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QUATERNARY DEEP-SEA OSTRACODE TAXONOMY OF OCEAN DRILLING PROGRAM SITE 980, EASTERN NORTH ATLANTIC OCEAN

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ABSTRACT—Ocean Drilling Program (ODP) Holes 980 B and C, Feni Drift at the eastern slope of the Rockall Plateau, eastern North Atlantic, were examined for late Quaternary deep-sea ostracode taxonomy. Nineteen genera and 32 species were examined and (re-)illustrated with high-resolution scanning electron microscopy images. One new species *Cytheropteron paramassoni* n. sp. is described and one new name *Eucytherura zehali* is proposed for *Eucytherura hazeli* Yasuhara et al., 2009. This study provides updated taxonomic information for deep-sea ostracode genera and species from the eastern North Atlantic, which is an important baseline for application of deep-sea ostracodes to paleoceanographical reconstructions and paleoecological studies in this region.

INTRODUCTION

DEEP-SEA OSTRACODA (Crustacea) are an important component of deep-sea meiobenthos (Brandt et al., 2007). Compared to other abundant deep-sea meiobenthic groups of Nematoda and Copepoda, taxonomy is much better investigated in ostracodes. For example, most of deep-sea nematode and copepod species are not formally described and are left in open nomenclature (e.g., Shimanaga et al., 2004; Danovaro et al., 2009). In contrast, hundreds of deep-sea ostracode species have been described and majority of specimens are identified to known species in deep-sea ostracode paleontological and biological studies especially in well-studied regions of, for example, the North Atlantic Ocean (Coles et al., 1990; Dingle and Lord, 1990; Whatley and Ayress, 1988; Didié and Bauch, 2000; Cronin et al., 1999). However, significant taxonomic problems remain, mainly because a considerable part of the taxonomic studies had been done before the 1970s before the scanning electron microscope (SEM) became a routine tool for micropaleontology (e.g., Brady, 1880; Sars, 1866; van den Bold, 1946; Puri and Hulings, 1976), and reliable specimens (e.g., holotype, lectotype, topotypes) of species described in such studies were not always re-illustrated using SEM in subsequent studies. Consequently, the paucity of reliable, high-resolution SEM images has prevented accurate identification.

Deep-sea ostracode taxonomy is relatively well investigated in the North Atlantic Ocean. However, since the 1980s studies (Coles and Whatley, 1989; Whatley and Coles, 1987), formal taxonomic investigations are few in the North Atlantic, although Yasuhara and his collaborators conducted intensive taxonomic investigation in the western North Atlantic recently (Yasuhara et al., 2009). This two-to-three decade absence of taxonomic research resulted in a lack of progress in clarifying many taxonomic problems that remain today, and prevents accuracy in applied deep-sea ostracode studies of paleoceanography and paleoecology. Furthermore, a considerable number of deep-sea species remain undescribed even in this well-studied region of the North Atlantic Ocean. To improve these situations, we examine late Quaternary sediments from Ocean Drilling Program (ODP) Holes 980 B and C cored at the Feni Drift at the eastern slope of the Rockall Plateau, eastern North Atlantic (N 55°29.095′, W 14°42.133′; 2169.5 m water depth; Fig. 1), for deep-sea ostracode taxonomy, because ostracodes are abundant and well preserved in this core. Shallow-water contaminated species found in this core are also examined.

SYSTEMATIC PALEONTOLOGY

The full information for the specimens used for the present study is shown in Table 1. All specimens are from late Quaternary sediments of ODP Holes 980 B or C. Uncoated specimens were digitally imaged with Philips XL-30 environmental SEM and were deposited in the National Museum of Natural History (Washington, D.C., catalog numbers USNM 594900–USNM 594944). High-resolution figures of ostracod SEM images (Figs. 2–8) are available as online Supplemental files 1–7. We follow the higher classification scheme of the World Register of Marine Species (WoRMS: http://www.marinespecies.org/) with certain modifications. Abbreviations: LV, left valve; RV, right valve; L, length (mm); H, height (mm).

