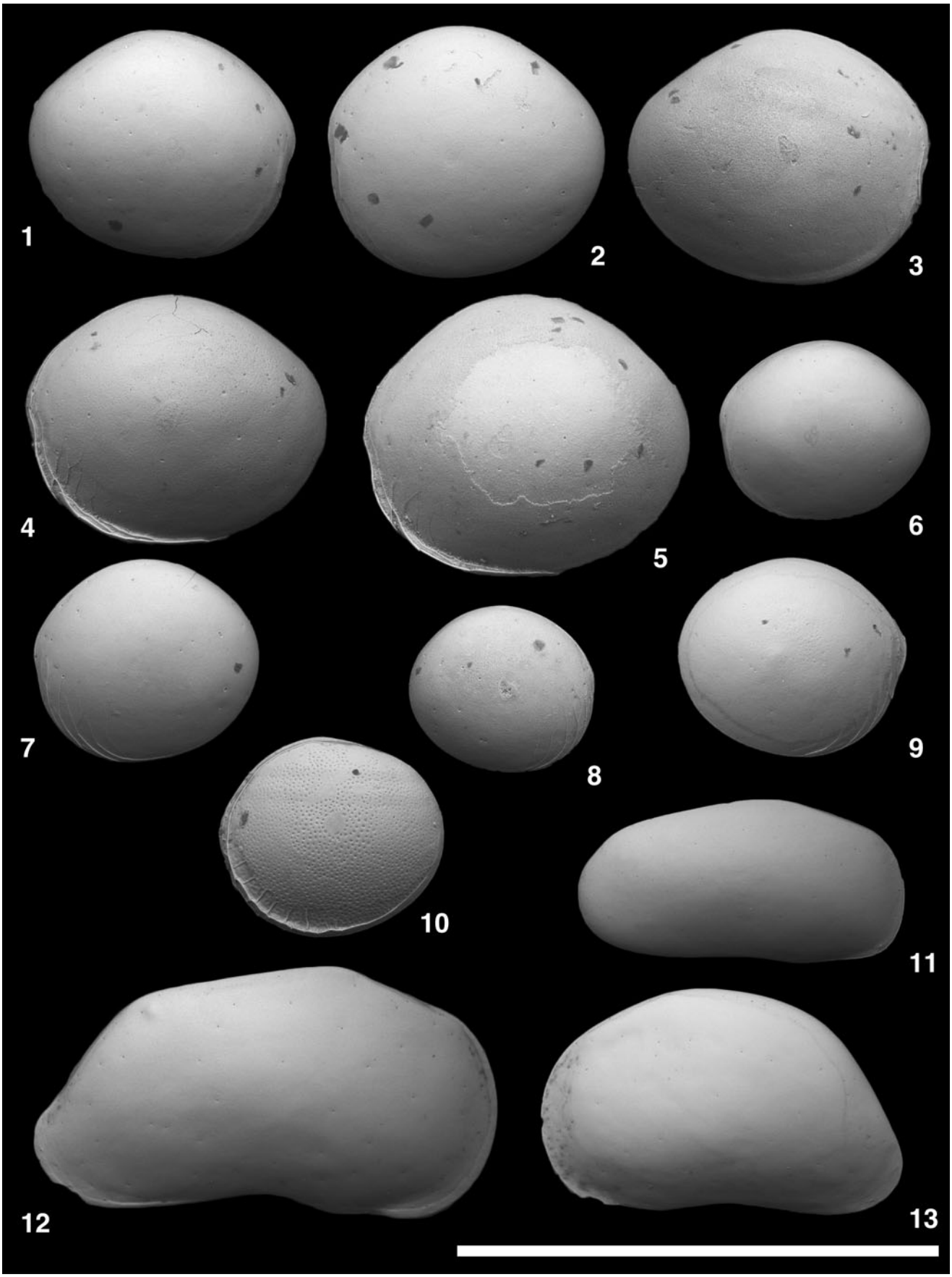

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Figure 2. Scanning electron microscope images of *Polycope*, *Bythocypris*, and *Zabythocypris* species. (**1–9**) *Polycope orbicularis* s.l. Sars, 1866; (**1**) USNM PAL 771616 (ODP925202), RV; (**2**) USNM PAL 771617 (ODP925203), LV; (**3**) USNM PAL 771618 (ODP925207), RV; (**4**) USNM PAL 771619 (ODP925208), LV; (**5**) USNM PAL 771620 (ODP925209), LV; (**6**) USNM PAL 771621 (ODP925211), LV; (**7**) USNM PAL 771622 (ODP925204), LV; (**8**) USNM PAL 771623 (ODP925205), RV; (**9**) USNM PAL 771624 (ODP925210), RV. (**10**) *Polycope vasfiensis* Sissingh, 1972, USNM PAL 771625 (ODP925206), LV. (**11**) *Bythocypris weddellensis* Brandão, 2008, USNM PAL 771626 (ODP925013), juvenile? RV. (**12, 13**) *Zabythocypris ancipita* Maddocks, 1969; (**12**) USNM PAL 771627 (ODP925011), adult? RV; (**13**) USNM PAL 771628 (ODP925012), juvenile LV. All lateral views. Scale bar = 1 mm.

Bythocypris weddellensis Brandão, 2008
Figure 2.11

2008 *Bythocypris weddellensis* Brandão, p. 428, figs. 40A–N, 41, 42.

Holotype.—ZMH K-41325, Weddell Sea, Southern Ocean, living.

Remarks.—*Bythocypris weddellensis* is similar to *Bythocypris tenera* Breman, 1975, but the latter is more slender.

Genus *Zabythocypris* Maddocks, 1969

Type species.—?*Bythocypris heterodoxa* Chapman, 1910.

Zabythocypris ancipita Maddocks, 1969
Figure 2.12, 2.13

1969 *Zabythocypris ancipita* Maddocks, p. 108, fig. 59.
?1980 *Zabythocypris ancipita*; Schornikov, p. 188.
?1987 *Bythocypris* sp. 1 Whatley and Coles, pl. 1, fig. 3.
?1988 *Zabythocypris ancipita*; Whatley and Ayress, p. 747.

Holotype.—LV (National Museum of Natural History, Washington DC, USA), Mozambique Channel, western Indian Ocean, Recent.

Remarks.—Our specimens are almost identical to the asymmetrical dimorph of *Zabythocypris ancipita* Maddocks, 1969. Schornikov (1980) and Whatley and Ayress (1988) reported this species, but without any drawings or microphotographic images.

Zabythocypris heterodoxa (Chapman, 1910)
Figure 3.1–3.3

1910 ?*Bythocypris heterodoxa* Chapman, p. 429, pl. 56, fig. 20a, b.
1969 *Zabythocypris heterodoxa* (Chapman); Maddocks, p. 102, figs. 56a–c, 57, 58.
1980 *Zabythocypris heterodoxa*; Schornikov, p. 188.

Holotype.—Not designated. The original description shows a left valve from the western Pacific Ocean, Recent.

Remarks.—Several species very similar to *Zabythocypris heterodoxa* (Chapman, 1910) are known (Athersuch and Gooday, 1979; Schornikov, 1980). Our specimens are most similar to the specimens shown as *Zabythocypris heterodoxa* in Maddocks (1969) in lateral outline and in the nearly vertical angle of dorsal spine.

Suborder Cypridocopina Jones, 1901
Superfamily Macrocypridoidea Müller, 1912
Family Macrocyprididae Müller, 1912
Genus *Macrocypris* Brady, 1868b

Type species.—*Cythere minna* Baird, 1850.

Macrocypris miranda s.l. Maddocks, 1990
Figure 3.4

1987 *Macrocypris* sp. cf. *M. minna* (Baird); Whatley and Coles, pl. 1, fig. 7.
1990 *Macrocypris miranda* Maddocks, p. 46, figs. 2.5, 2.6, 3.5, 3.6, 18.3, 22.17, 24.2, 25.11, 25.12, 29.13, 32.11, 38.3, 46.7, 46.8, 48.10–48.13, 49.10–49.13, 56.17, 56.36, 57.1, 57.31, 58.1, 59.12, 59.29, 59.34, 60.3, 63.13, 63.22, 64.2, 65.1, 80.2, pls. 4.7–4.12, 5.7–5.12, 58.1, 58.2, 58.9–58.15, 59.1, 59.2, 59.11, 64.5–64.8, 78.8–78.10, 82.13, 82.14, 83.5, 83.6, 85.10–85.12, 98.3–98.7, 110.2, 110.3.
2000 *Macrocypris* sp. Didié and Bauch, pl. 4, fig. 16.

Holotype.—USNM 240194 (National Museum of Natural History, Washington DC, USA), southeastern Atlantic Ocean, Holocene.

Remarks.—We tentatively assign our juvenile specimen in this species in a broad sense.

Superfamily Pontocypridoidea Müller, 1894
Family Pontocyprididae Müller, 1894
Genus *Aratrocypris* Whatley et al., 1985

Type species.—*Aratrocypris rectoporrecta* Whatley et al., 1985.

Aratrocypris sp. 1
Figure 3.5, 3.6

1985 *Aratrocypris* sp. Whatley et al., p. 72, pl. 2, figs. ?14, 16, ?17 (non fig. 15).
1987 *Aratrocypris* sp. cf. *A. rectoporrecta* Whatley and Coles, pl. 1, fig. 10.
?1989 *Aratrocypris gigantea* Whatley, Witte, and Coles, p. 212, pl. 1, figs. 11, 12, pl. 2, figs. 1–3, 6.
1996 *Aratrocypris* sp. Zhao and Zheng, pl. 1, fig. 15.

Remarks.—Our specimens are identical to the specimen shown as *Aratrocypris* sp. in Whatley et al. (1985, pl. 2, fig. 16) from

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the Pleistocene southwestern Pacific. Although *Aratrocypris* sp. of Whatley et al. (1985) was described later as *Aratrocypris maddocksae* Whatley, Witte, and Coles, 1989, this Pleistocene southwestern Pacific specimen differs from the type specimens from the Paleogene North Atlantic Ocean in outline (the former has a narrower and more rounded posterior margin). Our specimens are also very similar to *Aratrocypris gigantea* Whatley et al., 1989 (type locality and horizon: tropical North Atlantic, Recent) and their outlines are identical each other. The only differences are: (1) our specimens are much smaller, and (2) the plough-like anteroventral structure is denticulate in *Aratrocypris gigantea*. It is likely that our specimens (as well as the Pleistocene southwestern Pacific specimen of *Aratrocypris* sp.) are juveniles of *Aratrocypris gigantea*. Given this considerable uncertainty, however, we prefer to call our specimens *Aratrocypris* sp. 1.

Genus *Argilloecia* Sars, 1866

Type species.—*Argilloecia cylindrica* Sars, 1866.

Argilloecia acuminata Müller, 1894
Figure 3.7, 3.8

1894 *Argilloecia acuminata* Müller, p. 261, pl. 12, figs. 1, 2, 12–22.
1975 *Argilloecia acuminata*; Breman, p. 82, pl. 2, fig. 21, pl. 6, fig. 69.
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. 144, pl. 3, fig. 10.
1988 *Argilloecia acuminata*; Ruan and Hao, p. 239, pl. 36, figs. 23–26.
1988 *Argilloecia conoidea* Sars; Ruan and Hao, p. 239, pl. 37, fig. 4.
1988 *Argilloecia conoidea*; Wang et al., p. 231, fig. 5.70, pl. 36, figs. 11–13.
1994 *Argilloecia* (*Robustoargilloecia*) *acuminata* Müller; Malz and Jellinek, p. 24, pl. 5, figs. 27, 28.
2004 *Argilloecia acuminata*; Aiello and Szczechura, p. 16, pl. 1, fig. 2.
2007 *Argilloecia acuminata*; Hou and Gou, p. 546, pl. 108, figs. 22, 23.
2007 *Argilloecia conoidea*; Hou and Gou, p. 547, pl. 165, fig. 21, pl. 225, figs. 10, 11.
2009c *Argilloecia acuminata*; Yasuhara et al., p. 886, pl. 3, figs. 1, 2, 4, 5.
2009 *Argilloecia* sp. 2 Alvarez Zarikian, p. 7, pl. P8, fig. 4 (part; non fig. 3).
2014 *Argilloecia acuminata*; Yasuhara and Okahashi, p. 774, fig. 2.5.
2014a *Argilloecia acuminata*; Yasuhara et al., p. 347, fig. 3.1, 3.2.
2015 *Argilloecia acuminata*; Yasuhara and Okahashi, p. 28, fig. 4A–D.
2017 *Argilloecia acuminata*; Bergue et al., p. 506, pl. 4, figs. 15, 16.

Holotype.—Not designated. The type locality is Bay of Naples, Italy, Recent.

Remarks.—This species is widely known from the Mediterranean Sea and the Atlantic and Pacific oceans.

Argilloecia labri Yasuhara and Okahashi, 2015
Figure 3.9–3.11

1987 *Argilloecia* sp. 4 Whatley and Coles, p. 86, pl. 1, figs. 17, 18.
2000 *Argilloecia* sp. 2 Didié and Bauch, p. 116, pl. 3, figs. 3, 4.
2015 *Argilloecia labri* Yasuhara and Okahashi, p. 28, fig. 4G–J.

Holotype.—Adult LV, USNM PAL 603651 (National Museum of Natural History, Washington DC, USA), eastern North Atlantic Ocean, Quaternary.

Remarks.—This species has been reported from the North Atlantic Ocean.

Argilloecia sp. 1
Figure 3.12, 3.13

Remarks.—This distinctly shaped *Argilloecia* species is probably an undescribed species, but we are not sure whether our specimens are adults or juveniles. Thus, we prefer to keep this species in open nomenclature until definitively adult specimens are recovered.

Genus *Propontocypris* Sylvester-Bradley, 1947

Type species.—*Pontocypris trigonella* Sars, 1866.

Propontocypris trigonella s.l. (Sars, 1866)
Figure 3.14

1866 *Potocypris trigonella* (sic.) Sars, p. 16.
1923 *Pontocypris trigonella* Sars; Sars, p. 48, pl. 20, figs. 1–16.
1982 *Propontocypris trigonella* (Sars); Athersuch and Whittaker, p. 67, text-figs. 1–4, pls. 9.64, 9.66.
1987 *Pontocypris* sp. cf. *P. trigonella* Sars; Whatley and Coles, pl. 1, fig. 25.
2000 *Propontocypris trigonella*; Didié and Bauch, pl. 3, fig. 17.
2009 *Propontocypris trigonella*; Alvarez Zarikian, p. 7, pl. P8, fig. 10.

Holotype.—Not designated. The type locality is off Norway, Norwegian Sea, Recent.

Remarks.—Specimens resembling this juvenile have been identified as *Propontocypris trigonella* or its affinity in the

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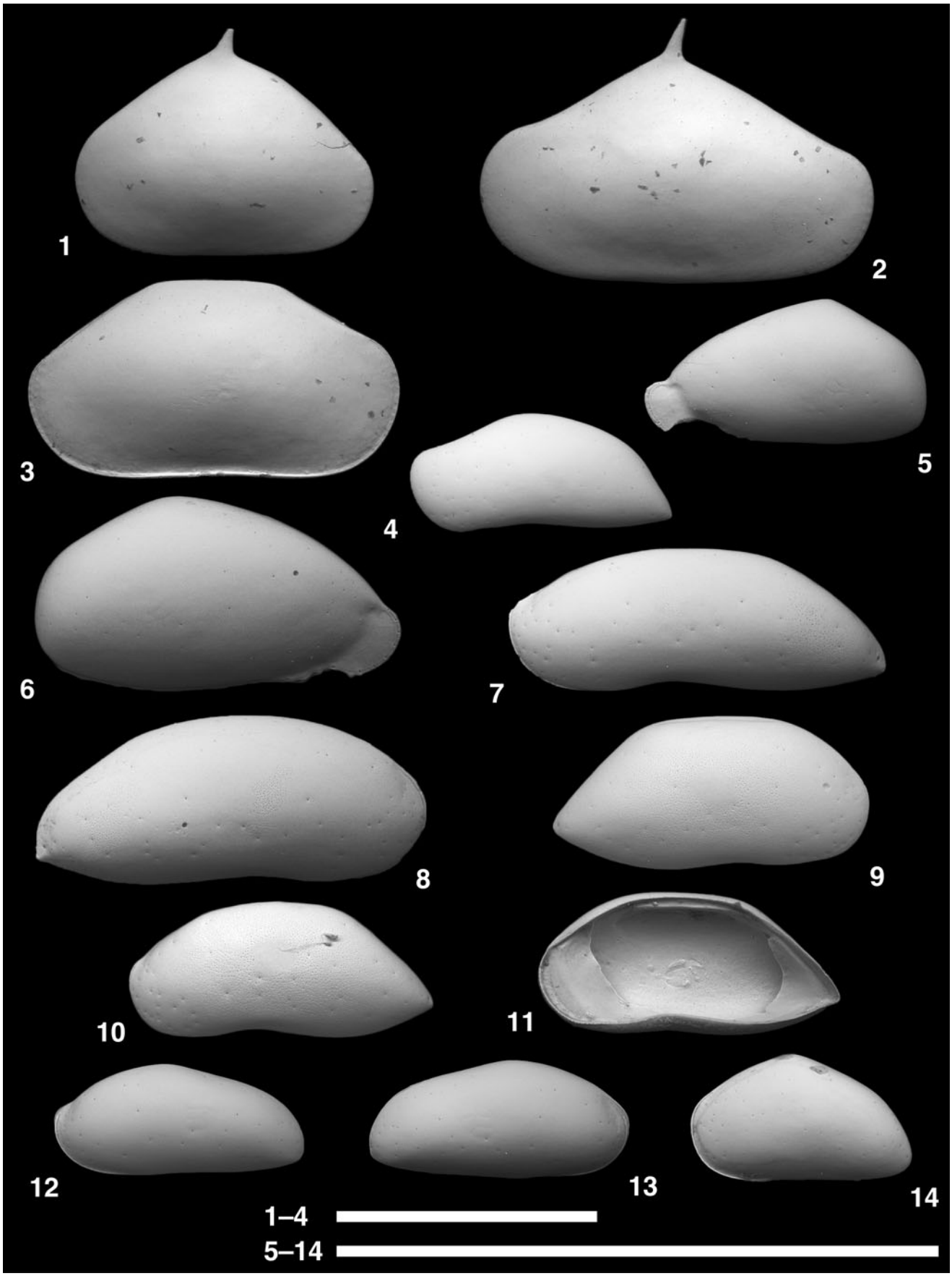

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Figure 3. Scanning electron microscope images of *Zabythocypris*, *Macrocypris*, *Aratrocypris*, *Argilloecia*, and *Propontocypris* species. (**1–3**) *Zabythocypris heterodoxa* (Chapman, 1910); (**1**) USNM PAL 771629 (ODP925257), A-1 juvenile LV; (**2**) USNM PAL 771630 (ODP925258), adult LV; (**3**) USNM PAL 771631 (ODP925259), adult RV. (**4**) *Macrocypris miranda* s.l. Maddocks, 1990, USNM PAL 771632 (ODP925212), adult? LV. (**5, 6**) *Aratrocypris* sp. 1; (**5**) USNM PAL 771633 (ODP925003), juvenile? LV; (**6**) USNM PAL 771634 (ODP925002), juvenile? RV. (**7, 8**) *Argilloecia acuminata* Müller, 1894; (**7**) USNM PAL 771635 (ODP925004), adult LV; (**8**) USNM PAL 771636 (ODP925005), adult? RV. (**9–11**) *Argilloecia labri* Yasuhara and Okahashi, 2015; (**9**) USNM PAL 771637 (ODP925006), adult? RV; (**10**) USNM PAL 771638 (ODP925007), adult? LV; (**11**) USNM PAL 771639 (ODP925159), adult RV. (**12, 13**) *Argilloecia* sp. 1; (**12**) USNM PAL 771640 (ODP925008), adult? LV; (**13**) USNM PAL 771641 (ODP925009), adult? RV. (**14**) *Propontocypris trigonella* s.l. (Sars, 1866), USNM PAL 771642 (ODP925218), juvenile LV. All lateral views, except (**11**), internal view. Scale bars = 1 mm.

North Atlantic Ocean (Whatley and Coles, 1987; Didié and Bauch, 2000; Alvarez Zarikian, 2009). But it is not clear if they are conspecific. We tentatively identify this juvenile specimen as *Propontocypris trigonella* (Sars, 1866) in a broad sense.

Suborder Cytherocopina Gründel, 1967
Superfamily Cytheroidea Baird, 1850
Family Bythocytheridae Sars, 1866
Genus *Pseudocythere* Sars, 1866

Type species.—*Pseudocythere caudata* Sars, 1866.

Pseudocythere caudata Sars, 1866
Figure 4.2–4.14

1866 *Pseudocythere caudata* Sars, p. 88.
1926 *Pseudocythere caudata*; Sars, p. 239, pl. 109, fig. 2a–k.
1961 *Pseudocythere caudata*; Moore, p. Q268, fig. 195.5.
1967 *Pseudocythere caudata*; Neale, fig. 5e–i, pl. 1, fig. e, f.
1967 *Pseudocythere* cf. *P. caudata* Sars; Neale, p. 14, fig. 5a–d, pl. 1, figs. a, b.
1976 *Pseudocythere caudata*; Bonaduce et al., p. 119, pl. 14, figs. 9, 10.
1977 *Pseudocythere caudata*; Joy and Clark, p. 137, pl. 1, figs. 1–3.
1980 *Pseudocythere caudata mediterranea* Bonaduce et al., p. 136, pl. 1, fig. 1, pl. 2, figs. 1, 2, 6.
1986 *Pseudocythere caudata*; Horne, p. 119, figs. 1m, 2c.
1989 *Pseudocythere caudata*; Athersuch et al., p. 255, fig. 108.
1994 *Pseudocythere* cf. *caudata*; Malz and Jellinek, figs. 3, 4, 6.
1996a *Pseudocythere caudata*; Whatley et al., pl. 1, figs. 10, 12.
1996 *Pseudocythere* gr. *caudata* Sars; Coles et al., p. 150, pl. 2, figs. 3, 4.
1998 *Pseudocythere caudata*; Freiwald and Mostafawi, pl. 60, fig. 5.
1998a *Pseudocythere caudata*; Whatley et al., pl. 1, figs. 8, 9.
2001 *Pseudocythere caudata*; Didié and Bauch, pl. 1, fig. 20 (as erratum for Didié and Bauch, 2000).
2003 *Pseudocythere caudata*; Stepanova et al., pl. 1, fig. 4.
2005 *Pseudocythere* (*Dopseucythere*) *caudata* Sars; Guernet, p. 108.
2009 *Pseudocythere caudata*; Alvarez Zarikian, p. 3, pl. P2, fig. 4.
2009c *Pseudocythere caudata*; Yasuhara et al., p. 892, pl. 4, figs. 7–12.
2014 *Pseudocythere caudata*; Yasuhara and Okahashi, p. 774, fig. 2.9, 2.10.
2014a *Pseudocythere caudata*; Yasuhara et al., p. 348, fig. 5.1, 5.2.
2014c *Pseudocythere caudata*; Yasuhara et al., p. 412, pl. 6, figs. 1–12.
2015 *Pseudocythere caudata*; Yasuhara and Okahashi, p. 31, fig. 5F, G.
2016 *Pseudocythere caudata*; Alvarez Zarikian, p. 98, pl. 1, fig. 8.