Class OSTRACODA Latreille, 1802
Subclass MYODOCOPA Sars, 1866
Order HALOCYPRIDA Dana, 1853
Suborder CLADOCOPINA Sars, 1866
Superfamily POLYCOPIDEA Sars, 1866
Family POLYCOPIDAE Sars, 1866
Genus POLYCOPE Sars, 1866

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

POLYCOPE cf. CLATHRATA Sars, 1923
Figure 2.1

2009 *Polycope* cf. *P. clathrata* Sars; ALVAREZ ZARIKIAN, p. 3, pl. P1, fig. 5.

Remarks.—This species is conspecific with *Polycope* cf. *P. clathrata* Sars, 1923 of Alvarez Zarikian (2009).

Subclass PODOCOPA Müller, 1894
Order PLATYCOPIDA Sars, 1866
Suborder PLATYCOPINA Sars, 1866
Superfamily CYTHERELLOIDEA Sars, 1866
Family CYTHERELLIDAE Sars, 1866
Genus CYTHERELLA Jones, 1849

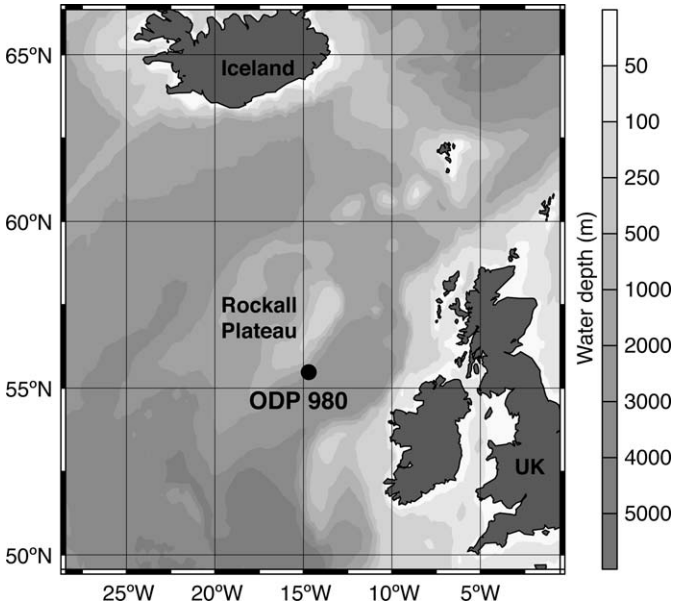

FIGURE 1—Map of the eastern North Atlantic Ocean showing location of ODP Site 980 (N 55°29.095′, W 14°42.133′; 2169.5 m water depth).

Type species.—*Cytherina ovata* Roemer, 1841 (designated by Ulrich, 1894).

CYTHERELLA ROBUSTA Colalongo and Pasini, 1980
Figure 2.2

1979 *Cytherella* sp. 11; DUCASSE AND PEYPOUQUET, pl. 1, figs. 3, 4.
1980 *Cytherella robusta* COLALONGO AND PASINI, p. 78, pl. 6, figs. 4–10.
?1988 *Cytherella optima* RUAN (*in* Ruan and Hao, 1988), p. 385, pl. 72, figs. 1–5.
1996 *Cytherella robusta* AIELLO ET AL., 1996, p. 184, pl. 2, figs. 4, 5, 8–12.
2001 *Cytherella serratula* (Brady); DIDIÉ AND BAUCH, p. 104, pl. 1, fig. 5 (as erratum for Didié and Bauch, 2000).
2001 *Cytherella* sp. 1; DIDIÉ AND BAUCH, p. 104, pl. 1, fig. 6 (as erratum for Didié and Bauch, 2000).
2001 *Cytherella* sp. 2; DIDIÉ AND BAUCH, p. 104, pl. 1, fig. 7 (as erratum for Didié and Bauch, 2000).
2009 *Cytherella* sp.; ALVAREZ ZARIKIAN, p. 7, pl. P10, fig. 5.
2009 *Cytherella robusta* s.l. Colalongo and Pasini; YASUHARA ET AL., p. 882, pl. 1, figs. 7–12.
in press a *Cytherella robusta* YASUHARA ET AL., fig. 8.1.

TABLE 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 (core/section/interval). Abbreviations: USNM=National Museum of Natural History catalog number; T=type; P=paratype; H=holotype; V=valve; L=left; R=right; A=adult; J=juvenile.