Holotype.—Not designated. The type locality is off Norway, Norwegian Sea, Recent.

Remarks.—This species has considerable intraspecific variation. See Yasuhara et al. (2014c) for detailed discussion.

Pseudocythere fuegiensis Brady, 1880
Figure 4.1

1880 *Pseudocythere fuegiensis* Brady, p. 145, pl. 1, fig. 7a–d.
1976 *Pseudocythere fuegiensis*; Puri and Hulings, p. 309, pl. 1, figs. 9, 10.

Holotype.—Adult RV, BM 81.5.54 (Natural History Museum, London, UK), southeastern Pacific, Recent.

Remarks.—*Pseudocythere fuegiensis* Brady, 1880 is very similar to ?*Pseudocythere* sp.1 of Didié and Bauch (2000), but has more upturned caudal process and better developed primary reticulation (referred to as 'striae' in previous papers). This species is also very similar to ?*Pseudocythere* sp.2 (Didié and Bauch, 2000; Alvarez Zarikian, 2009) in outline, but surface reticulation patterns differ.

Pseudocythere spinae new species
Figure 4.16–4.19

Holotype.—Adult RV, USNM PAL 771658 (ODP925229) (Fig. 4.16) from the Ceara Rise, western equatorial Atlantic, ODP Site 925D, 1/5/137–139 (ca. 238 ka).

Paratypes.—Adult LV, USNM PAL 771659 (ODP925228) (Fig. 4.17); adult RV, USNM PAL 771660 (ODP925231) (Fig. 4.18); adult LV, USNM PAL 771661(ODP925230) (Fig. 4.19).

Diagnosis.—A slender species of *Pseudocythere* with well-developed spine(s) and a slightly concave dorsal margin.

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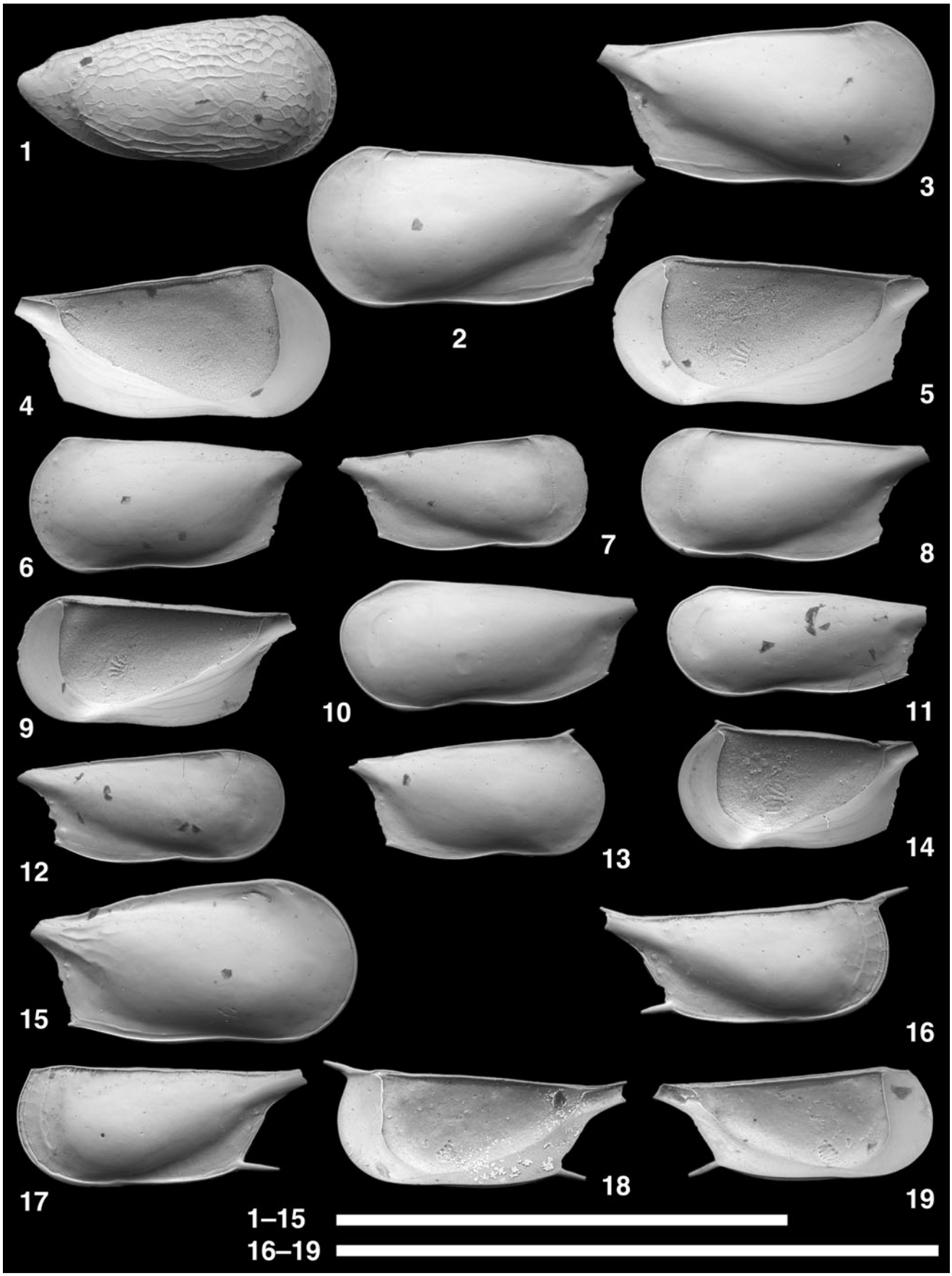

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Figure 4. Scanning electron microscope images of *Pseudocythere* species. (**1**) *Pseudocythere fuegiensis* Brady, 1880, USNM PAL 771643 (ODP925223), adult RV. (**2–14**) *Pseudocythere caudata* Sars, 1866; (**2**) USNM PAL 771644 (ODP925224), adult LV; (**3**) USNM PAL 771645 (ODP925225), adult RV; (**4**) USNM PAL 771646 (ODP925233), adult LV; (**5**) USNM PAL 771647 (ODP925234), adult RV; (**6**) USNM PAL 771648 (ODP925227), adult LV; (**7**) USNM PAL 771649 (ODP925232), adult RV; (**8**) USNM PAL 771650 (ODP925235), adult LV; (**9**) USNM PAL 771651 (ODP925236), adult RV; (**10**) USNM PAL 771652 (ODP925238), adult LV; (**11**) USNM PAL 771653 (ODP925239), adult LV; (**12**) USNM PAL 771654 (ODP925241), adult RV; (**13**) USNM PAL 771655 (ODP925237), adult RV; (**14**) USNM PAL 771656 (ODP925240), adult RV. (**15**) *Pseudocythere* sp. 1, USNM PAL 771657 (ODP925226), adult RV. (**16–19**) *Pseudocythere spinae* n. sp.; (**16**) USNM PAL 771658 (ODP925229), holotype, adult RV; (**17**) USNM PAL 771659 (ODP925228), paratype, adult LV; (**18**) USNM PAL 771660 (ODP925231), paratype, adult RV; (**19**) USNM PAL 771661 (ODP925230), paratype, adult LV. (**1–3**, **6–8**, **10–13**, **15–17**) lateral views; (**4, 5**, **9**, **14**, **18, 19**) internal views. Scale bars = 1 mm.

Description.—Carapace moderately calcified, small in size, height similar throughout because of parallel dorsal and ventral margins. Outline subrectangular in lateral view; anterior margin rounded in ventral half; caudal process well developed, prominent, upturned, bearing a long spine ventrally; dorsal margin straight in LV and slightly concave in RV; ventral margin slightly rounded, but almost straight. Anterodorsal corner angular and bearing a long spine in RV; posterodorsal corner absent. Lateral surface almost smooth, but with pore conuli scattered, very weak reticulation in anterior margin, and a fine, long ridge along dorsal margin. Inner lamella broad. Hingement adont. Frontal scar subrectangular or I-shaped; adductor muscle scars consisting of vertical row of five elongate scars.

Etymology.—From Latin *spinae* (noun, genitive singular) = spine.

Dimensions.—USNM PAL 771658 (ODP925229) (holotype), L = 514 µm, H = 194 µm; USNM PAL 771659 (ODP925228) (paratype), L = 483 µm, H= 199 µm.

Remarks.—*Pseudocythere spinae* n. sp. is similar to *Pseudocythere hastata* Bonaduce et al., 1980 in having a long spine at the anterodorsal corner, but distinguished by having a posteroventral spine and straighter dorsal and ventral margins.

Pseudocythere sp. 1
Figure 4.15

Remarks.—This species is similar to *Pseudoloxoconcha*? sp. of Malz and Jellinek (1994), but it is distinguished by weaker development of carinae on the lateral surface (restricted to the posterior one-fifth of the carapace in this species, but broadly developed in posterior half in *Pseudoloxoconcha*? sp.) and the presence of a flat area along dorsal margin.

Genus *Ruggieriella* Colalongo and Pasini, 1980

Type species.—*Ruggieriella decemcostata* Colalongo and Pasini, 1980.

Ruggieriella mcmanusi Yasuhara, Okahashi, and Cronin, 2009c
Figure 5.1

2009c *Ruggieriella mcmanusi* Yasuhara, Okahashi, and Cronin, p. 892, pl. 4, figs. 1–5.

Holotype.—Adult RV, USNM PAL 537137 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—This is the second report of this species, which originally was described from the Carolina Slope, northwestern Atlantic Ocean.

Family Cytheruridae Müller, 1894
Genus *Aversovalva* Hornibrook, 1952

Type species.—*Cytheropteron* (*Aversovalva*) *aureum* Hornibrook, 1952.

Aversovalva atlantica Whatley and Coles, 1987
Figure 5.2

1983 *Cytheropteron* sp. B Cronin, pl. 8, fig. H.
1987 *Aversovalva atlantica* Whatley and Coles, p. 68, pl. 3, figs. 7–9.
1988 *Aversovalva* sp. 1 Whatley and Ayress, pl. 2, fig. 4a, b.
2005 *Aversovalva atlantica*; Zhao, pl. 2, figs. 9, 10.

Holotype.—RV, OS 12550 (Natural History Museum, London, UK), North Atlantic Ocean, Pleistocene.

Remarks.—This species has been reported both from the Atlantic and Pacific oceans.

Genus *Cytheropteron* Sars, 1866

Type species.—*Cythere latissima* Norman, 1865 (designated by Brady and Norman, 1889; see Horne and Whittaker, 1988, for details and lectotype).

Cytheropteron carolinae Whatley and Coles, 1987
Figure 5.3–5.5

1987 *Cytheropteron carolinae* Whatley and Coles, p. 60, pl. 2, figs. 6, 7, 9.
1996a *Cytheropteron carolinae*; Whatley et al., pl. 1, figs. 13, 14.
1998a *Cytheropteron carolinae*; Whatley et al., pl. 1, figs. 13, 14.
non 1996 *Cytheropteron carolinae*; Cronin, fig. 6a.
non 2000 *Cytheropteron* sp. cf. *C. carolinae* Whatley and Coles; Didié and Bauch, pl. 2, fig. 23.

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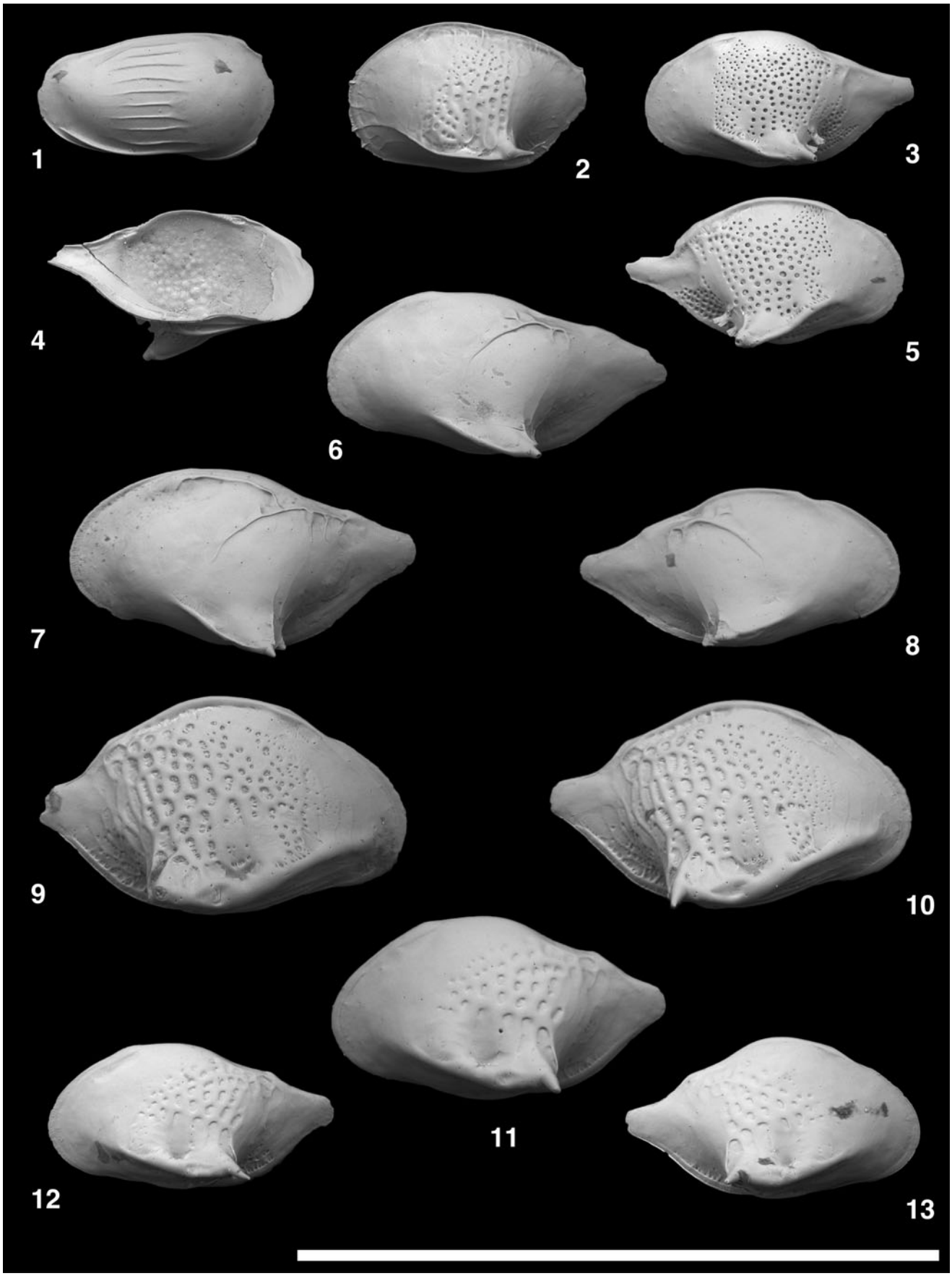

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Figure 5. Scanning electron microscope images of *Ruggieriella*, *Aversovalva*, and *Cytheropteron* species. (**1**) *Ruggieriella mcmanusi* Yasuhara, Okahashi, and Cronin, 2009c, USNM PAL 771662 (ODP925244), adult RV. (**2**) *Aversovalva atlantica* Whatley and Coles, 1987, USNM PAL 771663 (ODP925010), juvenile LV. (**3–5**) *Cytheropteron carolinae* Whatley and Coles, 1987; (**3**) USNM PAL 771664 (ODP925014), adult LV; (**4**) USNM PAL 771665 (ODP925015), adult LV; (**5**) USNM PAL 771666 (ODP925016), adult RV. (**6–8**) *Cytheropteron omega* Aiello, Barra, and Bonaduce, 1996; (**6**) USNM PAL 771667 (ODP925018), adult LV; (**7**) USNM PAL 771668 (ODP925019), adult LV; (**8**) USNM PAL 771669 (ODP925030), adult RV. (**9, 10**) *Cytheropteron porterae* Whatley and Coles, 1987; (**9**) USNM PAL 771670 (ODP925020), juvenile? RV; (**10**) USNM PAL 771671 (ODP925029), adult RV. (**11–13**) *Cytheropteron demenocali* Yasuhara, Okahashi, and Cronin, 2009c; (**11**) USNM PAL 771672 (ODP925021), adult LV; (**12**) USNM PAL 771673 (ODP925242), adult LV; (**13**) USNM PAL 771674 (ODP925243), adult? RV. All lateral views, except (**4**), internal view. Scale bar = 1 mm.

non 2009 *Cytheropteron carolinae*; Alvarez Zarikian, p. 4, pl. P4, fig. 7.

2009c *Cytheropteron carolinae*; Yasuhara et al., p. 900, pl. 7, figs. 8, 9.

2014a *Cytheropteron carolinae* s.l. Whatley and Coles; Yasuhara et al., p. 349, fig. 6.3, 6.4.

2014c *Cytheropteron carolinae*; Yasuhara et al., p. 418, pl. 5, figs. 8, 9, pl. 10, figs. 4, 5.

2018 *Cytheropteron carolinae*; Jöst et al., p. 769, fig. 2.7–2.10.

2019 *Cytheropteron carolinae*; Bergue et al., p. 1502, fig. 3J.

Holotype.—RV, OS 12526 (Natural History Museum, London, UK), North Atlantic Ocean, Pleistocene.

Remarks.—This species has been widely reported from the Atlantic and Arctic oceans.

Cytheropteron omega Aiello, Barra, and Bonaduce, 1996
Figure 5.6–5.8

1987 *Cytheropteron syntomoalatum* Whatley and Coles, pl. 2, fig. 27 (non pl. 2, figs. 25, 26, 28, 29).

1996 *Cytheropteron omega* Aiello, Barra, and Bonaduce, p. 170, pl. 2, figs. 7–9.

2015 *Cytheropteron omega*; Yasuhara and Okahashi, p. 35, fig. 8C–F.

Holotype.—LV, B.O.C. 2151 (Paleontological Department, the University "Federico II" of Napes, Italy), Monte San Nicole Section, Italy, Pliocene.

Remarks.—Our specimens are slightly more slender compared to the type specimens, but are otherwise identical.

Cytheropteron porterae Whatley and Coles, 1987
Figure 5.9, 5.10

1987 *Cytheropteron porterae* Whatley and Coles, p. 64, pl. 2, figs. 21–23.

2000 *Cytheropteron porterae*; Didié and Bauch, p. 110, pl. 2, figs. 19–21.

2009 *Cytheropteron porterae*; Alvarez Zarikian, p. 4, pl. P4, figs. 5, 6.

Holotype.—RV, OS 12536 (Natural History Museum, London, UK), North Atlantic Ocean, Pliocene.

Remarks.—Reliable records of this species (showing specimens with thick alae) are so far known only from the North and equatorial Atlantic Ocean.

Cytheropteron demenocali Yasuhara, Okahashi, and Cronin, 2009c
Figure 5.11–5.13

1999 *Cytheropteron* sp. A Boomer, pl. 3, figs. 18, 19.

?2000 *Cytheropteron* sp. F Zhao, Whatley, and Zhou, p. 278, pl. 4, fig. 24.

2009c *Cytheropteron demenocali* Yasuhara, Okahashi, and Cronin, p. 900, pl. 9, figs. 1–10.

2014 *Cytheropteron demenocali*; Yasuhara and Okahashi, p. 776, fig. 3.3, 3.4.

2015 *Cytheropteron demenocali*; Yasuhara and Okahashi, p. 36, fig. 9C, D.

2015 *Cytheropteron* sp. D Alvarez Zarikian, pl. 3, figs. 7, 8.

2016 *Cytheropteron* sp. C Alvarez Zarikian, p. 103, pl. 1, fig. 4.

2018 *Cytheropteron demenocali*; Jöst et al., p. 769, fig. 2.17–2.26.

2019 *Cytheropteron demenocali*; Yasuhara et al., p. 94, fig. 2E–H.

Holotype.—Adult RV, USNM PAL 536984 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—This species has been reported widely from the Atlantic, Arctic, and Pacific oceans.

Cytheropteron lineoporosa Whatley and Coles, 1987
Figure 6.5–6.7

1987 *Cytheropteron lineoporosa* Whatley and Coles, p. 62, pl. 2, figs. 11–14.

2000 *Cytheropteron lineoporosa*; Didié and Bauch, p. 110, pl. 2, fig. 14.

2009 *Cytheropteron lineoporosa*; Alvarez Zarikian, p. 4, pl. P3, figs. 3, 5.

2018 *Cytheropteron lineoporosa*; Jöst et al., p. 770, fig. 3.10.

non 2019 *Cytheropteron lineoporosa*; Bergue et al., p. 1505, fig. 3L.

Holotype.—RV, OS 12530 (Natural History Museum, London, UK), North Atlantic Ocean, Pleistocene.

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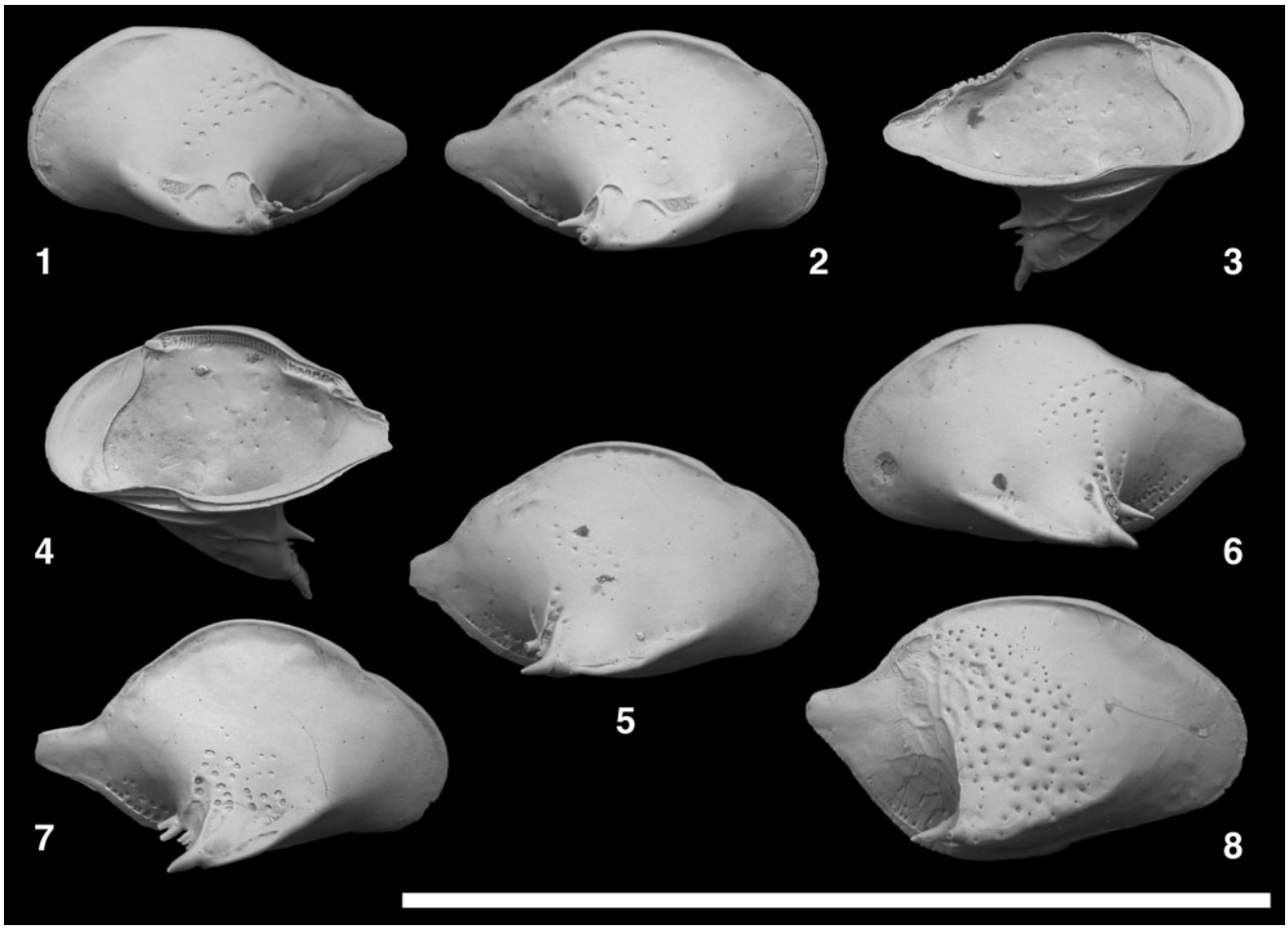

Figure 6. Scanning electron microscope images of *Cytheropteron* species. (**1–4**) *Cytheropteron* cf. *C. lineoporosa* Whatley and Coles, 1987; (**1**) USNM PAL 771675 (ODP925023), adult LV; (**2**) USNM PAL 771676 (ODP925024), adult RV; (**3**) USNM PAL 771677 (ODP925025), adult LV; (**4**) USNM PAL 771678 (ODP925026), adult RV. (**5–7**) *Cytheropteron lineoporosa* Whatley and Coles, 1987; (**5**) USNM PAL 771679 (ODP925027), adult RV; (**6**) USNM PAL 771680 (ODP925028), adult LV; (**7**) USNM PAL 771681 (ODP925017), adult RV. (**8**) *Cytheropteron* sp. 1, USNM PAL 771682 (ODP925022), adult RV. All lateral views, except (**3, 4**), internal views. Scale bar = 1 mm.

Remarks.—The specimens of Figure 6.5, 6.6 have a weak carina close to the posterodorsal corner, which is absent in Figure 6.7 and in the type specimens (Whatley and Coles, 1987).

Cytheropteron cf. *C. lineoporosa* Whatley and Coles, 1987
Figure 6.1–6.4

Remarks.—This species is similar to *Cytheropteron lineoporosa* Whatley and Coles, 1987, but has a carina and punctation in the posterodorsal area close to posterodorsal corner and lacks punctation in the posteroventral area just behind the ala.

Cytheropteron sp. 1
Figure 6.8

Remarks.—We found only one specimen of this species and thus keep this species in open nomenclature, awaiting recovery of additional specimens.

Genus *Eucytherura* Müller, 1894

Type species.—*Cythere complexa* Brady, 1867 (designated by Alexander, 1936).

Eucytherura spinicorona Yasuhara, Okahashi, and Cronin, 2009c
Figure 7.1–7.3

1987 *Eucytherura calabra* (Colalongo and Pasini); Whatley and Coles, p. 91, pl. 3, figs. 14–16.
?1996 *Eucytherura calabra*; Coles et al., p. 137, pl. 3, fig. 18.
2001 *Eucytherura calabra*; Didié and Bauch (as erratum for Didié and Bauch, 2000), p. 104, pl. 1, figs. 9, 10.
2009c *Eucytherura spinicorona* Yasuhara, Okahashi, and Cronin, p. 912, pl. 12, figs. 2–7.

Holotype.—Adult female RV, USNM PAL 537046 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—This species has been recorded from the North Atlantic Ocean.

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Eucytherura calabra (Colalongo and Pasini, 1980)
Figure 7.4–7.6

1980 *Typhloeucytherura calabra* Colalongo and Pasini, p. 122, pl. 20, figs. 1–8, pl. 21, figs. 1, 2.
1983 *Typhloeucytherura* sp. Cronin, pl. 6, fig. C.
1987 *Eucytherura shinzatoensis* Nohara, p. 88, pl. 7, fig. 2a–c.
1987 *Eucytherura calabra* (Colalongo and Pasini); Whatley and Coles, pl. 3, figs. 14–16.
1988 *Eucytherura* sp. 1; Ruan and Hao, p. 291, pl. 49, fig. 18.
1988 *Eucytherura spinosa* Ruan in Ruan and Hao, 1988, p. 289, pl. 49, figs. 15–17.
1988 *Eucytherura calabra*; Whatley and Ayress, pl. 1, fig. 9a, b.
1995 *Eucytherura calabra*; Ayress et al., p. 211, fig. 3A–D.
1996 *Eucytherura calabra*; Ayress, p. 22, pl. 3, figs. 9, 10.
1996 *Eucytherura calabra*; Coles et al., p. 136, pl. 3, fig. 18.
1996 *Eucytherura calabra*; Zhao and Zheng, p. 72, pl. 2, fig. 36.
2001 *Eucytherura calabra*; Didié and Bauch (as erratum of Didié and Bauch, 2000), p. 103, pl. 1, figs. 9, 10.
2015 *Eucytherura calabra*; Yasuhara and Okahashi, p. 38, fig. 10F–H.
?2015 *Eucytherura calabra*; Alvarez Zarikian, pl. 4, figs. 4, 5.
?2015 *Eucytherura* sp. B Alvarez Zarikian, pl. 4, fig. 3.

Holotype.—Female RV, LO.195/a (Istituto di Paleontologia Universita di Bologna, Italy), Vrica coastal section, Italy, Pleistocene.

Remarks.—This species has been widely reported from the Mediterranean Sea and the Atlantic and Pacific oceans.

Eucytherura downingae (Coles and Whatley, 1989)
Figure 7.7–7.10

1987 *Eucytherura* sp. 3 Whatley and Coles, pl. 3, fig. 19.
1988 Gen. et sp. 3 Ruan and Hao, p. 389, pl. 45, fig. 22.
1989 Gen. 1 et sp. Ruan, p. 131, pl. 24, figs. 15, 16.
1989 *Parahemingwayella downingae* Coles and Whatley, p. 91, pl. 2, figs. 14–16.
1991 *Parahemingwayella downingae*; Whatley and Coles, p. 132.
1995 *Eucytherura downingae* (Coles and Whatley); Ayress et al., p. 212, fig. 4E.
?1996 *Parahemingwayella downingae*; Zhao and Zheng, pl. 3, fig. 38.
?1999 *Parahemingwayella downingae*; Boomer, pl. 3, fig.13.
2007 *Parahemingwayella downingae*; Hou and Gou, p. 327, pl. 152, figs. 3–6.

Holotype.—LV, 13186 (Natural History Museum, London, UK), North Atlantic Ocean, Oligocene.

Remarks.—This species is known both from the Atlantic and Pacific oceans with a long stratigraphic range from Eocene to Quaternary.

Eucytherura multituberculata Ayress, Whatley, Downing, and Millson, 1995
Figure 7.15, 7.16

1983 ?*Tuberculocythere* sp. Cronin, pl. 6, fig. A.
1987 *Eucytherura* sp. 2 Whatley and Coles, pl. 3, fig. 18.
1995 *Eucytherura multituberculata* Ayress, Whatley, Downing, and Millson, p. 213, fig. 5A–E.
2009c *Eucytherura* sp. 3 Yasuhara, Okahashi, and Cronin, p. 914, pl. 12, fig. 13.
2015 *Eucytherura multituberculata*; Yasuhara and Okahashi, p. 38, fig. 10I, J.
2015 *Eucytherura multituberculata*; Alvarez Zarikian, pl. 4, fig. 13.

Holotype.—Adult LV, OS 14071 (Natural History Museum, London, UK), southwestern Pacific, Pliocene.

Remarks.—This species has been reported from the North Atlantic and southwestern Pacific oceans.

Genus *Hemiparacytheridea* Herrig, 1963

Type species.—*Hemiparacytheridea occulta* Herrig, 1963.

Hemiparacytheridea zarikiani new species
Figure 7.11–7.14

2015 *Eucytherura* sp. A Alvarez Zarikian, pl. 4, figs. 7, 8.

Holotype.—Adult LV, USNM PAL 771693 (ODP925044) (Fig. 7.11) from the Ceara Rise, western equatorial Atlantic, ODP Site 925C, 1/1/6–8 (ca. 2 ka).

Paratypes.—Adult RV, USNM PAL 771694 (ODP925048) (Fig. 7.12); adult LV, USNM PAL 771695 (ODP925049) (Fig. 7.13); adult RV, USNM PAL 771696 (ODP925050) (Fig. 7.14).

Diagnosis.—A moderately calcified *Hemiparacytheridea* species with a subtriangular outline, well-developed caudal process, weakly punctate carapace, and thin ventrolateral ridge while lacking large tubercles.

Description.—Carapace moderately calcified, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded, weakly rimmed; caudal process well developed and subtriangular, pointed at mid-height; dorsal and ventral margins slightly sinuous. Anterodorsal corner moderately angular in LV, weakly angular in RV; posterodorsal corner almost straight and slightly convex. Lateral surface ornamented with weak punctation in the central part and smooth in the posterior and anterior margins; sizes of puncta increase posteriorly; ventrolateral lateral ridge weakly curved, bearing a spine at its posterior end; normal

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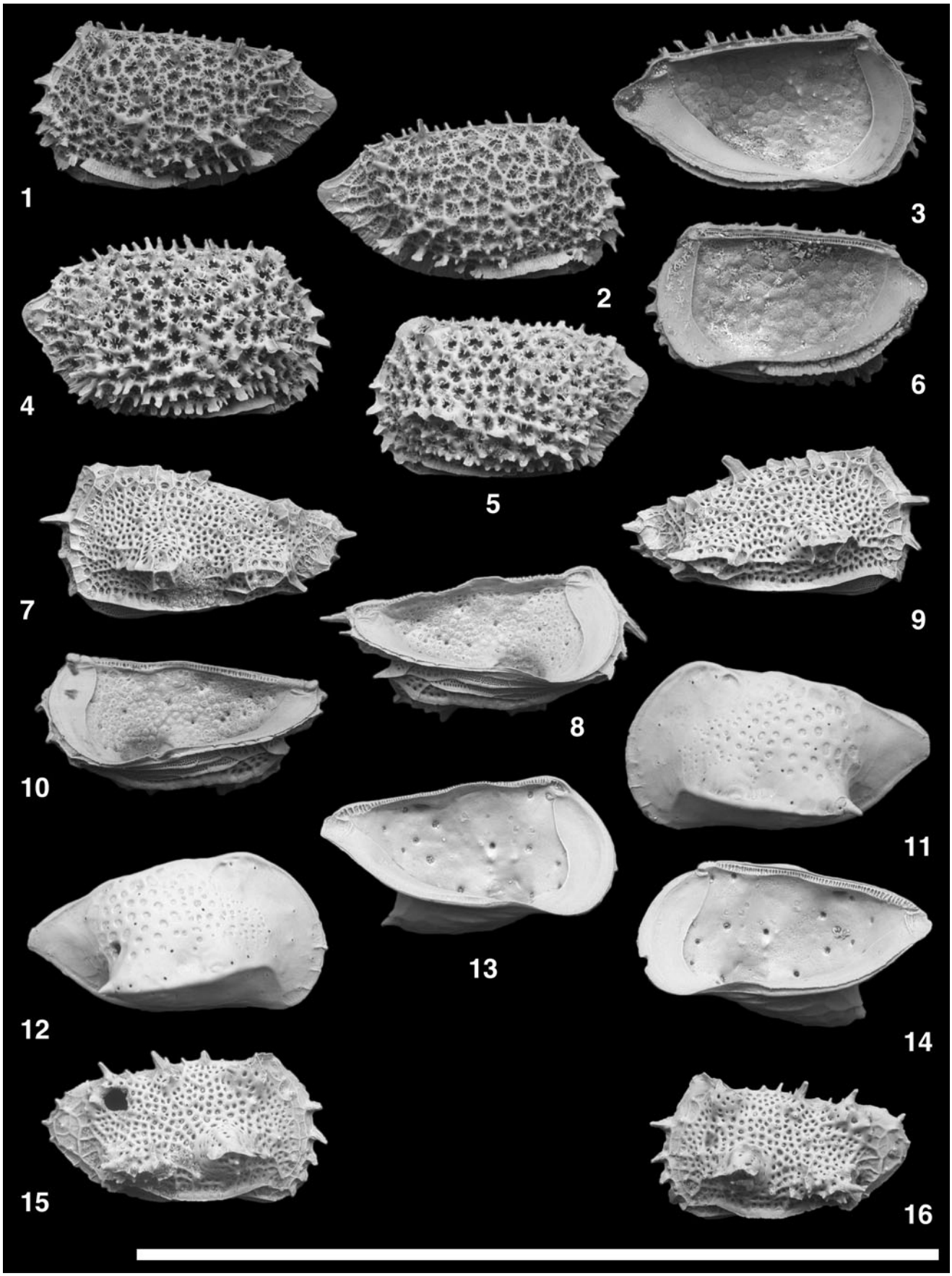

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Figure 7. Scanning electron microscope images of *Eucytherura* and *Hemiparacytheridea* species. (**1–3**) *Eucytherura spinicorona* Yasuhara, Okahashi, and Cronin, 2009c; (**1**) USNM PAL 771683 (ODP925033), adult? LV; (**2**) USNM PAL 771684 (ODP925034), adult? RV; (**3**) USNM PAL 771685 (ODP925035), adult? LV. (**4–6**) *Eucytherura calabra* (Colalongo and Pasini, 1980); (**4**) USNM PAL 771686 (ODP925036), adult RV; (**5**) USNM PAL 771687 (ODP925037), adult LV; (**6**) USNM PAL 771688 (ODP925038), adult RV. (**7–10**) *Eucytherura downingae* (Coles and Whatley, 1989); (**7**) USNM PAL 771689 (ODP925039), adult LV; (**8**) USNM PAL 771690 (ODP925042), adult LV; (**9**) USNM PAL 771691 (ODP925040), adult RV; (**10**) USNM PAL 771692 (ODP925041), adult RV. (**11–14**) *Hemiparacytheridea zarikiani* n. sp.; (**11**) USNM PAL 771693 (ODP925044), holotype, adult LV; (**12**) USNM PAL 771694 (ODP925048), paratype, adult RV; (**13**) USNM PAL 771695 (ODP925049), paratype, adult LV; (**14**) USNM PAL 771696 (ODP925050), paratype, adult RV. (**15, 16**) *Eucytherura multituberculata* Ayress et al., 1995; (**15**) USNM PAL 771697 (ODP925046), adult RV; (**16**) USNM PAL 771698 (ODP925043), adult LV. (**1, 2, 4, 5, 7, 9, 11, 12, 15, 16**) lateral views; (**3, 6, 8, 10, 13, 14**) internal views. Scale bar = 1 mm.

pores scattered. Internal features as for genus. Hingement typical of genus, lacking posterior terminal tooth in RV.

Etymology.—In honor of Carlos A. Alvarez Zarikian, Texas A&M University, for his work on Cenozoic deep-sea ostracodes. He first recognized this species.

Dimensions.—USNM PAL 771693 (ODP925044) (holotype), L = 379 µm, H = 209 µm; USNM PAL 771694 (ODP925048) (paratype), L = 375 µm, H= 199 µm.

Remarks.—*Hemiparacytheridea zarikiani* n. sp. is similar to *Hemiparacytheridea vanharteni* Ayress et al., 1995 in having a subtriangular outline and relatively smooth lateral surface, but distinguished by having punctation and lacking any large tubercle on its lateral surface.

Genus *Pedicythere* Eagar, 1965

Type species.—*Pedicythere tessae* Eagar, 1965.

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

Pedicythere atroposopetasi Yasuhara, Okahashi, and Cronin, 2009c
Figure 8.1, 8.2

?2000 *Pedicythere* sp. B Guernet and Bellier, p. 270, pl. 5, fig. 3.
2009c *Pedicythere atroposopetasi* Yasuhara, Okahashi, and Cronin, p. 914, pl. 15, figs. 1–13.
2015 *Pedicythere atroposopetasi*; Yasuhara and Okahashi, p. 39, figs. 11F–I, 12A–D.

Holotype.—Adult LV, USNM PAL 537011 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—This species is known both from the northwestern and northeastern Atlantic Ocean.

Pedicythere canis new species
Figure 9.5–9.8

Holotype.—Adult RV, USNM PAL 771712 (ODP925199) (Fig. 9.5, 9.6) from the Ceara Rise, western equatorial Atlantic, ODP Site 925D, 1/4/137–139 (ca. 197 ka).

Paratype.—Adult LV, USNM PAL 771713 (ODP925195) (Fig. 9.7, 9.8).

Diagnosis.—A small, weakly calcified *Pedicythere* species with a denticulate dorsal margin, a hand-shaped process at the anterior cardinal angle (of RV), feather-like posteroventral and ventrolateral processes, and an ala with a very well-developed anterior carina.

Description.—Carapace thin, small, highest at anterior cardinal angle. Outline subtriangular in lateral view; anterior margin rounded, bearing five spines; caudal process prominent and upturned, bearing a feather-like posteroventral process; dorsal margin denticulate, straight in RV, slightly convex in LV. Alae extending below ventral margin, bearing very well-developed anterior carina; three fine carinae running on and along ala. Anterodorsal corner bearing a hand-shaped process at the anterior cardinal angle; posterodorsal corner absent. Lateral surface smooth, with normal pores scattered. Internal features as for genus.

Etymology.—From Latin *canis* (noun, genitive singular), meaning 'dog,' referring to the lateral view that looks like a dog face. Hand-shaped process at the anterior cardinal angle, caudal process, and posteroventral and ventrolateral processes and ala as ear, nose, and beard of a dog, respectively.

Dimensions.—USNM PAL 771712 (ODP925199) (holotype), L = 496 µm, H = 210 µm; USNM PAL 771713 (ODP925195) (paratype), L = 477 µm, H= 221 µm.

Remarks.—*Pedicythere canis* n. sp. is distinguished from other *Pedicythere* species (e.g., Schornikov, 2005; Yasuhara et al., 2009c) by having a hand-shaped process at the anterior cardinal angle, a denticulate dorsal margin, and three fine carinae running on and along the ala. Note that the hand-shaped process of anterior cardinal angle seems to be broken in one of our specimens (Fig. 9.7, 9.8).

Pedicythere kennettopetasi Yasuhara, Okahashi, and Cronin, 2009c
Figure 8.3–8.16

2000 *Pedicythere* sp. A Guernet and Bellier, p. 270, pl. 5, fig. 2 (non fig. 1).
2009c *Pedicythere kennettopetasi* Yasuhara, Okahashi, and Cronin, p. 916, pl. 16, figs. 1–10.
2015 *Pedicythere kennettopetasi*; Yasuhara and Okahashi, p. 39, fig. 13E, F.