USNM	Species	T	V	Instar	Hole	Section	Figure
594900	*Polycope* cf. *clathrata*		R	?	980B	1/3/41–43	2.1
594901	*Cytherella robusta*		L	J	980B	1/1/121–123	2.2
594902	*Argilloecia abba*		R	A	980B	1/3/41–43	2.3
594903	*Australoecia posteroacuta*		L	A	980B	1/1/121–123	2.4
594904	*Argilloecia acuminata*		R	A	980B	1/1/121–123	2.5
594905	*Australoecia posteroacuta*		R	A	980B	1/1/121–123	2.6
594906	*Pontocypris* sp. A		L	?	980B	1/2/119–121	2.7
594907	*Pontocypris* sp. A		R	?	980B	1/2/119–121	2.8
594908	*Pseudocythere caudata*		L	?	980C	2/2/0–2	2.9
594909	*Pseudocythere caudata*		L	A	980C	2/2/0–2	2.10
594910	*Palmenella limicola*		L	J	980C	2/3/0–2	3.1
594911	*Cytheropteron alatum*		R	A	980B	1/1/41–43	3.2
594912	*Cytheropteron demenocali*		L	J	980C	2/3/0–2	3.3
594913	*Cytheropteron demenocali*		R	J	980C	2/3/0–2	3.4
594914	*Cytheropteron massoni*		L	A	980B	6/5/120–122	3.5
594915	*Cytheropteron massoni*		R	A	980C	2/5/0–2	3.6
594916	*Cytheropteron paramassoni*	P	L	A	980C	2/3/81–83	3.7
594917	*Cytheropteron pyramidale*		R	J	980C	2/3/81–83	3.8
594918	*Cytheropteron paramassoni*	H	R	A	980C	2/3/81–83	3.9
594919	*Cytheropteron pherozigzag*		R	A	980C	2/5/0–2	4.1
594920	*Cytheropteron perlaria*		L	A	980B	1/1/0–2	4.2
594921	*Cytheropteron mediotumidum*		R	A	980B	1/2/40–42	4.3
594922	*Cytheropteron richarddinglei*		L	J	980C	2/2/0–2	4.4
594923	*Cytheropteron* cf. *aielloi*		L	A	980C	2/2/0–2	4.5
594924	*Cytheropteron* cf. *aielloi*		R	A	980C	2/2/0–2	4.6
594925	*Eucytherura calabra*		R	A	980C	2/3/0–2	4.7
594926	*Cytheropteron* sp. A		L	A	980C	2/5/0–2	4.8
594927	*Pelecocythere sylvesterbradleyi*		L	A	980B	1/3/41–43	5.1
594928	*Pelecocythere sylvesterbradleyi*		R	A	980B	1/3/41–43	5.2
594929	*Pelecocythere sylvesterbradleyi*		L	A	980B	1/1/0–2	5.3
594930	*Pelecocythere sylvesterbradleyi*		R	A	980B	1/1/0–2	5.4
594931	*Eucythere pubera*		L	J	980B	1/3/41–43	6.1
594932	*Eucythere triangula*		R	A	980B	6/5/120–122	6.2
594933	*Eucythere triangula*		L	A	980B	1/3/41–43	6.3
594934	*Eucythere* sp. A		L	J	980C	2/3/0–2	6.4
594935	*Finmarchinella finmarchica*		L	J	980C	2/4/0–2	7.1
594936	*Loxoconchidea minima*		L	A	980B	1/3/41–43	7.2
594937	*Loxoconchidea minima*		R	A	980B	1/3/41–43	7.3
594938	*Arcacythere enigmatica*		R	J	980C	2/4/0–2	7.4
594939	*Thaerocythere crenulata*		L	J	980C	2/4/0–2	8.1
594940	*Echinocythereis echinata*		R	A	980B	1/1/121–123	8.2
594941	*Echinocythereis echinata*		L	A	980B	1/1/121–123	8.3
594942	*Henryhowella asperrima*		L	J	980B	1/1/121–123	8.4
594943	*Pterygocythereis mucronata*		R	J	980C	2/5/0–2	8.5
594944	*Xestoleberis* sp. A		R	J	980C	2/4/0–2	8.6