Holotype.—Adult RV, USNM PAL 537023 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

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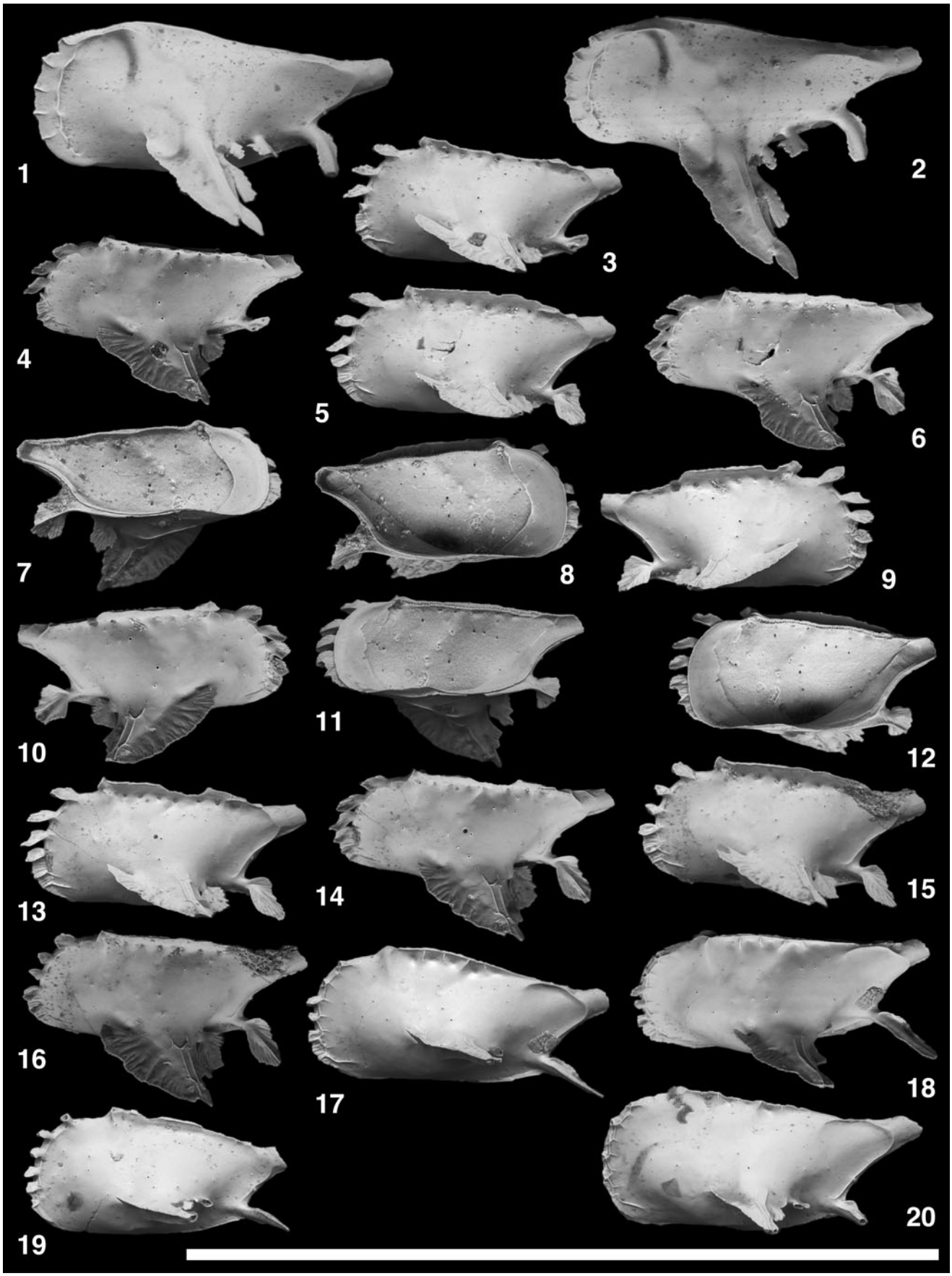

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Figure 8. Scanning electron microscope images of *Pedicythere* species. (**1, 2**) *Pedicythere atroposopetasi* Yasuhara, Okahashi, and Cronin, 2009c, USNM PAL 771699 (ODP925198), adult LV. (**3–16**) *Pedicythere kennettopetasi* Yasuhara, Okahashi, and Cronin, 2009c; (**3, 4**) USNM PAL 771700 (ODP925183), adult LV; (**5, 6**) USNM PAL 771701 (ODP925187), adult LV; (**7, 8**) USNM PAL 771702 (ODP925188), adult LV; (**9, 10**) USNM PAL 771703 (ODP925192), adult RV; (**11, 12**) USNM PAL 771704 (ODP925193), adult RV; (**13, 14**) USNM PAL 771705 (ODP925196), adult LV; (**15, 16**) USNM PAL 771706 (ODP925200), adult LV. (**17–20**) *Pedicythere* cf. *P. kennettopetasi* Yasuhara, Okahashi, and Cronin, 2009c; (**17, 18**) USNM PAL 771707 (ODP925191), adult LV; (**19**) USNM PAL 771708 (ODP925185), adult LV; (**20**) USNM PAL 771709 (ODP925184), adult LV. (**1–6, 9, 10, 13–20**) lateral views; (**7, 8, 11, 12**) internal views; (**2, 4, 6, 7, 10, 11, 14, 16, 18**) oblique views. Scale bar = 1 mm.

Remarks.—This species is known both from the northwestern and northeastern Atlantic Ocean.

Pedicythere cf. *P. kennettopetasi* Yasuhara, Okahashi, and Cronin, 2009c
Figures 8.17–8.20, 9.1–9.4

Remarks.—This species is very similar to *Pedicythere kennettopetasi* Yasuhara, Okahashi, and Cronin, 2009c, but the blade-like carina at the anterior edge of the ala is less developed in this species.

Pedicythere lachesisopetasi Yasuhara, Okahashi, and Cronin, 2009c
Figure 9.12, 9.13

1983 *Pedicythere* sp. A Cronin, p. 110, pl. 4H.
2008 *Pedicythere* sp. Bergue and Coimbra, p. 130, pl. 6, fig. 13.
2009c *Pedicythere lachesisopetasi* Yasuhara, Okahashi, and Cronin, p. 918, pl. 16, figs. 11–21.
2015 *Pedicythere lachesisopetasi*; Yasuhara and Okahashi, p. 40, figs. 12E–J, 13A–D.

Holotype.—Adult LV, USNM PAL 537025 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—Like *Pedicythere atroposopetasi* Yasuhara, Okahashi, and Cronin, 2009c and *Pedicythere kennettopetasi* Yasuhara, Okahashi, and Cronin, 2009c, this species is also known both from the northwestern and northeastern Atlantic Ocean.

Pedicythere sp. 1
Figure 9.9–9.11

Remarks.—This rare species is kept in open nomenclature in this study.

Pedicythere sp. 2
Figure 9.14, 9.15

Remarks.—This rare species is kept in open nomenclature in this study.

Genus *Rimacytheropteron* Whatley and Coles, 1987

Type species.—*Monoceratina longipunctata* Breman, 1976.

Rimacytheropteron longipunctatum (Breman, 1976)
Figure 10.1

1976 *Monoceratina longipunctata* Breman, p. 15, pl. 1, figs. 4a, b, pl. 2, figs. 4c–i.
1976 '*Pedicythere' tessellata* Bonaduce, Ciampo, and Masoli, p. 88, pl. 36, figs. 12–15.
1987 *Rimacytheropteron longipunctata* (Breman); Whatley and Coles, p. 70, pl. 3, figs. 12, 13.
1996 *Rimacytheropteron longipunctata*; Zhao and Zheng, pl. 4, fig. 29.
2000 *Rimacytheropteron longipunctatum*; Aiello et al., p. 97, pl. 3, fig. 11.
2000 *Rimacytheropteron longipunctata*; Didié and Bauch, p. 115, pl. 4, fig. 26.
2004 *Rimacytheropteron longipunctatum*; Aiello and Szczechura, p. 56, pl. 14, figs. 7, 8.
2006 *Rimacytheropteron longipunctatum*; Bergue et al., p. 207, fig. 7M.
2008 *Rimacytheropteron longipunctatum*; Bergue and Coimbra, p. 133, pl. 7, fig. 12.
2009 *Rimacytheropteron longipunctatum*; Alvarez Zarikian, p. 4, pl. P3, fig. 8.
2009c *Rimacytheropteron longipunctatum*; Yasuhara et al., p. 918, pl. 14, figs. 1–5.
2015 *Rimacytheropteron longipunctatum*; Alvarez Zarikian, pl. 3, fig. 13.

Holotype.—Adult LV, EB-NS-118-1 (Paleontological Department, Instituut voor Aardwetenschappen, Vrije Universiteit, Netherlands), Adriatic Sea, Holocene.

Remarks.—This species is widely known from the Mediterranean Sea and Atlantic and Pacific oceans.

Genus *Semicytherura* Wagner, 1957

Type species.—*Cythere nigrescens* Baird, 1838.

Remarks.—Following Ayress and Correge (1992), we consider *Mayburya* Coles and Whatley as a junior synonym of *Semicytherura* Wagner, 1957. Internal views of well-preserved specimens of the type species of *Mayburya*, i.e., *Semicytherura pulchra* (Coles and Whatley, 1989) (Fig. 10.3, 10.5) clearly show typical characters of *Semicytherura* including very broad inner lamella.

Semicytherura pulchra (Coles and Whatley, 1989)
Figure 10.2–10.5

1986 *Trinacriacythere cornuta* Ciampo, p. 104, pl. 15, figs. 1–4, pl. 18, fig. 6.

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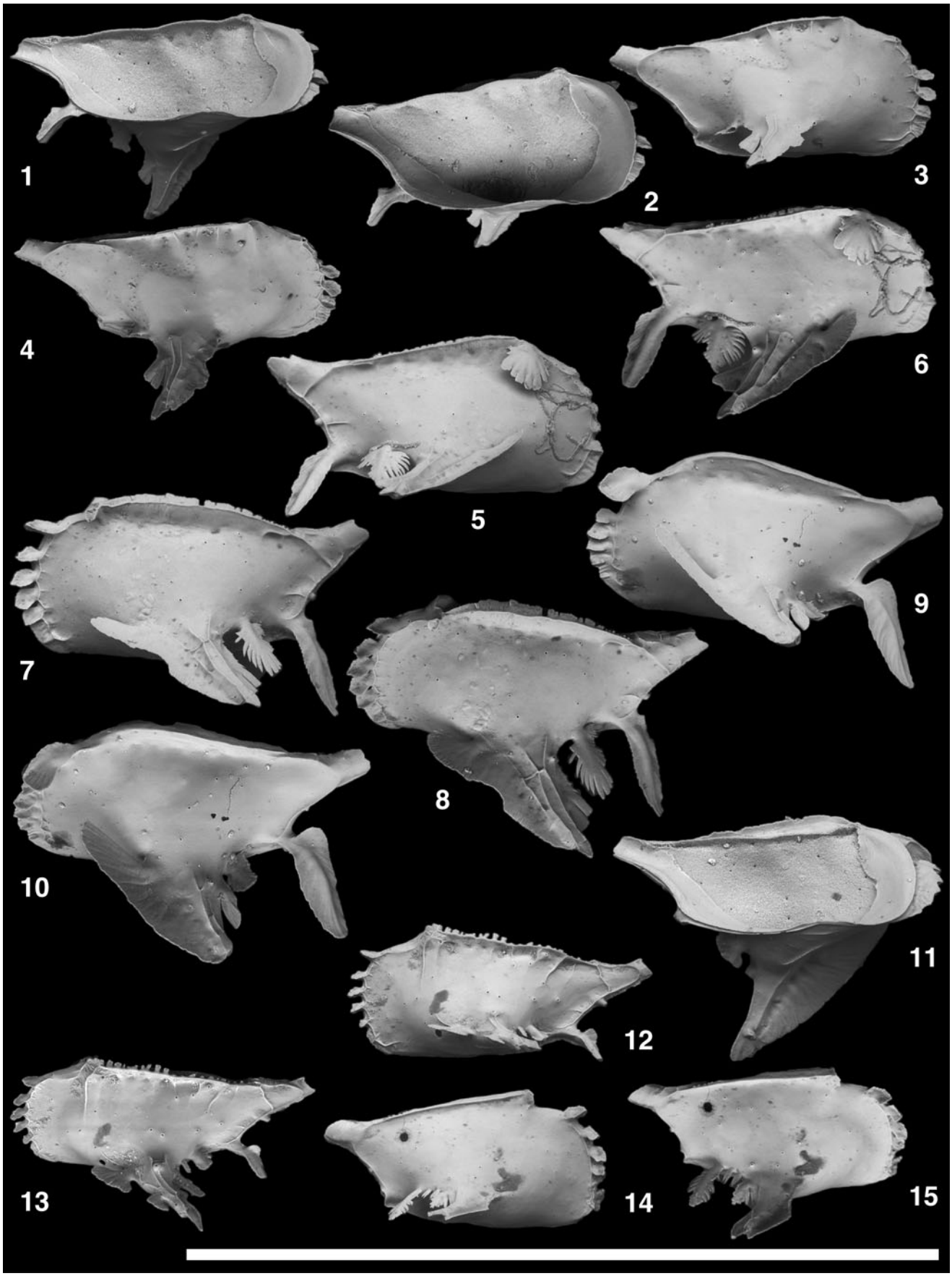

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Figure 9. Scanning electron microscope images of *Pedicythere* species. (**1–4**) *Pedicythere* cf. *P. kennettopetasi* Yasuhara, Okahashi, and Cronin, 2009c; (**1, 2**) USNM PAL 771710 (ODP925194), adult LV; (**3, 4**) USNM PAL 771711 (ODP925201), adult RV. (**5–8**) *Pedicythere canis* n. sp.; (**5, 6**) USNM PAL 771712 (ODP925199), holotype, adult RV; (**7, 8**) USNM PAL 771713 (ODP925195), paratype, adult LV. (**9–11**) *Pedicythere* sp. 1; (**9, 10**) USNM PAL 771714 (ODP925189), adult LV; (**11**) USNM PAL 771715 (ODP925190), adult LV. (**12, 13**) *Pedicythere lachesisopetasi* Yasuhara, Okahashi, and Cronin, 2009c, USNM PAL 771716 (ODP925186), adult LV. (**14, 15**) *Pedicythere* sp. 2, USNM PAL 771717 (ODP925197), adult RV. (**3–10, 12–15**) lateral views; (**1, 2, 11**) internal views; (**1, 4, 6, 8, 10, 11, 13, 15**) oblique views. Scale bar = 1 mm.

1988 *Rostrocythere*? sp. Whatley and Ayress, pl. 1, figs. 2, 3.
1989 *Mayburya pulchra* Coles and Whatley, p. 87, pl. 1, figs. 5–7.
1992 *Semicytherura pulchra* (Coles and Whatley); Ayress and Correge, p. 57, pl. 19.
1996 *Mayburya pulchra*; Zhao and Zheng, pl. 3, fig. 18.
non 1998b *Semicytherura pulchra*; Whatley et al., p. 124, pl. 3, fig. 21.
1999 *Semicytherura* cf. *S. pulchra* (Coles and Whatley); Boomer, pl. 3, figs. 12, 15.
2000 *Semicytherura pulchra*; Didié and Bauch, p. 111, pl. 4, fig. 9.
2015 *Semicytherura pulchra*; Alvarez Zarikian, p. 138, pl. 4, fig. 15.

Holotype.—RV, 13168 (Natural History Museum, London, UK), North Atlantic, Oligocene.

Remarks.—The name *Semicytherura cornuta* (Ciampo, 1986) is a junior homonym of *Semicytherura cornuta* (Brady, 1868a), and thus cannot be used for this species (Ayress and Correge, 1992).

Semicytherura coeca Ciampo, 1986
Figure 10.6–10.9

1980 *Semicytherura* sp. 3 Ciampo, pl. 2, fig. 5.
1986 *Semicytherura coeca* Ciampo, p. 95, pl. 7, fig. 7.
?1988 *Semicytherura prona* Ruan in Ruan and Hao, 1988, p. 304, pl. 53, figs. 21–24.
1995 *Semicytherura coeca*; Ayress, p. 901.
1996 *Semicytherura coeca*; Ayress, p. 25, pl. 4, fig. 9.
1996 *Semicytherura coeca*; Coles et al., p. 151, pl. 2, figs. 7, 8.

Holotype.—LV, COC no. 520 (Dipartamento della Scienze della Terra, Universita di Napoli, Italy), Santa Agata Fossili, Italy, Miocene.

Remarks.—*Semicytherura prona* Ruan in Ruan and Hao, 1988 is almost identical to *Semicytherura coeca* Ciampo, 1986, except for the presence of a spine on the posterior end of the ventrolateral ridge that the type specimen of *Semicytherura coeca* and our specimens do not have. We are not sure if *Semicytherura coeca* and *Semicytherura prona* are conspecific.

Genus *Xylocythere* Maddocks and Steineck, 1987

Type species.—*Xylocythere turnerae* Maddocks and Steineck, 1987.

Xylocythere denticulata new species
Figure 10.12–10.15

?1990 *Xylocythere* sp. 5 Steineck et al., pl. 1, fig. 6, pl. 2, fig. 5.

Holotype.—Adult LV, USNM PAL 771725 (ODP925251) (Fig. 10.12) from the Ceara Rise, western equatorial Atlantic, ODP Site 925C, 1/3/27–29 (ca. 78 ka).

Paratypes.—Adult RV, USNM PAL 771726 (ODP925252) (Fig. 10.13); adult LV, USNM PAL 771727 (ODP925253) (Fig. 10.14); adult RV, USNM PAL 771728 (ODP925254) (Fig. 10.15).

Diagnosis.—A species of *Xylocythere* ornamented with denticulation.

Description.—Carapace well calcified, medium in size, highest at anterior cardinal angle. Outline subrectangular-oval in lateral view; anterior margin evenly rounded in ventral half, bearing short spines but straighter and smoother in dorsal half; posterior margin upturned; dorsal margin weakly sinuous and ventral margin almost straight. Anterodorsal and posterodorsal corners angular. Lateral surface ornamented with well-developed primary and secondary reticulation; denticulation on muri; a posteroventoral spine; pore conuli scattered on muri; and a fine ridge running along ventral margin. Anterior marginal rim and sulcus present. Inner lamella broad. Hingement merodont type. Frontal scar divided; adductor muscle scars consisting of vertical row of four elongate scars.

Etymology.—From Latin *denticulata* (adjective, nominative singular, gender feminine), referring to denticulate muri.

Dimensions.—USNM PAL 771725 (ODP925251) (holotype), L = 642 µm, H = 350 µm; USNM PAL 771727 (ODP925253) (paratype), L = 655 µm, H = 328 µm.

Remarks.—*Xylocythere denticulata* n. sp. is distinguished from other *Xylocythere* species by having well-developed denticulation on the lateral surface. This species is similar to *Xylocythere* sp. of Yasuhara et al. (2009c), but is distinguished by its much stronger primary reticulation and denticulation on the lateral surface. *Xylocythere* is known from wood-fall and chemosynthetic environments (Maddocks and Steineck, 1987; Steineck et al., 1990; Tanaka et al., 2019). It is uncertain whether *Xylocythere denticulata* n. sp. is a *Xylocythere* species adapted to the normal soft-sediment environment or if the presence of this species suggests a wood-fall environment nearby, especially given low abundance of this species in the studied site.

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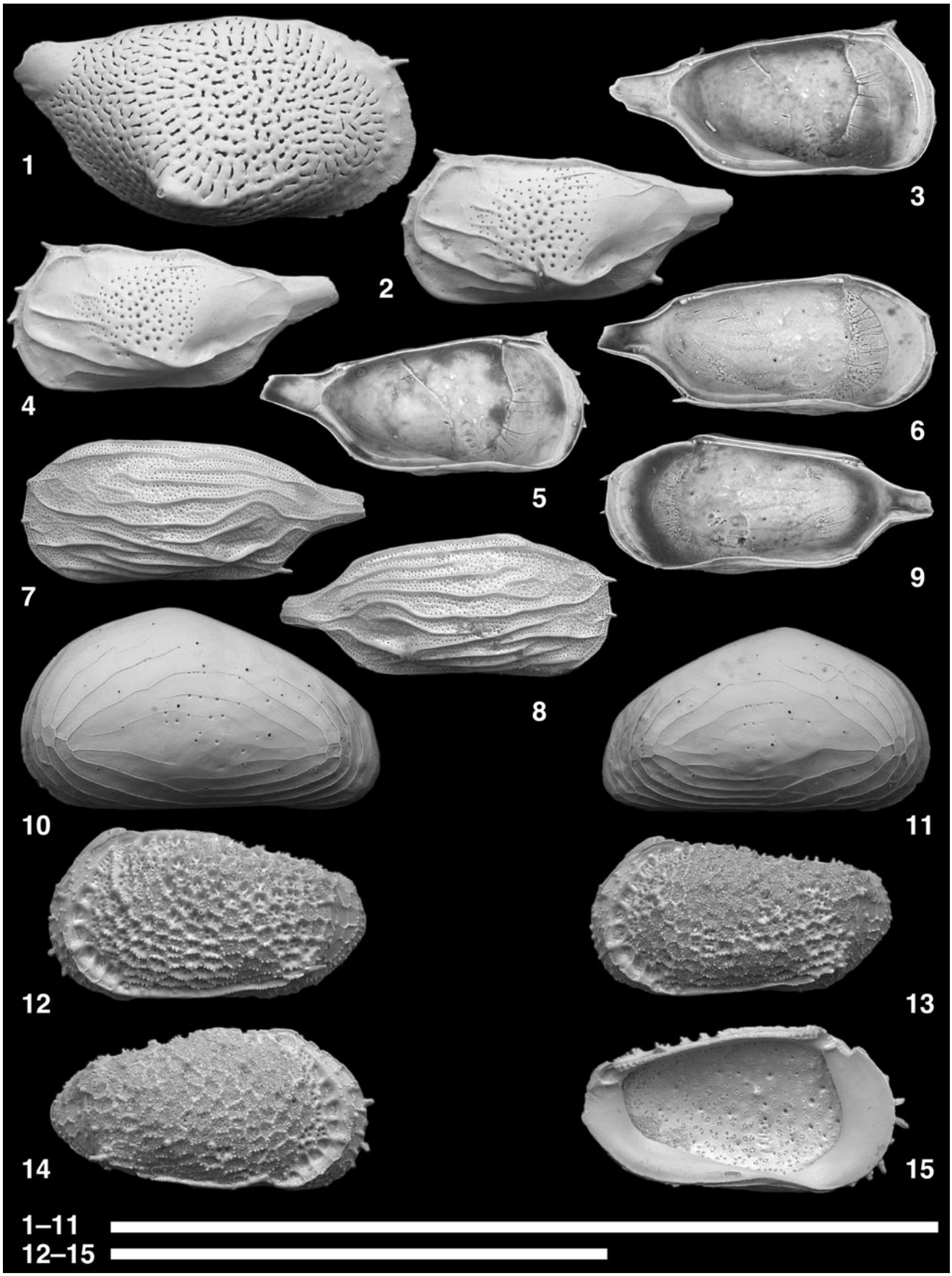

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Figure 10. Scanning electron microscope images of *Rimacytheropteron*, *Semicytherura*, *Eucythere*, and *Xylocythere* species. (**1**) *Rimacytheropteron longipunctatum* (Breman, 1976), USNM PAL 771718 (ODP925245), adult RV. (**2–5**) *Semicytherura pulchra* (Coles and Whatley, 1989); (**2, 3**) USNM PAL 771719 (ODP925045), adult LV; (**4, 5**) USNM PAL 771720 (ODP925047), adult LV. (**6–9**) *Semicytherura coeca* Ciampo, 1986; (**6, 7**) USNM PAL 771721 (ODP925255), adult LV; (**8, 9**) USNM PAL 771722 (ODP925256), adult RV. (**10, 11**) *Eucythere pubera* Bonaduce, Ciampo, and Masoli, 1976; (**10**) USNM PAL 771723 (ODP925031), juvenile? LV; (**11**) USNM PAL 771724 (ODP925032), juvenile RV. (**12–15**) *Xylocythere denticulata* n. sp.; (**12**) USNM PAL 771725 (ODP925251), holotype, adult LV; (**13**) USNM PAL 771726 (ODP925252), paratype, adult LV; (**14**) USNM PAL 771727 (ODP925253), paratype, adult RV; (**15**) USNM PAL 771728 (ODP925254), paratype, adult LV. (**1, 2, 4, 7, 8, 10–14**) lateral views; (**3, 5, 6, 9, 15**) inner views. Scale bars = 1 mm.