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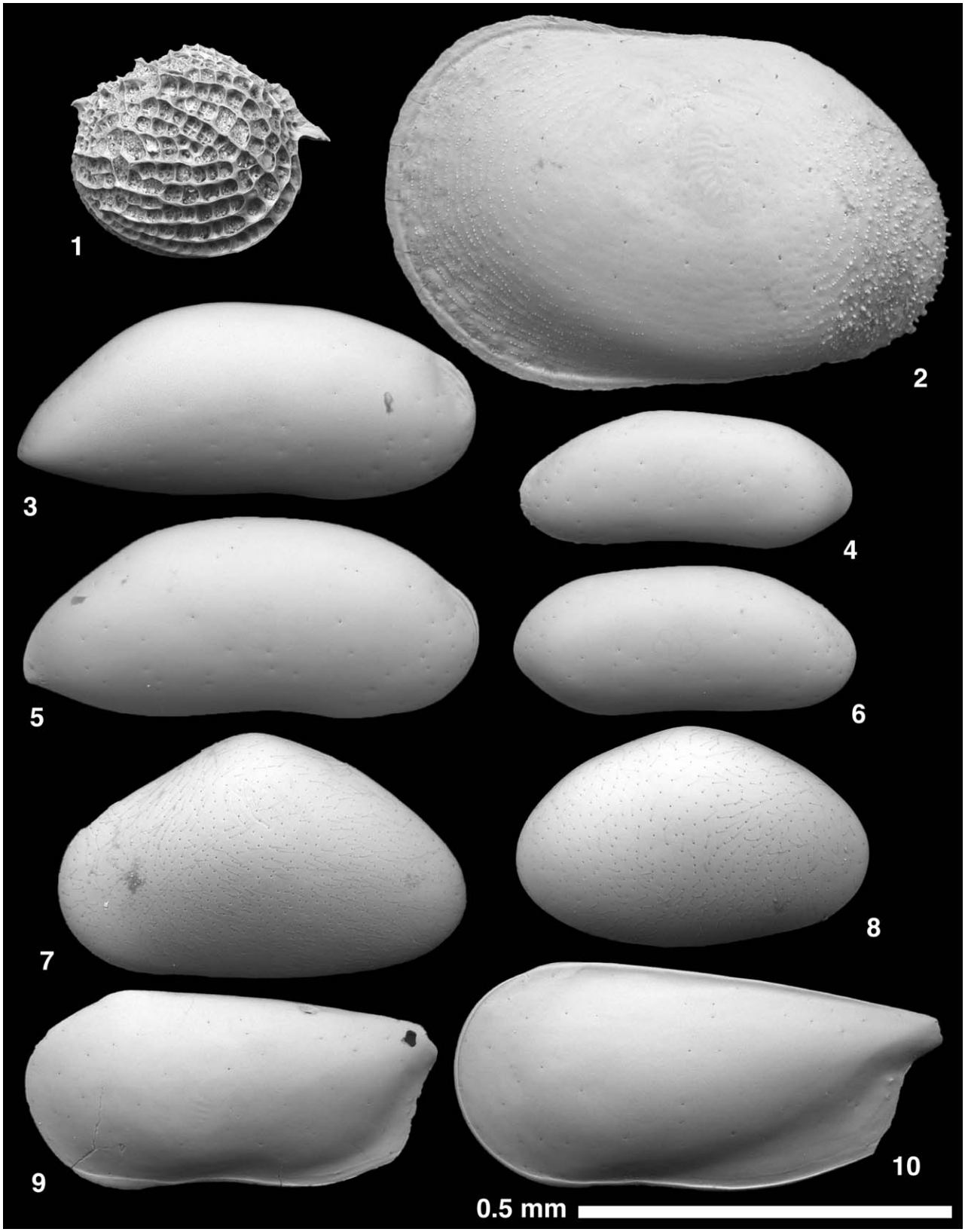