Family Eucytheridae Puri, 1954
Genus *Eucythere* Brady, 1868a

Type species.—*Cythere declivis* Norman, 1867 (designated by Brady and Norman,1889; see Horne and Whittaker, 1985, for details and lectotype).

Eucythere pubera Bonaduce, Ciampo, and Masoli, 1976
Figure 10.10, 10.11

1976 *Eucythere pubera* Bonaduce, Ciampo, and Masoli, p. 64, text-fig. 28, pl. 37, figs. 1–8.
1983 *Eucythere* (*Eucythere*) *parapubera* Whatley and Downing, p. 366, pl. 3, figs. 19–21.
1987 *Eucythere pubera*; Whatley and Coles, p. 93, pl. 4, fig. 15.
1988 *Eucythere parapubera* Whatley and Downing; Whatley and Ayress, p. 740, pl. 1, fig. 4a, b.
1988 *Eucythere serrata* Zhao in Wang et al., p. 238, fig. 5.75, pl. 39, figs. 11–16.
1993 *Pseudeucythere parapubera* (Whatley and Downing); McKenzie et al., p. 88, pl. 2, figs. 23, 24.
?1995 *Eucythere* cf. *parapubera* Whatley and Downing; Ayress, fig. 5.11.
2000 *Eucythere pubera*; Aiello et al., p. 97, pl. 3, fig. 12.
2000 *Eucythere pubera*; Didié and Bauch, p. 116, pl. 3, fig. 23.
2005 *Eucythere pubera*; Zhao, p. 41, pl. 3, fig. 8.
2007 *Eucythere serrata*; Hou and Gou, p. 252, pl. 94, figs. 5–7.
2009 *Eucythere pubera*; Alvarez Zarikian, p. 4, pl. P6, fig. 3.
2014 *Eucythere pubera*; Yasuhara and Okahashi, p. 780, fig. 6.1.

Holotype.—LV, no. 233 (Zoological Station of Naples, Italy), Adriatic Sea, Recent.

Remarks.—This species is widely known from the Mediterranean Sea and the Atlantic and Pacific oceans.

Family Krithidae Mandelstam in Bubikyan, 1958
Genus *Krithe* Brady, Crosskey, and Robertson, 1874

Type species.—*Ilyobates praetexta* Sars, 1866.

Remarks.—*Krithe* is the dominant genus in this core, including *Krithe trinidadensis* van den Bold, 1958; *Krithe minima* Coles, Whatley, and Moguilevsky, 1994; *Krithe lamellata* Coles, Whatley, and Moguilevsky, 1994; *Krithe reversa* van den Bold, 1958; and other species. We follow the taxonomic scheme of Coles et al. (1994), but the detailed taxonomy of this genus will be discussed elsewhere.

Family Paracytheridae Puri, 1974
Genus *Chejudocythere* Ishizaki, 1981

Type species.—*Chejudocythere higashikawai* Ishizaki, 1981.

Chejudocythere subtriangulata Hao in Ruan and Hao, 1988
Figure 11.1, 11.2

1988 *Chejudocythere subtriangulata* Hao in Ruan and Hao, p. 251, pl. 39, figs. 20–23.

Holotype.—LV, 40330 (repository unknown), Okinawa Trough, northwestern Pacific, Quaternary.

Remarks.—This species originally was described from the northwestern Pacific Ocean.

Family Paradoxostomatidae Brady and Norman, 1889
Genus *Paracytherois* Müller, 1894

Type species.—*Paracytherois striata* Müller, 1894 (designated by Howe, 1955; he considered this species a junior synonym of *Paradoxostoma flexuosum* [Brady, 1868b] [sic: correctly, *Bythocythere*? *flexuosa* Brady, 1867]; see Ellis and Messina Catalogue at www.micropress.org/em).

Paracytherois bondi Yasuhara, Okahashi, and Cronin, 2009c
Figures 11.3–11.20, 12.1–12.3

2009c *Paracytherois bondi* Yasuhara, Okahashi, and Cronin, p. 924, pl. 19, figs. 5–10, 15 (?12).
2015 *Paracytherois bondi*; Yasuhara and Okahashi, p. 44, fig. 15B, C.

Holotype.—Adult RV, USNM PAL 537066 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—This species may be conspecific with *Paracytherois striata* Mueller, 1894, but detailed comparison is difficult because only a sketch is available for *Paracytherois striata*. Therefore, we prefer to call this species *Paracytherois bondi* Yasuhara, Okahashi, and Cronin, 2009c, at least for now.

Paracytherois obtusa new species
Figure 12.4–12.12

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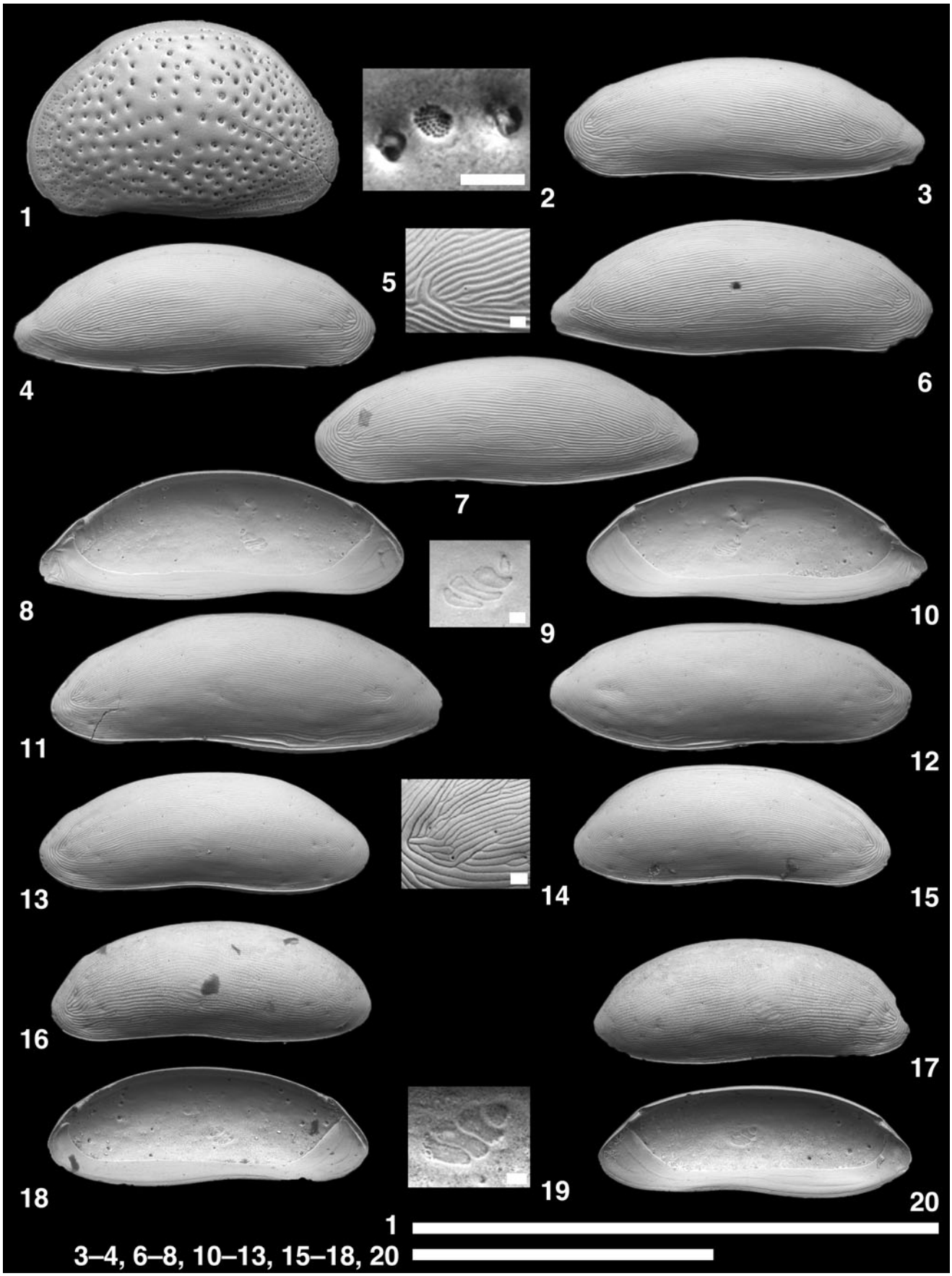

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Figure 11. Scanning electron microscope images of *Chejudocythere* and *Paracytherois* species. (**1, 2**) *Chejudocythere subtriangulata* Hao in Ruan and Hao, 1988, USNM PAL 771729 (ODP925260), adult LV. (**3–20**) *Paracytherois bondi* Yasuhara, Okahashi, and Cronin, 2009c; (**3**) USNM PAL 771730 (ODP925151), adult LV; (**4**) USNM PAL 771731 (ODP925152), adult RV; (**5, 6**) USNM PAL 771732 (ODP925154), adult RV; (**7**) USNM PAL 771733 (ODP925153), adult LV; (**8**) USNM PAL 771734 (ODP925155), adult LV; (**9, 10**) USNM PAL 771735 (ODP925156), adult RV; (**11**) USNM PAL 771736 (ODP925157), adult LV; (**12**) USNM PAL 771737 (ODP925158), adult RV; (**13, 14**) USNM PAL 771738 (ODP925164), adult LV; (**15**) USNM PAL 771739 (ODP925165), adult RV; (**16**) USNM PAL 771740 (ODP925166), adult LV; (**17**) USNM PAL 771741 (ODP925167), adult RV; (**18**) USNM PAL 771742 (ODP925168), adult LV; (**19, 20**) USNM PAL 771743 (ODP925169), adult RV. (**1–7, 11–17**) lateral views; (**8–10, 18–20**) internal views; (**2**) closeup of a sieve-type pore; (**5, 14**) closeup of fine striations; (**9, 19**) closeup of subcentral muscle scars. Scale bars of closeup views (**2, 5, 9, 14, 19**) = 10 µm; scale bars for the other images (**1, 3, 4, 6–8, 10–13, 15–18, 20**) = 0.5 mm.

Holotype.—Adult female? LV, USNM PAL 771748 (ODP925174) (Fig. 12.5, 12.6) from the Ceara Rise, western equatorial Atlantic, ODP Site 925C, 1/1/6–8 (ca. 2 ka).

Paratypes.—Adult male? LV, USNM PAL 771747 (ODP925170) (Fig. 12.4); adult female? RV, USNM PAL 771749 (ODP925175) (Fig. 12.7); adult male? RV, USNM PAL 771750 (ODP925176) (Fig. 12.8); adult female? LV, USNM PAL 771751 (ODP925177) (Fig. 12.9); adult female? RV, USNM PAL 771752 (ODP925178) (Fig. 12.10, 12.11); adult male? LV, USNM PAL 771753 (ODP925179) (Fig. 12.12).

Diagnosis.—A small, weakly calcified *Paracytherois* species, elongate in lateral view; posterior margin obtuse and rounded; 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 and pointed at mid height; posterior margin obtuse and rounded; dorsal margin slightly arched; ventral margin concave. Anterodorsal and posterodorsal corners rounded. Lateral surface covered with very fine, horizontal striations. Internal features as for genus. Adductor muscle scars consisting of vertical row of four scars; the dorsal scar is small and rounded, with the others elongated.

Etymology.—From Latin *obtusa* (adjective, nominative singular, gender feminine), referring to obtuse and rounded posterior margin.

Dimensions.—USNM PAL 771748 (ODP925174) (holotype), L = 580 µm, H = 240 µm; USNM PAL 771749 (ODP925175) (paratype), L = 574 µm, H = 248 µm.

Remarks.—*Paracytherois obtusa* n. sp. is distinguished from other *Paracytherois* species by having a non-acuminate posterior margin.

Paracytherois productum (Brady and Norman, 1889)
Figure 12.13–12.16

1889 *Paradoxostoma productum* Brady and Norman, p. 236, pl. 21, figs. 9, 10.
1993 ?*Paracytherois* sp. 1 Corrége, pl. 1, fig. 5.
2000 *Paracytherois* sp. Didié and Bauch, p. 115, pl. 4, fig. 14.
2009c *Paracytherois productum* (Brady and Norman); Yasuhara et al., p. 924, pl. 19, figs. 1–4 (?11).
2017 *Paracytherois bondi* (Brady and Norman) [sic.]; Jöst et al., fig. 3.23.

Holotype.—Unknown. Type locality is the Bergen Fjord, Norway, Recent.

Remarks.—Our specimens are identical to the original sketch of the lateral view of *Paracytherois productum* (Brady and Norman, 1889).

Family Thaerocytheridae Hazel, 1967
Genus *Poseidonamicus* Benson, 1972

Type species.—*Poseidonamicus major* Benson, 1972.

Poseidonamicus sculptus new species
Figure 13.1–13.6

1987 *Poseidonamicus* sp. cf. *P. major* Benson; Whatley and Coles, pl. 6, fig. 11.
1987 *Poseidonamicus* sp. cf. *P. pintoi* Benson; Whatley and Coles, pl. 6, fig. 12.
1990 *Poseidonamicus pintoi* Benson; Malz, pl. 4, figs. 3, 4, pl. 6, fig. 9.
2007 *Poseidonamicus pintoi*; Hunt, fig. 12.2, 12.3.
2010 *Poseidonamicus pintoi*; Hunt and Yasuhara, fig. 1.
2015 *Poseidonamicus pintoi*; Yasuhara et al., p. 165, fig. 94R.

Holotype.—Adult LV, USNM PAL 771757 (ODP925213) (Fig. 13.1) from the Ceara Rise, western equatorial Atlantic, ODP Site 925B, 3/3/7–9 (ca. 491 ka).

Paratypes.—Adult RV, USNM PAL 771758 (ODP925215) (Fig. 13.2); adult LV, USNM PAL 771759 (ODP925216) (Fig. 13.3, 13.4); adult RV, USNM PAL 771760 (ODP925217) (Fig. 13.5, 13.6).

Diagnosis.—Well-calcified species of *Poseidonamicus* with a dorsal ridge that is developed only in the posterior half and whose dorsal edge is straight or shifts upward towards the posterior; coarsely reticulate with alternating robust and quite reduced vertical muri in the region immediately posterior and ventral to the adductor muscle scars.

Description.—Carapace well calcified, medium-large in size, highest at anterior cardinal angle. Outline subrectangular in lateral view. Anterior margin evenly rounded with ~14 denticles; posterior margin slightly pointed, with a maximum extent at about mid-height, bearing several denticles and 1–2 longer spines; well-developed marginal rim on anterior, ventral, and posterior edges. Anterodorsal corner moderately

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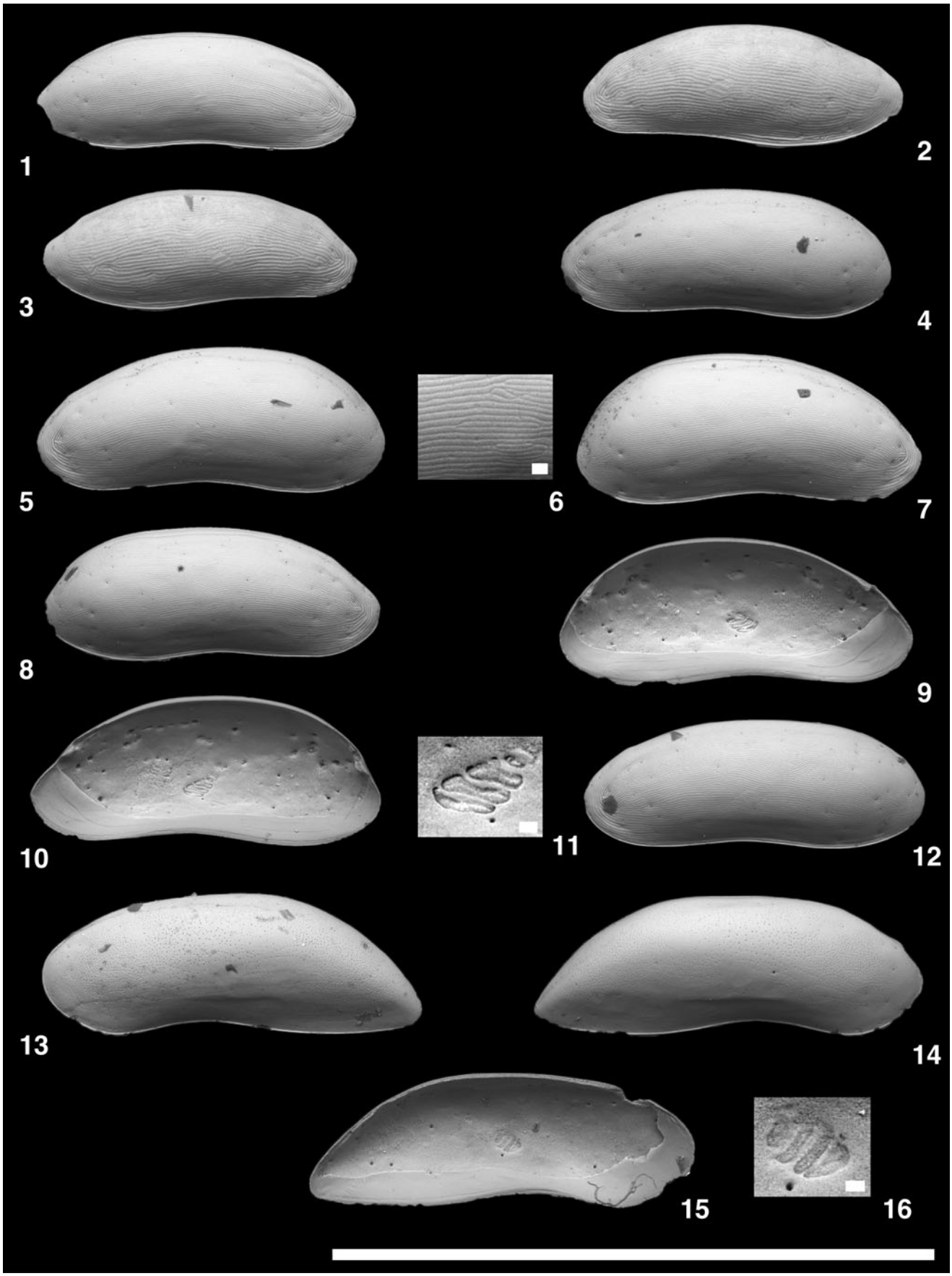

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Figure 12. Scanning electron microscope images of *Paracytherois* species. (**1–3**) *Paracytherois bondi* Yasuhara, Okahashi, and Cronin, 2009c; (**1**) USNM PAL 771744 (ODP925171), adult RV; (**2**) USNM PAL 771745 (ODP925172), adult LV; (**3**) USNM PAL 771746 (ODP925173), adult RV. (**4–12**) *Paracytherois obtusa* n. sp.; (**4**) USNM PAL 771747 (ODP925170), paratype, adult LV; (**5, 6**) USNM PAL 771748 (ODP925174), holotype, adult LV; (**7**) USNM PAL 771749 (ODP925175), paratype, adult RV; (**8**) USNM PAL 771750 (ODP925176), paratype, adult RV; (**9**) USNM PAL 771751 (ODP925177), paratype, adult LV; (**10, 11**) USNM PAL 771752 (ODP925178), paratype, adult RV; (**12**) USNM PAL 771753 (ODP925179), paratype, adult LV. (**13–16**) *Paracytherois productum* (Brady and Norman, 1889); (**13**) USNM PAL 771754 (ODP925180), adult LV; (**14**) USNM PAL 771755 (ODP925181), adult RV; (**15, 16**) USNM PAL 771756 (ODP925182), adult LV. (**1–8, 12–14**) lateral views; (**9–11, 15, 16**) internal views; (**6**) closeup of fine striations; (**11, 16**) closeup of subcentral muscle scars. Scale bars of closeup views (**6, 11, 16**) = 10 µm; scale bars for the other images (**1–5, 7–10, 12–15**) = 1 mm.

well developed; posterodorsal corner less developed, especially in RV. Lateral surface coarsely reticulate, divided into an anterior field with low and even reticulation and distinctly rounded fossae, and a posterior field with larger, polygonal fossae. Vertical muri generally more strongly developed than horizontal muri in the posterior field, although the vertical muri posterior and ventral to the muscle scars (separating the A and B fossae of Hunt, 2007) are quite reduced, sometimes nearly absent. Prominent ventral ridge that curves gently, terminating in a posterior spine; dorsal ridge mostly straight or shifting upward towards the posterior, well developed only in the posterior half. Inner lamella moderately broad, with a well-developed selvage in RV. Hingement holamphidont, with a stepped anterior tooth and subtly trilobate posterior tooth in RV; medial bar is smooth. Muscle scars typical for the genus: a vertical row of four adductors, the middle two more elongate than the top and bottom; two oval frontal scars, with the ventral one larger than the dorsal.

Etymology.—From Latin *sculptus* (adjective, singular, masculine), carved, referring to the well-defined ridges of the reticulum.

Dimensions.—USNM PAL 771757 (ODP925213) (holotype), L = 1073 µm, H = 626 µm; USNM PAL 771758 (ODP925215) (paratype), L = 1088 µm, H= 569 µm.

Remarks.—Poseidonamicus sculptus n. sp. is the most commonly encountered species of the genus in the deep North Atlantic Ocean from the Pliocene to Recent. When figured, it usually has been identified as, or compared to, *Poseidonamicus pintoi* Benson, 1972. The two species are similar in that their reticulum generally emphasizes vertical elements, and they both share a dorsal ridge that is well developed only in the posterior. There are, however, also clear differences between these two species. *Poseidonamicus pintoi* is somewhat smaller, less elongate (Fig. 14), and it has a more even reticulum and markedly narrower anterior marginal rims than *Poseidonamicus sculptus* n. sp. These features are clear in the figured specimens (Fig. 13.8, 13.9), which are from Benson's type sample for *Poseidonamicus pintoi* (Albatross station 2763, South Atlantic Ocean, 24.28° S, 42.8°W).

Specimens that we consider to be true *Poseidonamicus pintoi* have been reported from only a small area off the coast of southeast Brazil in the Campos and Santos basins, from the Pleistocene to Recent (Benson, 1972; Bergue and Coimbra, 2008; Bergue et al., 2017). These occurrences are from samples that range between 1100–1300 m in water depth, considerably shallower than depths for all the published occurrences for *Poseidonamicus sculptus* n. sp. in the synonymy list above (>2400 m). Some reports of *Poseidonamicus pintoi* we consider to be neither that species, nor *Poseidonamicus scultpus* n. sp. (e.g., Whatley et al., 1998b; Zhao, 2005).