FIGURE 2—SEM images of ostracode species. *1*, *Polycope* cf. *clathrata* Sars, 1923, RV from 980B, 1/3/41–43 (USNM 594900); *2*, *Cytherella robusta* Colalongo and Pasini, 1980, juvenile LV from 980B, 1/1/121–123 (USNM 594901); *3*, *Argilloecia abba* Yasuhara, Okahashi and Cronin, 2009, adult RV from 980B, 1/3/41–43 (USNM 594902); *4*, *6*, *Australoecia posteroacuta* Coles and Whatley, 1989: *4*, adult LV from 980B, 1/1/121–123 (USNM 594903); *6*, adult RV from 980B, 1/1/121–123 (USNM 594905); *5*, *Argilloecia acuminata* Müller, 1894, adult RV from 980B, 1/1/121–123 (USNM 594904); *7*, *8*, *Pontocypris* sp. A: *7*, LV from 980B, 1/2/119–121 (USNM 594906); *8*, RV from 980B, 1/2/119–121 (USNM 594907); *9*, *10*, *Pseudocythere caudata* Sars, 1866: *9*, LV from 980C, 2/2/0–2 (USNM 594908); *10*, adult LV from 980C, 2/2/0–2 (USNM 594909). All lateral views. Scale bar=0.5 mm.

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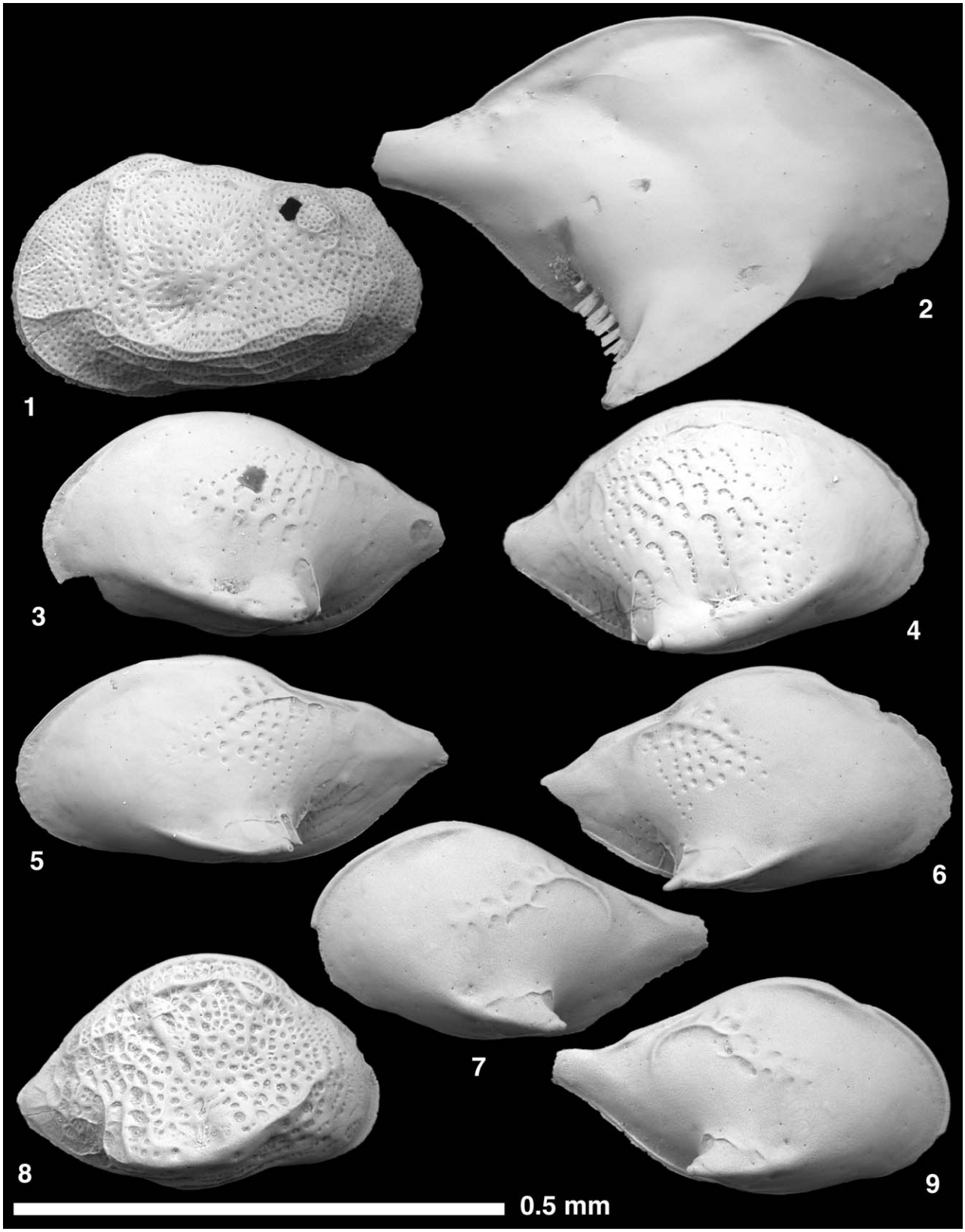

FIGURE 3—SEM images of ostracode species. *1*, *Palmenella limicola* (Norman, 1863), juvenile LV from 980C, 2/3/0–2 (USNM 594910); *2*, *Cytheropteron alatum* Sars, 1866, adult RV from 980B, 1/1/41–43 (USNM 594911); *3*, *4*, *Cytheropteron demenocali* Yasuhara, Okahashi, and Cronin, 2009: *3*, juvenile LV from 980C, 2/3/0–2 (USNM 594912); *4*, juvenile RV from 980C, 2/3/0–2 (USNM 594913); *5*, *6*, *Cytheropteron massoni* Whatley and Coles, 1987: *5*, adult LV from 980B, 6/5/120–122 (USNM 594914); *6*, adult RV from 980C, 2/5/0–2 (USNM 594915); *7*, *9*, *Cytheropteron paramassoni* n. sp.: *7*, paratype, adult LV from 980C, 2/3/81–83 (USNM 594916); *9*, holotype, adult RV from 980C, 2/3/81–83 (USNM 594918); *8*, *Cytheropteron pyramidale* Brady, 1868, juvenile RV from 980C, 2/3/81–83 (USNM 594917). All lateral views. Scale bar=0.5 mm.

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Remarks.—A juvenile specimen of *Cytherella robusta* Colalongo and Pasini, 1980 is shown here. As indicated by Yasuhara et al. (2009), there are some differences in outline between the type specimens from the Plio–Pleistocene, Italy (Colalongo and Pasini, 1980) and the North Atlantic specimens (often reported as *Cytherella serratula*; see Aiello et al., 1996; Yasuhara et al., 2009). However, the differences are subtle, and now we consider it as intraspecific variation and that all synonymies of *Cytherella robusta* of Aiello et al. (1996), Yasuhara et al. (2009), and this study are correct. Specimens reported as *Cytherella* sp. by Alvarez Zarikian (2009) and *Cytherella* sp. 1 and *Cytherella* sp. 2 by Didié and Bauch (2000; 2001) are juveniles of *Cytherella robusta*. *Cytherella optima* Ruan, 1988 may be a junior synonym of *Cytherella robusta*.

Order Podocopida Sars, 1866
Suborder Cypridocopina Jones, 1901
Superfamily Pontocypridoidea Müller, 1894
Family Pontocyprididae Müller, 1894
Genus Argilloecia Sars, 1866

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

Argilloecia abba Yasuhara, Okahashi, and Cronin, 2009
Figure 2.3

2009 *Argilloecia abba* Yasuhara, Okahashi, and Cronin, p. 884, pl. 3, figs. 7, 8, 10, 11.

Remarks.—This species was originally reported from western North Atlantic ocean (Yasuhara et al., 2009) and the present study confirmed eastern North Atlantic occurrence of this species.

Argilloecia acuminata Müller, 1894
Figure 2.5

1894 *Argilloecia acuminata* Müller, p. 261, pl. 12, figs. 1, 2, 12–22.
2004 *Argilloecia acuminata* Müller; Aiello and Szczechura, p. 16, pl. 1, fig. 2.
2009 *Argilloecia acuminata* Müller; Yasuhara et al., p. 886, p. 3, figs. 1, 2, 4, 5.

Remarks.—Comprehensive synonymy is found in Aiello and Szczechura (2004) and Yasuhara et al. (2009). This species is originally described in the Mediterranean Sea and widely reported both from the Mediterranean region and the eastern and western North Atlantic.

Genus Australoecia McKenzie, 1967

Type species.—*Australoecia victoriensis* McKenzie, 1967.