Poseidonamicus scultpus n. sp. is also similar in shape to *Poseidonamicus riograndensis* Benson in Benson and Peypouquet, 1983, and has a similar arrangement of emphasized muri posterior to the central scars, but that species is smaller, and its dorsal ridge is evenly developed and curves downward in the posterior. See also the remarks under *Poseidonamicus* cf. *P. sculptus* n. sp.

Poseidonamicus cf. *P. sculptus* new species
Figure 13.7

1987 *Poseidonamicus* sp. cf. *P. pintoi* Benson; Whatley and Coles, pl. 6, fig. 13.
?1988 *Poseidonamicus pintoi* Benson; Guernet and Fourcade, p. 144, pl. 3, fig. 1.
2007 *Poseidonamicus* species 4 Hunt, fig. 10.2.

Remarks.—Hunt (2007) recorded this species from the Pliocene through Recent of the North Atlantic Ocean. It often co-occurs with, but at a lower abundance than, *Poseidonamicus sculptus* n. sp., with which it is easily confused because of its quite similar size and shape. This species differs from *Poseidonamicus sculptus* n. sp. in its lower and more even reticulum, in being more prone to secondary reticulation, especially in the anterior field, and in that it bears a large sieve pore in the area antero-dorsal to the muscle scars that is absent in *Poseidonamicus sculptus* n. sp. (see Hunt, 2007, character 8).

Family Trachyleberididae Sylvester-Bradley, 1948
Genus *Abyssocythere* Benson, 1971

Type species.—Abyssocythere casca Benson, 1971.

Abyssocythere atlantica Benson, 1971
Figure 15.10

1971 *Abyssocythere atlantica* Benson, p. 13, fig. 10, pl. 3, fig. 1.
1987 *Abyssocythere atlantica*; Whatley and Coles, pl. 6, fig. 10.
?1988 *Abyssocythere trinidadensis* (van den Bold); Steineck et al., pl. 1, fig. 11.
?1989 *Abyssocythere atlantica*; Gründel, fig. 15.

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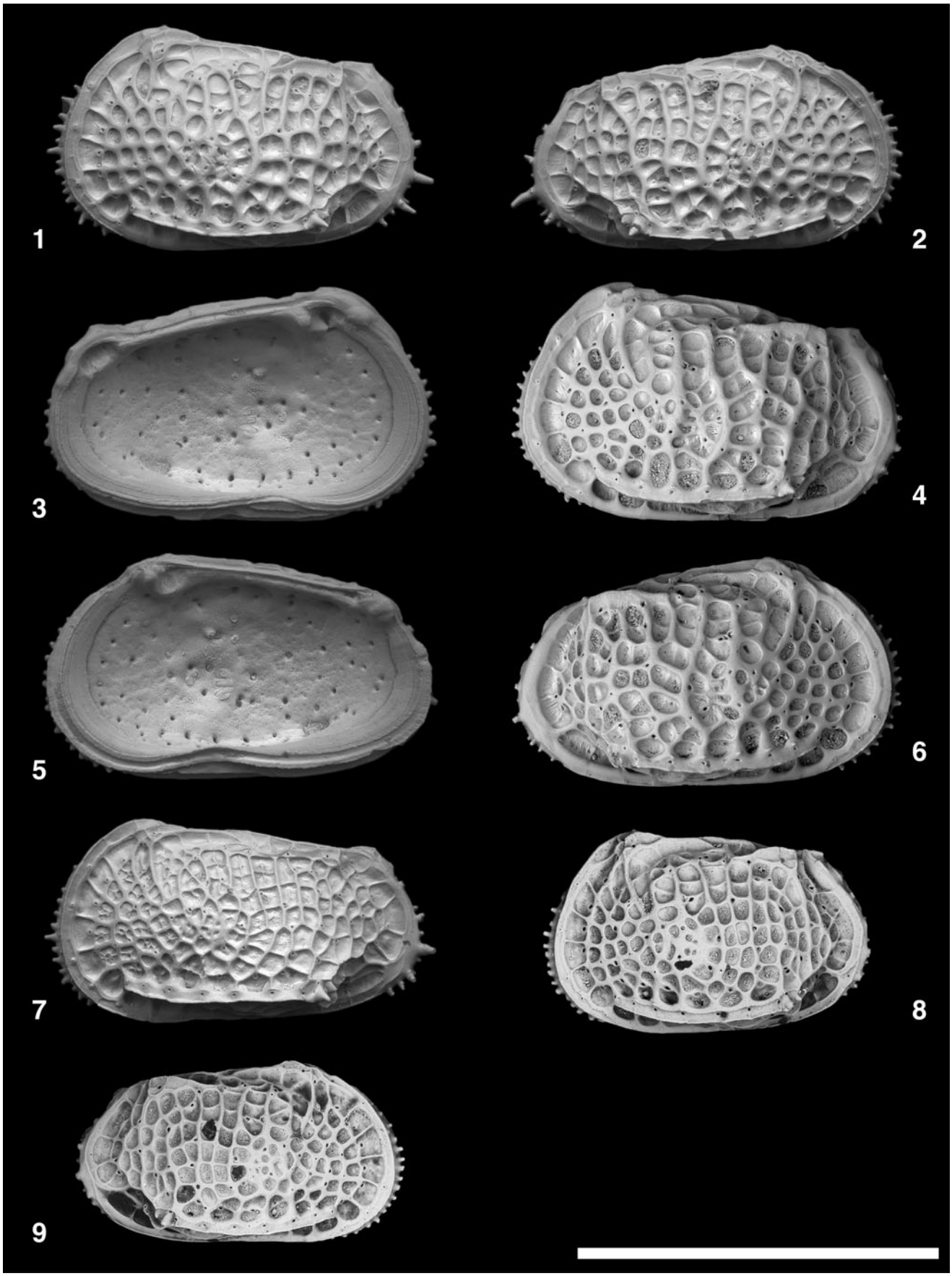

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Figure 13. Scanning electron microscope images of *Poseidonamicus* species. (**1–6**) *Poseidonamicus sculptus* n. sp.; (**1**) USNM PAL 771757 (ODP925213), holotype, adult female LV; (**2**) USNM PAL 771758 (ODP925215), paratype, adult male RV; (**3, 4**) USNM PAL 771759 (ODP925216), paratype, adult female LV; (**5, 6**) USNM PAL 771760 (ODP925217), paratype, adult female RV. (**7**) *Poseidonamicus* cf. *P. sculptus* n. sp., USNM PAL 771761 (ODP925214), adult male LV. (**8, 9**) *Poseidonamicus pintoi* Benson, 1972 from Albatross Station 2763, South Atlantic Ocean (24.28°S, 42.8°W); (**8**) USNM PAL 527091 (SI55-01), adult female LV; (**9**) USNM PAL 771762 (SI55-19), adult male RV. (**1, 2, 4, 6–9**) lateral views; (**3, 5**) internal views. Scale bar = 1 mm.

1994 *Abyssocythere atlantica*; Guernet and Moullade, p. 263, pl. 2, fig. 8 (?6).

2015 *Abyssocythere atlantica*; Yasuhara et al., p. 29, figs. 7E–L, 8F–K.

Holotype.—LV, 170280 (National Museum of Natural History, Washington DC, USA), equatorial-south Atlantic, Pleistocene.

Remarks.—This species is widely known from the deep North and South Atlantic oceans.

Genus *Henryhowella* Puri, 1957

Type species.—*Cythere evax* Ulrich and Bassler, 1904.

Henryhowella asperrima (Reuss, 1850)
Figure 16

1850 *Cypridina asperrima* Reuss, p. 74, pl. 10, fig. 5a, b.

1853 *Cypridina hirta* Costa, p. 174, pl. 15, fig. 2a, c.

1894 *Cythereis sarsii* Müller, p. 370, pl. 8, fig. 8.

1941 *Cythereis dunelmensis* Norman; Tressler, p. 100, pl. 19, fig. 21.

1960 *Henryhowella asperrima* (Reuss); van den Bold, p. 169, pl. 4, fig. 10, pl. 8, fig. 2.

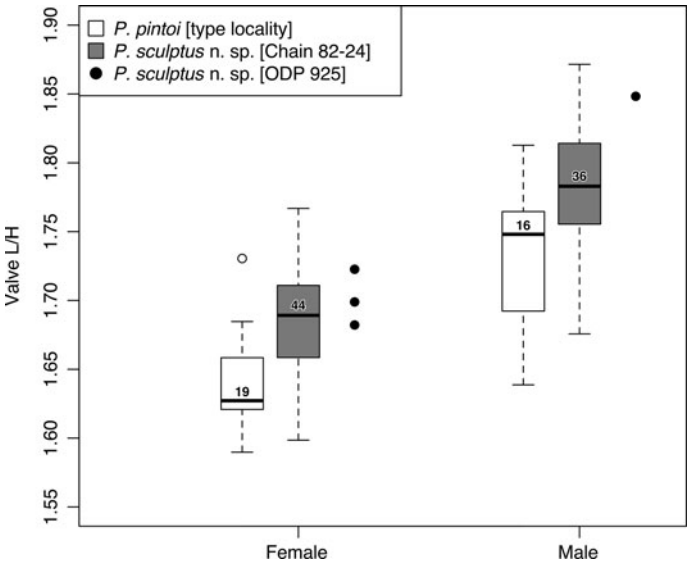

Figure 14. Length-to-height ratio for adults of *Poseidonamicus pintoi* and *Poseidonamicus sculptus* n. sp. Boxplots are for *Poseidonamicus pintoi* from its type locality (white) and a large sample of *Poseidonamicus sculptus* n. sp. from Chain Core 82-24 (gray) from the North Atlantic Ocean (41.7°N, 32.9°W). Males and females are shown separately. Sexes were identified using the procedure of Hunt et al. (2017); numbers inside boxes indicate sample sizes. Black dots indicate measurements from the four figured individuals from ODP 925 (Fig. 13.1, 13.2, 13.4, and 13.6).

1961 *Henryhowella ruggierii* Oertli, p. 28, pl. 4, figs. 39–45.

1972 *Henryhowella* (generic assignment only); Laughton et al., pl. 11, fig. 4.

1976 *Henryhowella asperrima*; Berggren et al., pl. 6, fig. 4.

1976 *Henryhowella sarsi* (Müller); Bonaduce et al., p. 52, pl. 31, figs. 1–7.

1977 *Henryhowella asperrima*? (Reuss); Benson, pl. 2, fig. 2.

1977 *Echinocythereis dasyderma* (Brady); Joy and Clark, p. 142, pl. 2, figs. 14–17.

1978 *Henryhowella asperrima*; Benson, pl. 1, fig. 3.

1978 *Henryhowella asperrima*; Rosenfeld and Bein, p. 18, pl. 1, fig. 23.

1979 *Henryhowella asperrima*; Ducasse and Peypouquet, pl. 3, fig. 1.

1981 *Henryhowella* ex. gr. *H. asperrima* (Reuss); Steineck, p. 346, pl. 2, fig. 1.

1981 *Henryhowella asperrima* s.l. (Reuss); Uffenorde, p. 148, pl. 2, figs. 14, 15, 17–19.

?1983 *Henryhowella asperrima*; Cronin, pl. 4, fig. F.

1983 *Henryhowella asperrima*?; Benson and Peypouquet, pl. 2, figs. 1, 3.

1984 *Henryhowella asperrima*; Malz and Jellinek, pl. 5, figs. 38, 39.

1987 *Henryhowella* sp. Cronin and Compton-Gooding, pl. 1, figs. 5, 6, pl. 2, fig. 1.

1987 *Henryhowella asperrima*; Whatley and Coles, pl. 5, figs. 9–11.

1988 *Henryhowella* cf. *evax* (Ulrich and Bassler); Guernet and Fourcade, pl. 3, figs. 18–20.

1990 *Henryhowella melobesioides* (Brady); Dingle et al., p. 311, figs. 42E, F, 43A–F, 44A–D, 47A (non fig. 42C, D).

1990 *Henryhowella asperrima*; Malz, fig. 6.8.

1993 *Henryhowella asperrima*; Kempf and Nink, p. 95, figs. 1–30.

1994 *Henryhowella* cf. *asperrima* (Reuss); Guernet and Moullade, p. 268, pl. 3, figs. 8–11, 14.

1996 *Henryhowella asperrima*; Cronin, fig. 7a.

1996 *Henryhowella* gr. *asperrima* (Brady) [sic]; Coles et al., pl. 6, figs. 2, 3.

non 1996b *Henryhowella asperrima*; Whatley et al., p. 67, pl. 3, fig. 8.

1998 *Henryhowella melobesioides*; Guernet, pl. 2, figs. 4–6.

1998a *Henryhowella dasyderma* (Brady); Whatley et al., pl. 3, figs. 20, 21.

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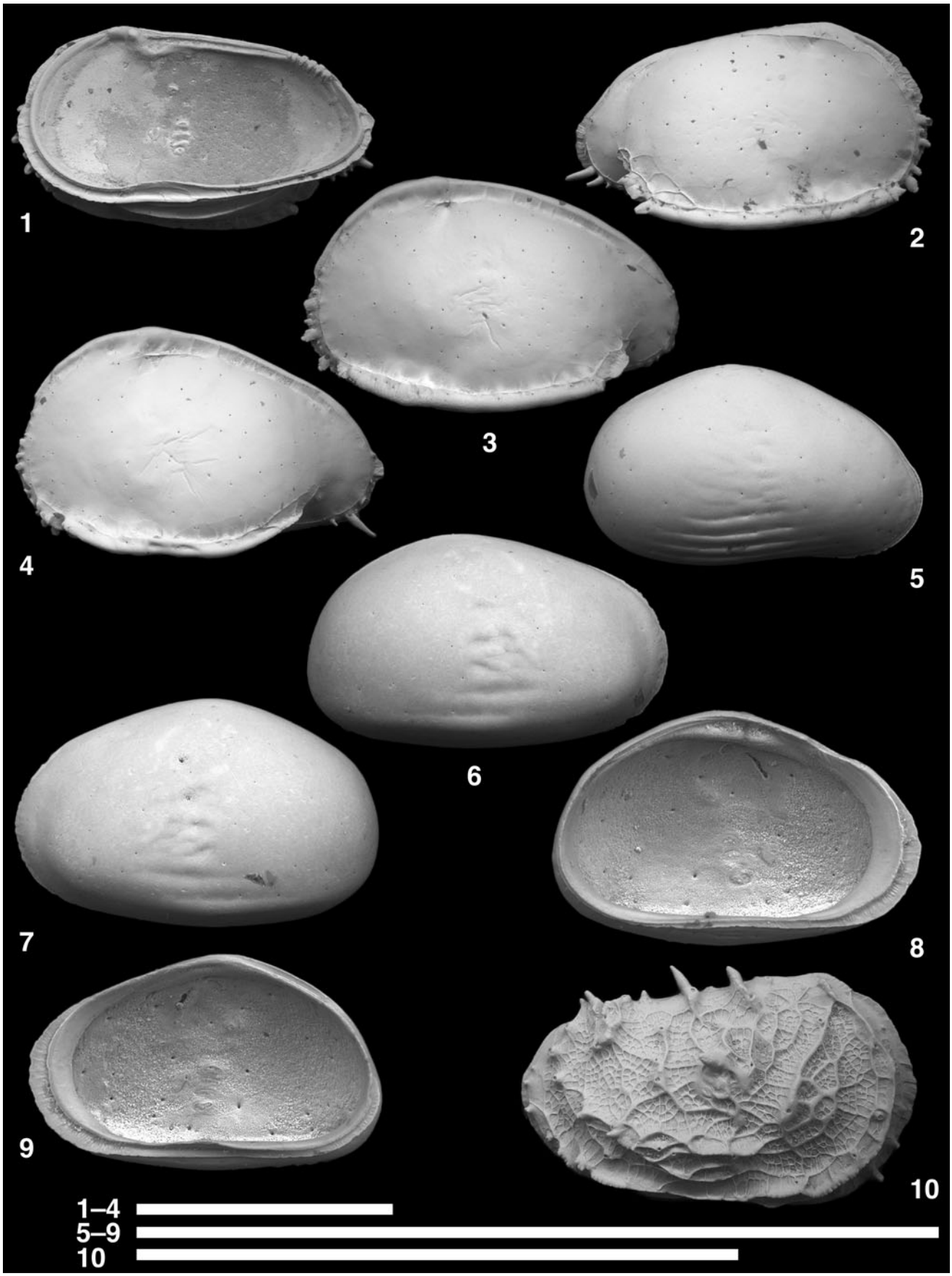

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Figure 15. Scanning electron microscope images of *Pterygocythere*, *Xestoleberis*, and *Abyssocythere* species. (**1–4**) *Pterygocythere nobilis* (Jellinek, Swanson, and Mazzini, 2006); (**1**) USNM PAL 771763 (ODP925219), adult RV; (**2**) USNM PAL 771764 (ODP925220), adult RV; (**3**) USNM PAL 771765 (ODP925221), adult LV; (**4**) USNM PAL 771766 (ODP925222), A-1 juvenile? LV. (**5–9**) *Xestoleberis oppoae* Yasuhara, Okahashi, and Cronin, 2009c; (**5**) USNM PAL 771767 (ODP925246), juvenile? RV; (**6**) USNM PAL 771768 (ODP925248), adult RV; (**7**) USNM PAL 771769 (ODP925247), adult LV; (**8**) USNM PAL 771770 (ODP925249), adult LV; (**9**) USNM PAL 771771 (ODP925250), adult RV. (**10**) *Abyssocythere atlantica* Benson, 1971, USNM PAL 771772 (ODP925001), juvenile RV. (**2–7, 10**) lateral views; (**1, 8, 9**) internal views. Scale bars = 1 mm.

non 1998b *Henryhowella asperrima*; Whatley et al., p. 129, pl. 4, figs. 22, 23.

non 1999 *Henryhowella* cf. *H. asperrima* (Reuss); Boomer, p. 145, pl. 2, figs. 1, 2, 4.

1999 *Henryhowella asperrima*; Bonaduce et al., p. 60, pl. 1, figs. 1, 2.

1999 *Henryhowella*? *asperrima* (Reuss); Bonaduce et al., p. 61, pl. 1, figs. 3, 4.

1999 *Henryhowella sarsii sarsii* (Müller); Bonaduce et al., p. 64, pl. 2, figs. 1–10, pl. 3, fig. 12, pl. 4, figs. 9, 10, pl. 5, figs. 1, 2, 6–8, 11.

1999 *Henryhowella sarsii profunda* Bonaduce, Barra, and Aiello, p. 68, pl. 1, figs. 5–12, pl. 4, figs. 1–8.

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

2001 *Henryhowella* sp. cf. *H. dasyderma* (Brady); Didié and Bauch, pl. 1, figs. 1, 2.

2001 *Henryhowella sarsii profunda*; Barra and Bonaduce, p. 64, pl. 4, fig. 8.

2001 *Henryhowella asperrima*; Dall'Antonia and Bossio, p. 418, pl. 5, figs. 3–7.

2004 *Henryhowella asperrima*; Aiello and Szczechura, p. 26, pl. 4, figs. 12–14.

2005 *Henryhowella asperrima*; Mazzini, p. 50, figs. 26A–I, 27B.

2005 *Fallacihowella* sp. B Mazzini, p. 57, fig. 32A–Q.

2009 *Henryhowella dasyderma*; Alvarez Zarikian, p. 6, pl. P9, figs. 6–8.

2009c *Henryhowella* cf. *asperrima*; Yasuhara et al., p. 926, pl. 20, fig. 7, pl. 21, figs. 1–4.

2010 *Henryhowella asperrima*; Bergue and Govindan, p. 751, fig. 3.14.

2010 *Henryhowella* sp. 1 Bergue and Govindan, p. 752, fig. 3.15.

2010 *Henryhowella asperrima*; Nachite and Bekkali, pl. 2, fig. 10.

2011 *Henryhowella asperrima*; Pirkenseer and Berger, p. 54, pl. 7, figs. 6a–c, 7a–c, pl. 8, figs. 1a–c, 2a–c, 3a–c.

2011 *Henryhowella asperrima*; Hajek-Tadesse and Prtoljan, fig. 3.4.

2012 *Henryhowella asperrima*; Seko et al., fig. 8O.

2012 *Henryhowella asperrima*; Russo et al., pl. 1, fig 5.

2014 *Henryhowella* ex *H. hirta* (Costa) group; Sciuto, p. 6, pl. 1, fig. H.

2014 *Henryhowella* ex *H. profunda* Bonaduce et al. group; Sciuto, p. 8, pl. 1, fig. I.

2014 *Henryhowella asperrima*; Yasuhara and Okahashi, p. 782, fig. 8.4.

2014a *Henryhowella asperrima*; Yasuhara et al., p. 354, fig. 7.7, 7.8.

2014c *Henryhowella asperrima*; Yasuhara et al., p. 432, pl. 16, figs. 3–10.

2015 *Henryhowella asperrima*; Alvarez Zarikian, pl. 10, figs. 4–6.

2015 *Henryhowella asperrima*; DeNinno et al., p. 91, pl. 3, figs. 4, 5.

2015 *Henryhowella asperrima*; Yasuhara and Okahashi, p. 46, fig. 16E–K.

2015 *Henryhowella asperrima*; Yasuhara et al., p. 82, figs. 40Q–U, 41G–K, 42A–O, 43A–H.

2017 *Henryhowella asperrima*; Gemery et al., p. 62, fig. 20.2, 20.3.

2017 *Henryhowella asperrima*; Bergue et al., p. 501, pl. 2, fig. 18, pl. 3, fig. 1.

2019 *Henryhowella asperrima*; Bergue et al., p. 1508, fig. 4J, K.

Holotype.—Not designated.

Remarks.—See Yasuhara et al. (2015) for detailed discussion of this species, along with SEM images of topotype specimens.

Genus *Legitimocythere* Coles and Whatley, 1989

Type species.—*Cythere acanthoderma* Brady, 1880.

Legitimocythere acanthoderma (Brady, 1880)
Figure 17

1880 *Cythere acanthoderma* Brady, p. 104, pl. 18, fig. 5a–e.

1941 *Cythereis ericea* (Brady); Tressler, p. 101, pl. 19, fig. 23.

1976 *Cythere acanthoderma*; Puri and Hulings, 267, pl. 11, figs. 16–18.