Australoecia posteroacuta Coles and Whatley, 1989
Figure 2.4, 2.6

1989 *Australoecia posteroacuta* Coles and Whatley, p. 108, pl. 6, figs. 5–8.
2009 Undetermined; Alvarez Zarikian, p. 22, pl. P10, fig. 8.
2009 *Australoecia posteroacuta* Yasuhara et al., p. 890, pl. 3, figs. 3, 6, 9, 12.

Remarks.—The present study confirmed Quaternary distribution of this species both in the western and eastern North Atlantic.

Genus Propontocypris Sylvester-Bradley, 1947

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

Propontocypris sp. A
Figure 2.7, 2.8

Remarks.—This species very similar to *Pontocypris* sp. cf. *P. hispida* Sars of Whatley and Coles (1987), but the latter has more slender outline, more angular posterior margin, and distinct punctation in the dorso-central part. This species is also similar to *Propontocypris clara* Zhao, 1988 (*in* Wang et al., 1988), but the latter has much more slender outline.

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 2.9, 2.10

1866 *Pseudocythere caudata* Sars, p. 88.
1926 *Pseudocythere caudata* Sars, p. 239, pl. 109, fig. 2a–2k.
2009 *Pseudocythere caudata* Yasuhara et al., p. 892, pl. 4, figs. 7–12.

Remarks.—We think that this species has considerable intraspecific variation. Further details will be discussed and comprehensive synonymy will be shown in a separate paper (Yasuhara et al. in press b).

Family Cytheridae Baird, 1850
Genus Palmenella Hirschmann, 1916

Type species.—*Cythere limicola* Norman, 1863.

Palmenella limicola (Norman, 1863)
Figure 3.1

1863 *Cythere limicola* Norman, p. 266.
1867 *Cythereis limicola* (Norman); Norman, p. 20, pl. 6, figs. 1–4.
1993 *Palmenella limicola* (Norman); Penney, p. 245, fig. 4l.
1998 *Palmenella limicola* Freiwald and Mostafawi, p. 260, pl. 59, fig. 4.
2006 *Palmenella limicola* Stepanova, p. S169, pl. 4, figs. 1–3.

Remarks.—Original description does not include any illustration of this species and this species was first illustrated in Norman (1867). See van den Bold (1960) for details of this species. Comprehensive synonymy is found in Stepanova (2006) and supplemented here. *Palmenella limicola* is a well-known subpolar shallow-marine species (Penney, 1993), and thus is a shallow-water contaminated species transported by downslope processes or ice rafting (Didié and Bauch, 2000; Yasuhara et al., 2008).

Family Cytheruridae Müller, 1894
Genus Cytheropteron Sars, 1866

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

Cytheropteron cf. aielloi Yasuhara, Okahashi, and Cronin, 2009
Figure 4.5, 4.6

non 2009 *Cytheropteron aielloi* Yasuhara, Okahashi, and Cronin, p. 898, pl. 10, figs. 3–6.
2009 *Cytheropteron* sp. i; Yasuhara et al., p. 908, pl. 7, fig. 10.

Remarks.—*Cytheropteron* cf. *aielloi* is conspecific with *Cytheropteron* sp. i of Yasuhara et al. (2009). *Cytheropteron* cf. *aielloi* is very similar to *Cytheropteron aielloi* Yasuhara, Okahashi, and Cronin, 2009, but the latter has slightly less developed caudal process, more ventrally directed ala, better