?1979 *Thalassocythere acanthoderma* (Brady); Ducasse and Peypouquet, pl. 3, fig. 4.

non 1983 "*Thalassocythere*" *acanthoderma* (Brady); Benson et al., pl. 2, fig. 9.

?1987 "*Thalassocythere*" sp. Cronin and Compton-Gooding, pl. 2, fig. 3.

1987 "*Thalassocythere*" *acanthoderma*; Malz, fig. 2b.

1987 "*Thalassocythere*" *acanthoderma*; Whatley and Coles, pl. 6, figs. 1, 2.

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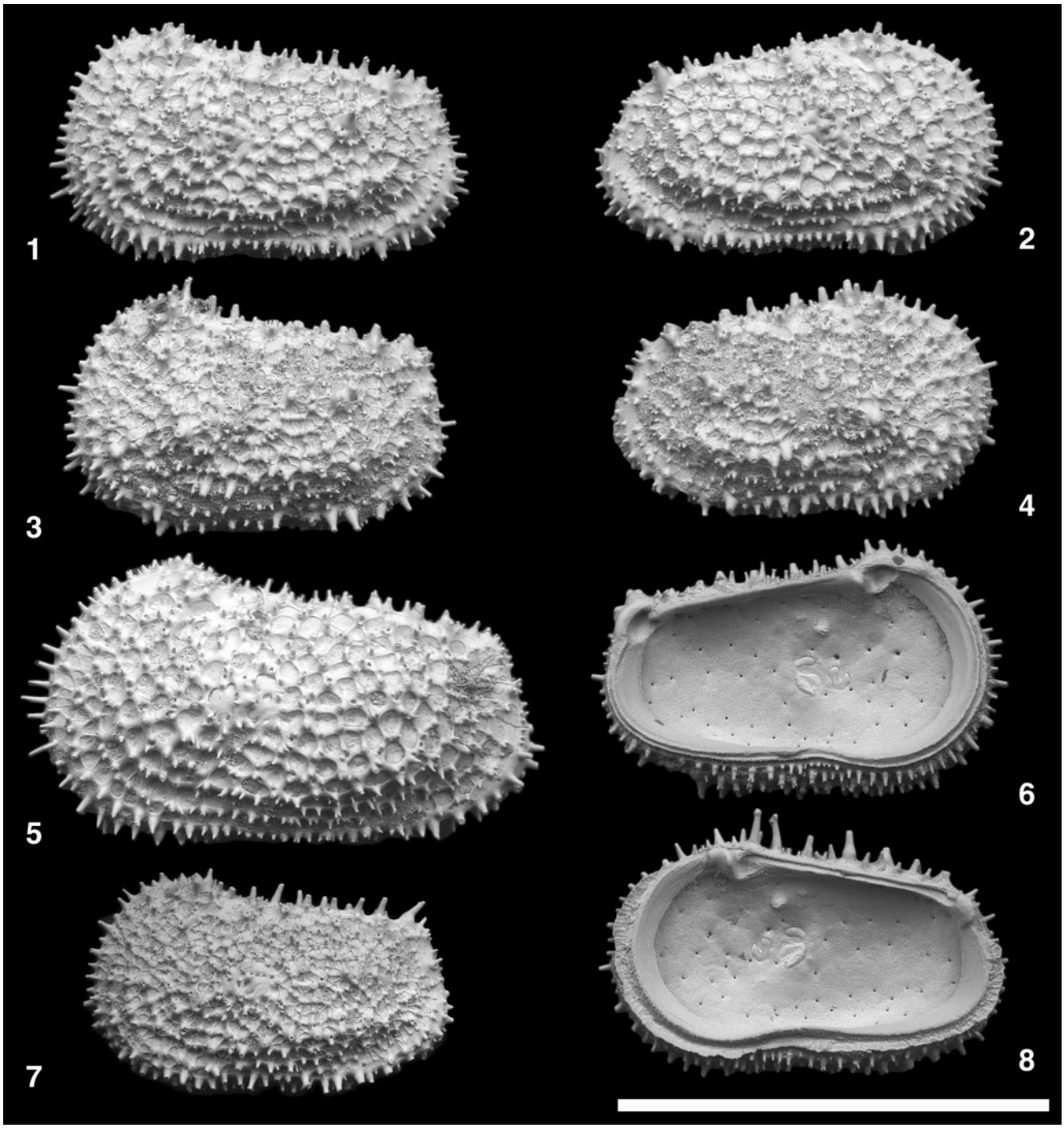

Figure 16. Scanning electron microscope images of *Henryhowella asperrima* (Reuss, 1850). (**1**) USNM PAL 771773 (ODP925051), adult LV; (**2**) USNM PAL 771774 (ODP925052), adult RV; (**3**) USNM PAL 771775 (ODP925053), adult LV; (**4**) USNM PAL 771776 (ODP925054), adult RV; (**5**) USNM PAL 771777 (ODP925055), adult LV; (**6**) USNM PAL 771778 (ODP925056), adult LV; (**7**) USNM PAL 771779 (ODP925058), adult LV; (**8**) USNM PAL 771780 (ODP925057), adult RV. (**1–5, 7**) lateral views; (**6, 8**) internal views. Scale bar = 1 mm.

non 1989 *Legitimocythere acanthoderma* (Brady); Coles and Whatley, p. 100, pl. 4, fig. 9.

1990 *Legitimocythere acanthoderma*; Dingle and Lord, fig. 2.11.

1990 "*Thalassocythere*" *acanthoderma*; Malz, fig. 8.5–8.7.

2000 *Thalassocythere acanthoderma*; Didié and Bauch, pl. 3, figs. 15, 16.

2003 *Legitimocythere acanthoderma*; Jellinek and Swanson, p. 33.

2003 *Legitimocythere* sp. A Jellinek and Swanson, p. 37, pl. 27, figs. 1, 2.

2003 *Legitimocythere* sp. B Jellinek and Swanson, p. 37, pl. 27, figs. 3, 4.

2004 *Legitimocythere acanthoderma*; Ayress et al., p. 36, pl. 1, figs. 6, 7.

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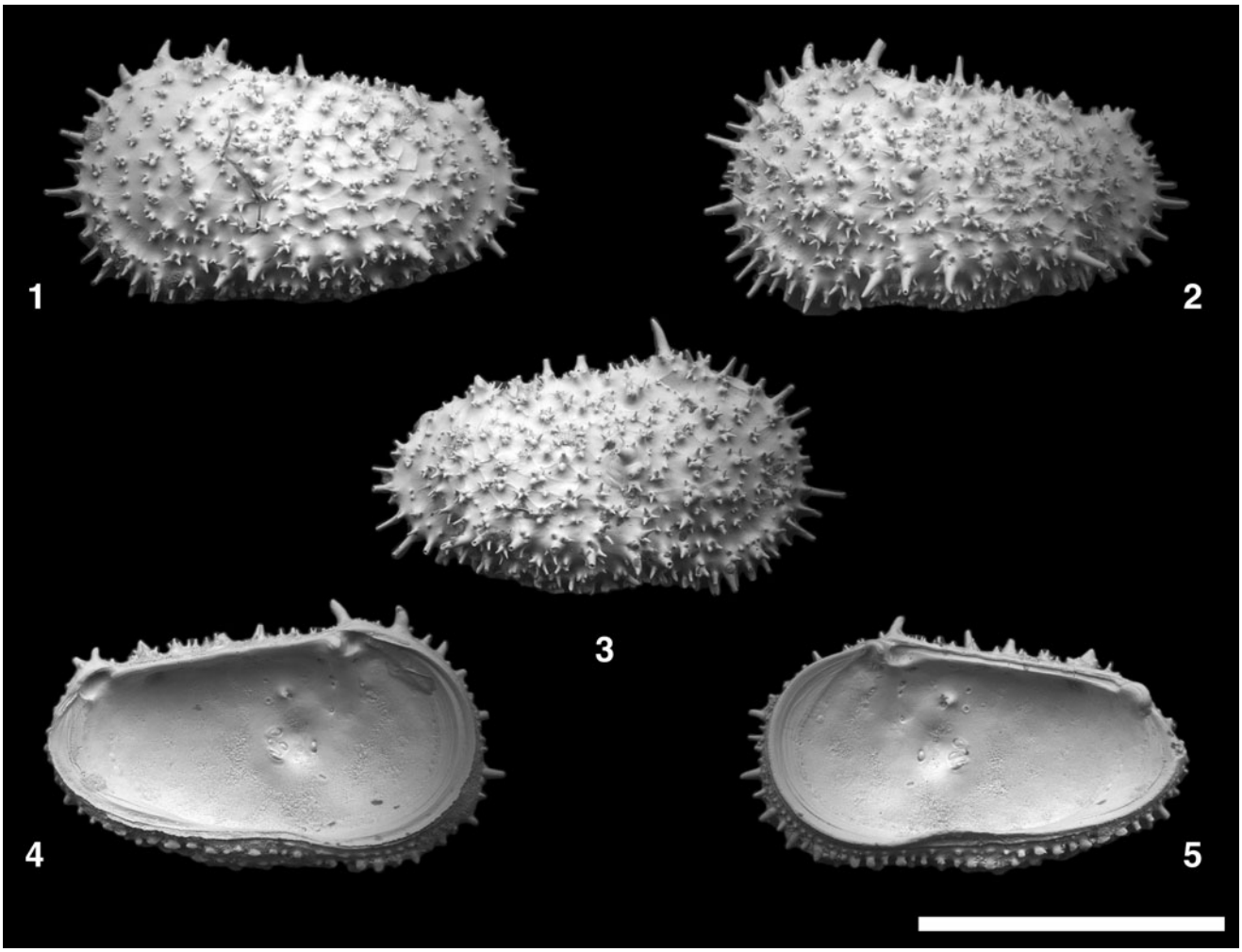

Figure 17. Scanning electron microscope images of *Legitimocythere acanthoderma* (Brady, 1880). (**1**) USNM PAL 771781 (ODP925150), adult LV; (**2**) USNM PAL 771782 (ODP925160), adult LV; (**3**) USNM PAL 771783 (ODP925161), adult RV; (**4**) USNM PAL 771784 (ODP925162), adult LV; (**5**) USNM PAL 771785 (ODP925163), adult RV. (**1–3**) lateral views; (**4, 5**) internal views. Scale bar = 1 mm.

2005 *Legitimocythere acanthoderma*; Mazzini, p. 42, figs. 22A–L, 23A–F.

2005 *Legitimocythere geniculata* Mazzini; p. 44, fig. 24A–M.

2009 *Legitimocythere acanthoderma*; Alvarez Zarikian, p. 6, pl. P1, figs. 4, 5 [sic: this should be pl. 1, figs. 4, 6].

2009a *Legitimocythere acanthoderma*; Yasuhara et al., p. 922, figs. 5.5, 11.1–11.6.

2009c *Legitimocythere* sp. Yasuhara, Okahashi, and Cronin, p. 927, pl. 21, fig. 5, pl. 22, figs. 7, 8.

2013 *Legitimocythere acanthoderma*; Brandão, p. 16, pls. 1, 2.

2014a *Legitimocythere acanthoderma*; Yasuhara et al., p. 354, fig. 8.4.

2015 *Legitimocythere acanthoderma* s.l. (Brady); Yasuhara et al., p. 133, figs. 63R, S, 65A–J, 73N–X, 74A–C, Q, 75E–N, 76, 77A–I.

Holotype.—Lectotype, juvenile LV, NHM 80.38.48.A.1 (Natural History Museum, London, UK), Southern Ocean, Recent.

Remarks.—See Yasuhara et al. (2015) and Brandão (2013) for detailed discussion of this species.

Genus *Pterygocythere* Hill, 1954

Type species.—*Cypridina alata* Bosquet, 1847.

Pterygocythere nobilis (Jellinek, Swanson, and Mazzini, 2006)
Figure 15.1–15.4

1941 *Cytheropteron mucronalatum* Brady; Tressler, p. 102, pl. 19, fig. 25.

1983 *Brachycythere mucronalatum* (Brady); Benson et al., pl. 1, figs. 6, 7.

1987 *Bosquetina mucronalatum* (Brady); Whatley and Coles, pl. 5, figs. 1, 2.

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2006 *Pseudobosquetina nobilis* Jellinek, Swanson, and Mazzini, p. 41, figs. 6–8.

2015 *Pseudobosquetina nobilis*; Yasuhara et al., p. 156, figs. 87K–N, 88G–S.

Holotype.—Female carapace, SMF Xe 21746 (Senckenberg Research Institute and Natural History Museum Frankfurt, Germany), South Atlantic, living.

Remarks.—We consider *Pseudobosquetina* a junior synonym of *Pterygocythere*. See Ayress et al. (2004) and Yasuhara et al. (2015) for detailed discussion.

Family *Xestoleberididae* Sars, 1928
Genus *Xestoleberis* Sars, 1866

Type species.—*Cythere nitida* Lilljeborg, 1853 (designated by Sars, 1866).

Xestoleberis oppoae Yasuhara, Okahashi, and Cronin, 2009c
Figure 15.5–15.9

2009c *Xestoleberis oppoae* Yasuhara, Okahashi, and Cronin, p. 927, pl. 22, figs. 1–6.

Holotype.—Adult female LV, USNM PAL 536985 (National Museum of Natural History, Washington DC, USA), northwestern Atlantic Ocean, Quaternary.

Remarks.—This is the second record of this species that was originally discovered in the northwestern Atlantic Ocean.

Discussion

We found that ODP Site 925 yielded an ostracode fauna with tropical deep-sea faunal elements that are distinct from higher latitude faunas. The genera *Zabythocypris*, *Aratrocypris*, *Hemiparacytheridea*, *Chejudocythere*, and deep-sea *Semicytherura* were found here (note that they are not abundant; see Fig. 18), but they have not been reported from mid to high latitudes of the Atlantic Ocean. These genera are known from Recent and Quaternary sediments in the low-latitude Atlantic (Cronin, 1983; Yasuhara et al., 2009c), Pacific (Maddocks, 1969; Coles et al., 1990; Corrége, 1993; Ayress et al., 1995), and Indian oceans (Maddocks, 1969; Ayress et al., 1995). O'Hara et al. (2011) reported a similar pattern for bathyal ophiuroids in the Pacific, Southern, and Indian oceans around Australia, finding a tropical bathyal fauna that was distinct from that from higher latitudes.

We suggest that this global distribution of tropical deep-sea fauna may be a Tethyan legacy. Many of these tropical deep-sea genera (*Aratrocypris*, *Hemiparacytheridea*, *Chejudocythere*, *Semicytherura*) are known from Cretaceous chalks in western Europe (Whatley et al., 1989; Coles et al., 1990; Ayress and Dorn, 2012). This suggests that they were widespread in the Tethys during the warm Cretaceous and Paleogene periods, even as they are limited to the tropics in the deep water of today's oceans.

It is puzzling that a characteristic deep-sea, low-latitude fauna exists even though the deep sea in the tropics does not have distinct environmental conditions from those of the deep sea in higher latitudes. Deep-sea temperature, particulate organic carbon flux, and seasonality do not change much at the tropical-extratropical boundary (O'Hara et al., 2011; Yasuhara and Danovaro, 2016; Sweetman et al., 2017). Deep-sea temperature has latitudinal structure, but it is mostly between colder polar and warmer temperate regions, rather than between tropical and temperate regions (Yasuhara and Danovaro, 2016). Particulate organic carbon flux from sea-surface production is the major food source of deep-sea benthos, but this carbon flux and its seasonality change depending on the distance from the coast, water depth, and presence of upwelling, rather than latitude (Watling et al., 2013; Sweetman et al., 2017).

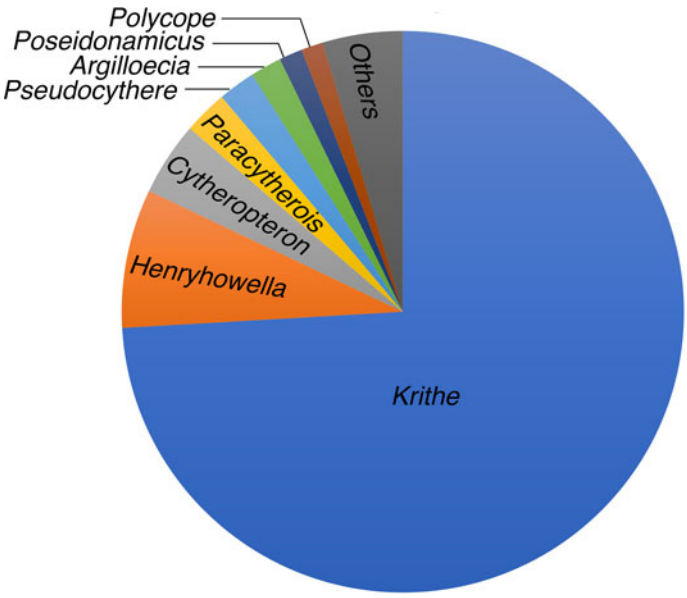

Figure 18. Pie chart showing the faunal composition of the ODP 925 ostracodes. All samples studied are lumped to calculate relative abundances of genera. *Zabythocypris*, *Aratrocypris*, *Hemiparacytheridea*, *Chejudocythere*, and *Semicytherura* are not abundant (<1% in total, among 5008 ostracode specimens that we picked and counted) and not among the top eight genera shown in the pie chart.

According to published fossil occurrences, Tethyan tropical genera were distributed widely, not only in the tropics, but also in mid–high latitudes during the Paleogene (Whatley and Coles, 1991). As climates cooled over the Cenozoic, however, they progressively disappeared from mid–high latitude regions. For example *Chejudocythere*, *Aratrocypris*, and *Semicytherura* do not occur after the Oligocene in the mid–high latitude North Atlantic, according to the compilation by Whatley and Coles (1991), suggesting their distributions contracted to the tropics by the Neogene. They may have persisted in the deep ocean in the tropics because their distributions included the relatively warm waters of the uppermost bathyal zone. Such water depths may have been a refuge for their populations, as has been suggested for other deep-sea organisms (Zezina, 1997; Eme et al., 2020). This is consistent with the deep-sea source-sink hypothesis that suggests that abyssal populations are a demographic sink, with source populations located in shallower bathyal zones (Rex et al., 2005). In this sense, bathyal (< ~3000 m) biogeography (Fig. 19) should be more similar to that of the shelf

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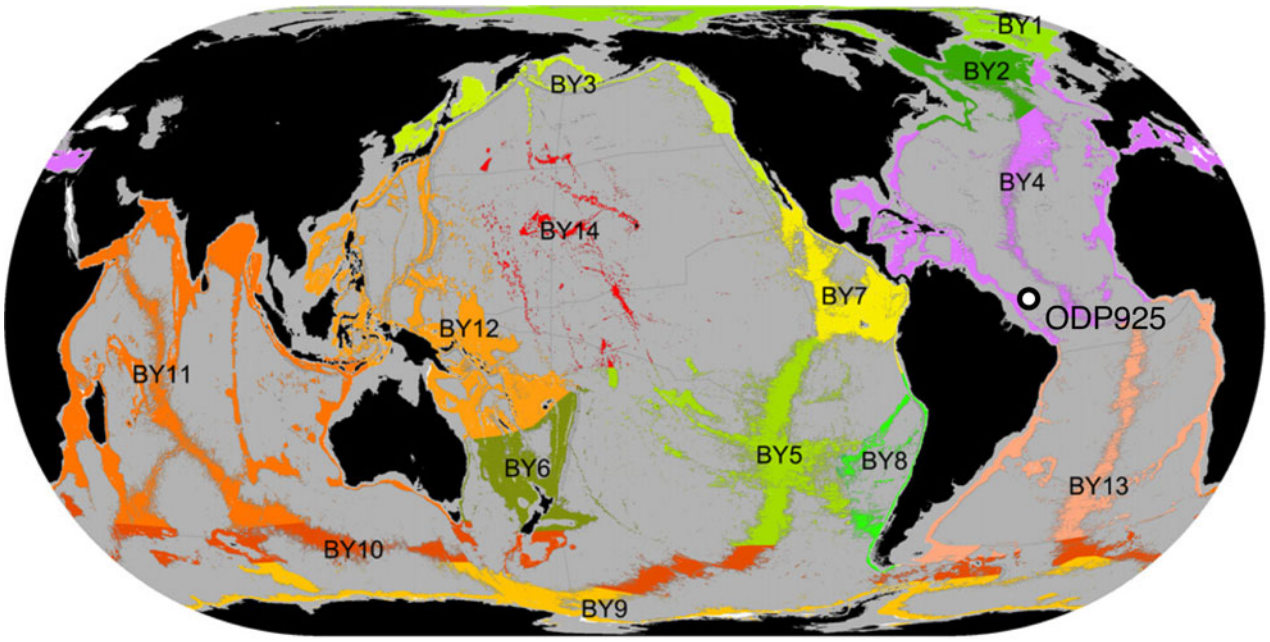
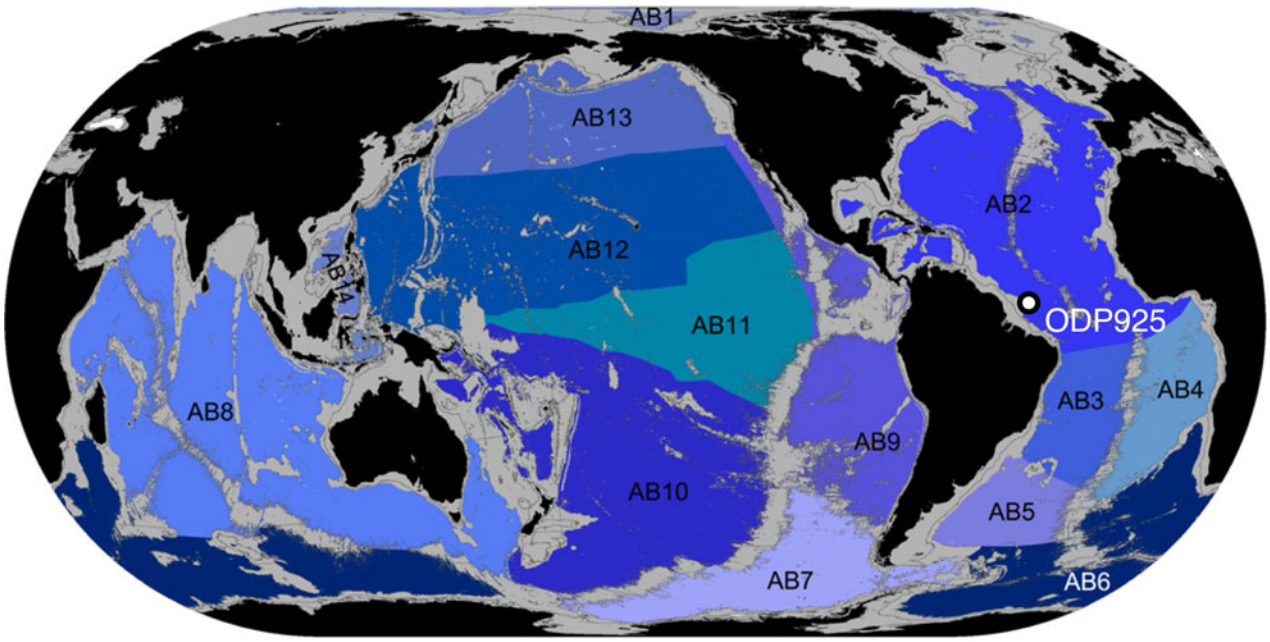


BY1: Arctic
BY2: Northern Atlantic Boreal
BY3: Northern Pacific Boreal
BY4: North Atlantic
BY5: Southeast Pacific Ridges
BY6: New Zealand-Kermadec
BY7: Cocos Plate
BY8: Nazca Plate
BY9: Antarctic
BY10: Subantarctic
BY11: Indian
BY12: West Pacific
BY13: South Atlantic
BY14: North Pacific



AB1: Arctic Basin
AB2:North Atlantic
AB3: Brazil Basin
AB4: Angola, Guinea, Sierra Leone Basins
AB5: Argentine Basin
AB6: Antarctica East
AB7: Antarctica West
AB8: Indian
AB9: Chile, Peru, Guatemala Basins
AB10: South Pacific
AB11: Equatorial Pacific
AB12: North Central Pacific
AB13: North Pacific
AB14: West Pacific Basins

Figure 19. Deep-sea benthic biogeographic provinces. Top panel for lower bathyal (BY) provinces (801–3500 m) and bottom panel for abyssal (AB) provinces (3501–6500 m). From Watling et al. (2013). ODP Site 925 is indicated.

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(Spalding et al., 2007; Costello et al., 2017) rather than that of deeper abyssal plain (Fig. 19) (UNESCO, 2009; Watling et al., 2013), as indicated by O'Hara et al. (2011). In fact, a recent study showed that deep-sea latitudinal diversity gradient is unclear in abyssal depths (Woolley et al., 2016). ODP Site 925 is situated in the lower bathyal North Atlantic province (BY4 of Watling et al., 2013), which is widely distributed in the North Atlantic from the equatorial Atlantic in the south to Cape Cod in the northwestern Atlantic and the Faeroe Islands in the northeast Atlantic to the north (Fig. 19). This biogeographic scheme is largely based on oceanographic proxies because of sparse deep-sea biological data available. It is possible that the BY4 province can be further divided into latitudinal sub-provinces because (some or all of) the tropical deep-sea genera found in ODP Site 925 are not known from the northern part of the BY4 province (Yasuhara et al., 2009c; Yasuhara and Okahashi, 2014, 2015).

The progressive restriction of certain genera to the deep tropics implies that the standard tropical-high and extratropical-low latitudinal diversity gradient (Rex et al., 2000; Yasuhara et al., 2009b) in the deep sea was less pronounced when these taxa had wider latitudinal ranges in the Paleogene. An increase in the relative diversity of the deep tropics is also seen in the benthic foraminiferal fossil record at ca. 37 Ma and, since then, the standard deep-sea foraminiferal latitudinal diversity gradient has been persistent until today (Thomas and Gooday, 1996; Culver and Buzas, 2000; Yasuhara et al., 2020).

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Appendix 1

Detailed information of the specimens used for the present study. All specimens from late Quaternary sediments. Core samples are specified by standard ODP notation (hole and core #/section #/interval [cm]). USNM PAL, catalog numbers of the National Museum of Natural History; No., MY's personal catalog number. T, type (P, paratype; H, holotype); V, valve (L, left; R, right); A, adult; J, juvenile (A-1, adult minus one juvenile).

USNM PAL	No.	Species	T	V	Instar	Hole	Section	Fig.
771616	ODP925202	*Polycope orbicularis* s.l.		R	?	925D	1/5/47–49	2.1
771617	ODP925203	*Polycope orbicularis* s.l.		L	?	925C	1/1/26–28	2.2
771618	ODP925207	*Polycope orbicularis* s.l.		R	?	925D	1/5/137–139	2.3
771619	ODP925208	*Polycope orbicularis* s.l.		L	?	925D	1/5/137–139	2.4
771620	ODP925209	*Polycope orbicularis* s.l.		L	?	925D	1/5/137–139	2.5
771621	ODP925211	*Polycope orbicularis* s.l.		L	?	925D	1/5/137–139	2.6
771622	ODP925204	*Polycope orbicularis* s.l.		L	?	925C	1/1/26–28	2.7
771623	ODP925205	*Polycope orbicularis* s.l.		R	?	925C	1/1/26–28	2.8
771624	ODP925210	*Polycope orbicularis* s.l.		R	?	925D	1/5/137–139	2.9
771625	ODP925206	*Polycope vasfiensis*		L	?	925C	1/1/26–28	2.10
771626	ODP925013	*Bythocypris weddellensis*		R	J?	925C	2/6/27–29	2.11
771627	ODP925011	*Zabythocypris ancipita*		R	A?	925C	1/1/6–8	2.12
771628	ODP925012	*Zabythocypris ancipita*		L	J	925C	1/1/6–8	2.13
771629	ODP925257	*Zabythocypris heterodoxa*		L	A-1	925C	1/1/6–8	3.1
771630	ODP925258	*Zabythocypris heterodoxa*		L	A	925C	1/1/26–28	3.2
771631	ODP925259	*Zabythocypris heterodoxa*		R	A	925D	1/5/137–139	3.3
771632	ODP925212	*Macrocypris miranda* s.l.		L	A?	925D	1/6/67–69	3.4
771633	ODP925003	*Aratrocypris* sp. 1		L	J?	925C	1/3/97–99	3.5
771634	ODP925002	*Aratrocypris* sp. 1		R	J?	925C	1/3/107–109	3.6
771635	ODP925004	*Argilloecia acuminata*		L	A	925C	1/1/6–8	3.7
771636	ODP925005	*Argilloecia acuminata*		R	A?	925C	1/3/27–29	3.8
771637	ODP925006	*Argilloecia labri*		R	A?	925C	1/1/46–48	3.9
771638	ODP925007	*Argilloecia labri*		L	A?	925C	1/3/27–29	3.10
771639	ODP925159	*Argilloecia labri*		R	A	925C	1/3/107–109	3.11
771640	ODP925008	*Argilloecia* sp. 1		L	A?	925C	1/1/26–28	3.12
771641	ODP925009	*Argilloecia* sp. 1		R	A?	925C	1/1/26–28	3.13
771642	ODP925218	*Propontocypris trigonella* s.l.		L	J	925C	1/1/6–8	3.14
771643	ODP925223	*Pseudocythere fuegiensis*		R	A	925C	1/3/107–109	4.1
771644	ODP925224	*Pseudocythere caudata*		L	A	925D	1/5/137–139	4.2
771645	ODP925225	*Pseudocythere caudata*		R	A	925D	1/5/137–139	4.3
771646	ODP925233	*Pseudocythere caudata*		L	A	925C	2/6/27–29	4.4
771647	ODP925234	*Pseudocythere caudata*		R	A	925C	2/6/27–29	4.5
771648	ODP925227	*Pseudocythere caudata*		L	A	925D	1/5/137–139	4.6
771649	ODP925232	*Pseudocythere caudata*		R	A	925D	1/5/137–139	4.7
771650	ODP925235	*Pseudocythere caudata*		L	A	925C	2/6/27–29	4.8
771651	ODP925236	*Pseudocythere caudata*		R	A	925C	2/6/27–29	4.9
771652	ODP925238	*Pseudocythere caudata*		L	A	925C	1/1/26–28	4.10
771653	ODP925239	*Pseudocythere caudata*		L	A	925C	1/4/27–29	4.11
771654	ODP925241	*Pseudocythere caudata*		R	A	925C	2/3/125–127	4.12
771655	ODP925237	*Pseudocythere caudata*		R	A	925C	1/1/26–28	4.13
771656	ODP925240	*Pseudocythere caudata*		R	A	925C	2/3/125–127	4.14
771657	ODP925226	*Pseudocythere* sp. 1		R	A	925D	1/5/137–139	4.15
771658	ODP925229	*Pseudocythere spinae* n. sp.	H	R	A	925D	1/5/137–139	4.16
771659	ODP925228	*Pseudocythere spinae* n. sp.	P	L	A	925D	1/5/137–139	4.17
771660	ODP925231	*Pseudocythere spinae* n. sp.	P	R	A	925D	1/5/137–139	4.18
771661	ODP925230	*Pseudocythere spinae* n. sp.	P	L	A	925D	1/5/137–139	4.19
771662	ODP925244	*Ruggieriella mcmanusi*		R	A	925D	1/4/97–99	5.1
771663	ODP925010	*Aversovalva atlantica*		L	J	925D	1/5/67–69	5.2
771664	ODP925014	*Cytheropteron carolinae*		L	A	925C	1/3/97–99	5.3
771665	ODP925015	*Cytheropteron carolinae*		L	A	925C	1/3/97–99	5.4
771666	ODP925016	*Cytheropteron carolinae*		R	A	925C	1/3/107–109	5.5
771667	ODP925018	*Cytheropteron omega*		L	A	925C	1/3/107–109	5.6
771668	ODP925019	*Cytheropteron omega*		L	A	925C	1/3/97–99	5.7
771669	ODP925030	*Cytheropteron omega*		R	A	925C	2/2/96–98	5.8
771670	ODP925020	*Cytheropteron porterae*		R	J?	925C	1/1/136–138	5.9
771671	ODP925029	*Cytheropteron porterae*		R	A	925C	2/2/96–98	5.10
771672	ODP925021	*Cytheropteron demenocali*		L	A	925C	1/1/26–28	5.11
771673	ODP925242	*Cytheropteron demenocali*		L	A	925C	1/4/27–29	5.12
771674	ODP925243	*Cytheropteron demenocali*		R	A?	925C	1/4/27–29	5.13
771675	ODP925023	*Cytheropteron cf. C. lineoporosa*		L	A	925C	1/1/26–28	6.1
771676	ODP925024	*Cytheropteron cf. C. lineoporosa*		R	A	925C	1/1/26–28	6.2
771677	ODP925025	*Cytheropteron cf. C. lineoporosa*		L	A	925C	1/1/26–28	6.3
771678	ODP925026	*Cytheropteron cf. C. lineoporosa*		R	A	925C	1/1/26–28	6.4
771679	ODP925027	*Cytheropteron lineoporosa*		R	A	925C	2/6/27–29	6.5

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Appendix 1 Continued.

USNM PAL	No.	Species	T	V	Instar	Hole	Section	Fig.
771680	ODP925028	*Cytheropteron lineoporosa*		L	A	925C	2/6/27–29	6.6
771681	ODP925017	*Cytheropteron lineoporosa*		R	A	925C	1/1/46–48	6.7
771682	ODP925022	*Cytheropteron* sp. 1		R	A	925C	1/1/26–28	6.8
771683	ODP925033	*Eucytherura spinicorona*		L	A?	925C	2/3/125–127	7.1
771684	ODP925034	*Eucytherura spinicorona*		R	A?	925C	2/3/125–127	7.2
771685	ODP925035	*Eucytherura spinicorona*		L	A?	925D	1/5/47–49	7.3
771686	ODP925036	*Eucytherura calabra*		R	A	925C	1/1/6–8	7.4
771687	ODP925037	*Eucytherura calabra*		L	A	925C	1/3/107–109	7.5
771688	ODP925038	*Eucytherura calabra*		R	A	925C	1/3/107–109	7.6
771689	ODP925039	*Eucytherura downingae*		L	A	925C	1/4/7–9	7.7
771690	ODP925042	*Eucytherura downingae*		L	A	925D	1/5/137–139	7.8
771691	ODP925040	*Eucytherura downingae*		R	A	925C	1/4/47–49	7.9
771692	ODP925041	*Eucytherura downingae*		R	A	925D	1/5/47–49	7.10
771693	ODP925044	*Hemiparacytheridea zarikiani* n. sp.	H	L	A	925C	1/1/6–8	7.11
771694	ODP925048	*Hemiparacytheridea zarikiani* n. sp.	P	R	A	925C	2/3/125–127	7.12
771695	ODP925049	*Hemiparacytheridea zarikiani* n. sp.	P	L	A	925C	2/3/125–127	7.13
771696	ODP925050	*Hemiparacytheridea zarikiani* n. sp.	P	R	A	925C	2/3/125–127	7.14
771697	ODP925046	*Eucytherura multituberculata*		R	A	925D	1/5/137–139	7.15
771698	ODP925043	*Eucytherura multituberculata*		L	A	925C	1/1/6–8	7.16
771699	ODP925198	*Pedicythere atroposopetasi*		L	A	925D	1/4/137–139	8.1, 8. 2
771700	ODP925183	*Pedicythere kennettopetasi*		L	A	925C	1/1/6–8	8.3, 8.4
771701	ODP925187	*Pedicythere kennettopetasi*		L	A	925C	1/1/6–8	8.5, 8.6
771702	ODP925188	*Pedicythere kennettopetasi*		L	A	925C	1/1/6–8	8.7, 8.8
771703	ODP925192	*Pedicythere kennettopetasi*		R	A	925C	1/1/26–28	8.9, 8.10
771704	ODP925193	*Pedicythere kennettopetasi*		R	A	925C	1/4/47–49	8.11, 8.12
771705	ODP925196	*Pedicythere kennettopetasi*		L	A	925D	1/5/137–139	8.13, 8.14
771706	ODP925200	*Pedicythere kennettopetasi*		L	A	925D	1/5/47–49	8.15, 8.16
771707	ODP925191	*Pedicythere cf. P. kennettopetasi*		L	A	925C	1/1/26–28	8.17, 8.18
771708	ODP925185	*Pedicythere cf. P. kennettopetasi*		L	A	925C	1/1/6–8	8.19
771709	ODP925184	*Pedicythere cf. P. kennettopetasi*		L	A	925C	1/1/6–8	8.20
771710	ODP925194	*Pedicythere cf. P. kennettopetasi*		L	A	925C	1/3/97–99	9.1, 9.2
771711	ODP925201	*Pedicythere cf. P. kennettopetasi*		R	A	925D	1/5/47–49	9.3, 9.4
771712	ODP925199	*Pedicythere canis* n. sp.	H	R	A	925D	1/4/137–139	9.5, 9.6
771713	ODP925195	*Pedicythere canis* n. sp.	P	L	A	925D	1/5/137–139	9.7, 9.8
771714	ODP925189	*Pedicythere* sp. 1		L	A	925C	2/6/27–29	9.9, 9.10
771715	ODP925190	*Pedicythere* sp. 1		L	A	925C	2/6/27–29	9.11
771716	ODP925186	*Pedicythere lachesisopetasi*		L	A	925C	1/1/6–8	9.12, 9.13
771717	ODP925197	*Pedicythere sp. 2*		R	A	925D	1/5/137–139	9.14, 9.15
771718	ODP925245	*Rimacytheropteron longipunctatum*		R	A	925C	1/3/107–109	10.1
771719	ODP925045	*Semicytherura pulchra*		L	A	925C	1/1/6–8	10.2, 10.3
771720	ODP925047	*Semicytherura pulchra*		L	A	925C	2/3/125–127	10.4, 10.5
771721	ODP925255	*Semicytherura coeca*		L	A	925D	1/5/47–49	10.6, 10. 7
771722	ODP925256	*Semicytherura coeca*		R	A	925D	1/5/47–49	10.8, 10.9
771723	ODP925031	*Eucythere pubera*		L	J?	925C	2/2/96–98	10.10
771724	ODP925032	*Eucythere pubera*		R	J	925C	2/2/96–98	10.11
771725	ODP925251	*Xylocythere denticulata* n. sp.	H	L	A	925C	1/3/27–29	10.12
771726	ODP925252	*Xylocythere denticulata* n. sp.	P	L	A	925C	1/3/47–49	10.13
771727	ODP925253	*Xylocythere denticulata* n. sp.	P	R	A	925C	1/3/47–49	10.14
771728	ODP925254	*Xylocythere denticulata* n. sp.	P	L	A	925C	1/3/47–49	10.15
771729	ODP925260	*Chejudocythere subtriangulata*		L	A	925C	1/4/47–49	11.1, 11.2
771730	ODP925151	*Paracytherois bondi*		L	A	925C	1/1/26–28	11.3
771731	ODP925152	*Paracytherois bondi*		R	A	925C	1/1/26–28	11.4
771732	ODP925154	*Paracytherois bondi*		R	A	925C	1/1/26–28	11.5, 11.6
771733	ODP925153	*Paracytherois bondi*		L	A	925C	1/1/26–28	11.7
771734	ODP925155	*Paracytherois bondi*		L	A	925D	1/5/137–139	11.8
771735	ODP925156	*Paracytherois bondi*		R	A	925D	1/5/137–139	11.9, 11.10
771736	ODP925157	*Paracytherois bondi*		L	A	925C	1/3/107–109	11.11
771737	ODP925158	*Paracytherois bondi*		R	A	925C	1/3/107–109	11.12
771738	ODP925164	*Paracytherois bondi*		L	A	925D	1/5/47–49	11.13, 11.14
771739	ODP925165	*Paracytherois bondi*		R	A	925D	1/5/47–49	11.15
771740	ODP925166	*Paracytherois bondi*		L	A	925D	1/5/47–49	11.16
771741	ODP925167	*Paracytherois bondi*		R	A	925D	1/5/47–49	11.17
771742	ODP925168	*Paracytherois bondi*		L	A	925D	1/5/47–49	11.18
771743	ODP925169	*Paracytherois bondi*		R	A	925D	1/5/47–49	11.19, 11.20
771744	ODP925171	*Paracytherois bondi*		R	A	925C	2/3/125–127	12.1
771745	ODP925172	*Paracytherois bondi*		L	A	925D	1/5/137–139	12.2
771746	ODP925173	*Paracytherois bondi*		R	A	925D	1/5/137–139	12.3
771747	ODP925170	*Paracytherois obtusa* n. sp.	P	L	A	925C	2/3/125–127	12.4
771748	ODP925174	*Paracytherois obtusa* n. sp.	H	L	A	925C	1/1/6–8	12.5, 12.6
771749	ODP925175	*Paracytherois obtusa* n. sp.	P	R	A	925C	1/1/6–8	12.7
771750	ODP925176	*Paracytherois obtusa* n. sp.	P	R	A	925C	1/1/6–8	12.8
771751	ODP925177	*Paracytherois obtusa* n. sp.	P	L	A	925C	2/3/125–127	12.9
771752	ODP925178	*Paracytherois obtusa* n. sp.	P	R	A	925C	2/3/125–127	12.10, 12.11
771753	ODP925179	*Paracytherois obtusa* n. sp.	P	L	A	925D	1/5/137–139	12.12

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Appendix 1 Continued.

USNM PAL	No.	Species	T	V	Instar	Hole	Section	Fig.
771754	ODP925180	*Paracytherois productum*		L	A	925C	1/3/107–109	12.13
771755	ODP925181	*Paracytherois productum*		R	A	925C	1/3/97–99	12.14
771756	ODP925182	*Paracytherois productum*		L	A	925C	1/3/97–99	12.15, 12.16
771757	ODP925213	*Poseidonamicus sculptus* n. sp.	H	L	A	925B	3/3/7–9	13.1
771758	ODP925215	*Poseidonamicus sculptus* n. sp.	P	R	A	925C	2/5/47–49	13.2
771759	ODP925216	*Poseidonamicus sculptus* n. sp.	P	L	A	925C	2/2/127–129	13.3, 13.4
771760	ODP925217	*Poseidonamicus sculptus* n. sp.	P	R	A	925C	2/2/127–129	13.5, 13.6
771761	ODP925214	*Poseidonamicus cf. P. sculptus*		L	A	925C	2/5/146–148	13.7
527091	SI55-01	*Poseidonamics pintoi*		L	A	Albatross Station 2763		13.8
771762	SI55-19	*Poseidonamics pintoi*		R	A	Albatross Station 2763		13.9
771763	ODP925219	*Pterygocythere nobilis*		R	A	925C	1/1/6–8	15.1
771764	ODP925220	*Pterygocythere nobilis*		R	A	925C	1/4/27–29	15.2
771765	ODP925221	*Pterygocythere nobilis*		L	A	925C	1/4/7–9	15.3
771766	ODP925222	*Pterygocythere nobilis*		L	A-1?	925C	2/3/106–108	15.4
771767	ODP925246	*Xestoleberis oppoae*		R	J?	925C	2/3/125–127	15.5
771768	ODP925248	*Xestoleberis oppoae*		R	A	925C	1/1/46–48	15.6
771769	ODP925247	*Xestoleberis oppoae*		L	A	925C	1/1/46–48	15.7
771770	ODP925249	*Xestoleberis oppoae*		L	A	925C	1/2/87–89	15.8
771771	ODP925250	*Xestoleberis oppoae*		R	A	925C	1/2/87–89	15.9
771772	ODP925001	*Abyssocythere atlantica*		R	J	925D	1/6/27–29	15.10
771773	ODP925051	*Henryhowella asperrima*		L	A	925C	2/6/127–129	16.1
771774	ODP925052	*Henryhowella asperrima*		R	A	925C	2/6/127–129	16.2
771775	ODP925053	*Henryhowella asperrima*		L	A	925C	1/1/136–138	16.3
771776	ODP925054	*Henryhowella asperrima*		R	A	925C	1/1/136–138	16.4
771777	ODP925055	*Henryhowella asperrima*		L	A	925C	1/3/67–68	16.5
771778	ODP925056	*Henryhowella asperrima*		L	A	925C	1/3/7–9	16.6
771779	ODP925058	*Henryhowella asperrima*		L	A	925C	2/5/146–148	16.7
771780	ODP925057	*Henryhowella asperrima*		R	A	925C	1/3/7–9	16.8
771781	ODP925150	*Legitimocythere acanthoderma*		L	A	925D	1/6/67–69	17.1
771782	ODP925160	*Legitimocythere acanthoderma*		L	A	925C	1/3/107–109	17.2
771783	ODP925161	*Legitimocythere acanthoderma*		R	A	925C	1/3/107–109	17.3
771784	ODP925162	*Legitimocythere acanthoderma*		L	A	925D	1/4/47–49	17.4
771785	ODP925163	*Legitimocythere acanthoderma*		R	A	925D	1/4/47–49	17.5

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