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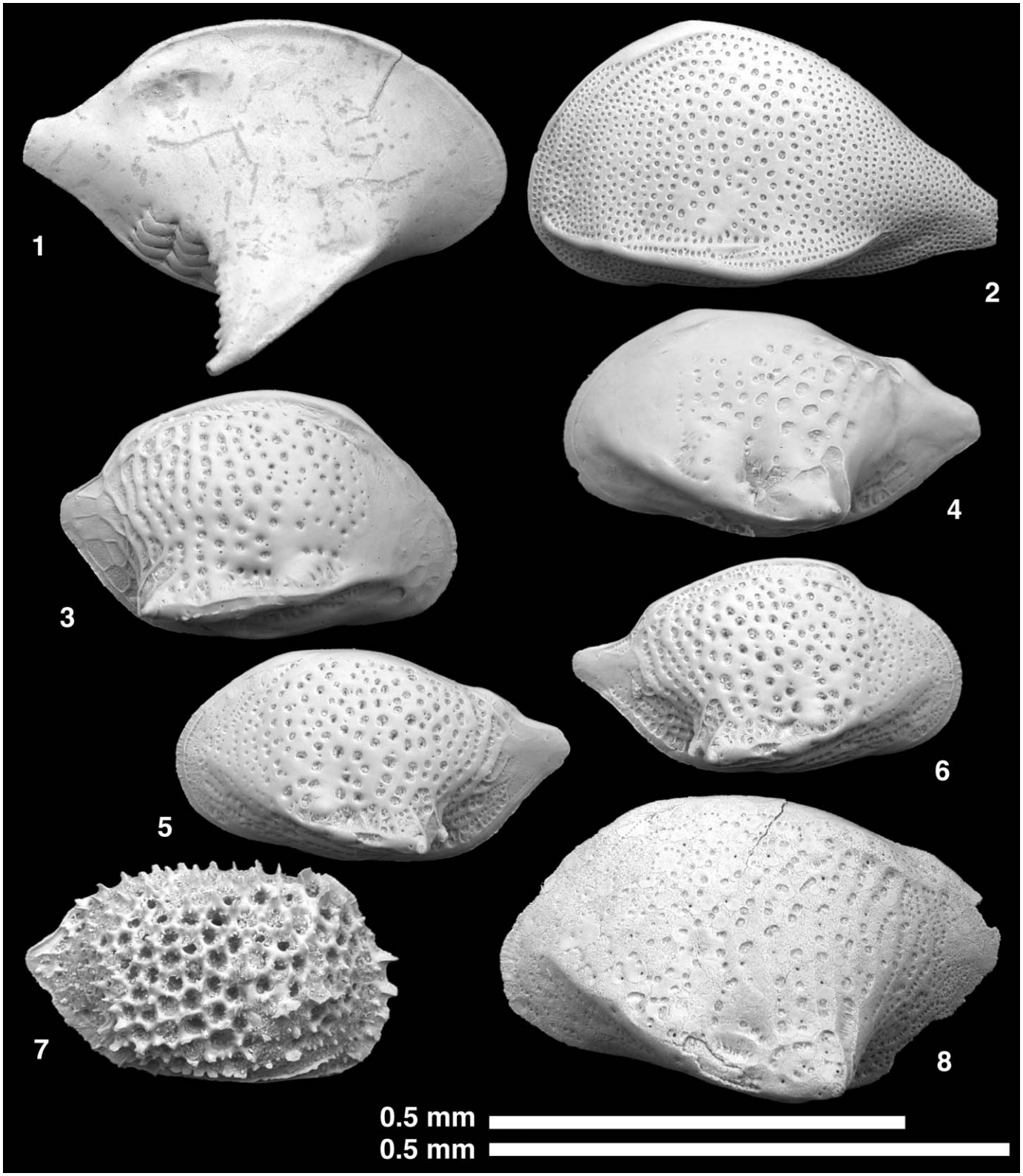

FIGURE 4—SEM images of ostracode species. *1*, *Cytheropteron pherozigzag* Whatley, Ayress, and Downing, 1986, adult RV from 980C, 2/5/0–2 (USNM 594919); *2*, *Cytheropteron perlaria* Hao, 1988, adult LV from 980B, 1/1/0–2 (USNM 594920); *3*, *Cytheropteron mediotumidum* Zhao, Whatley, and Zhou, 2000, adult RV from 980B, 1/2/40–42 (USNM 594921); *4*, *Cytheropteron richarddinglei* Yasuhara, Okahashi, and Cronin, 2009, juvenile LV from 980C, 2/2/0–2 (USNM 594922); *5*, *6*, *Cytheropteron* cf. *aielloi* Yasuhara, Okahashi, and Cronin, 2009: *5*, adult LV from 980C, 2/2/0–2 (USNM 594923); *6*, adult RV from 980C, 2/2/0–2 (USNM 594924); *7*, *Eucytherura calabra* (Colalongo and Pasini, 1980), adult RV from 980C, 2/3/0–2 (USNM 594925); *8*, *Cytheropteron* sp. A, adult LV from 980C, 2/5/0–2 (USNM 594926). All lateral views. Scale bars=0.5 mm. Top scale for *1*, *3*, *8*. Bottom scale for *2*, *4–7*.

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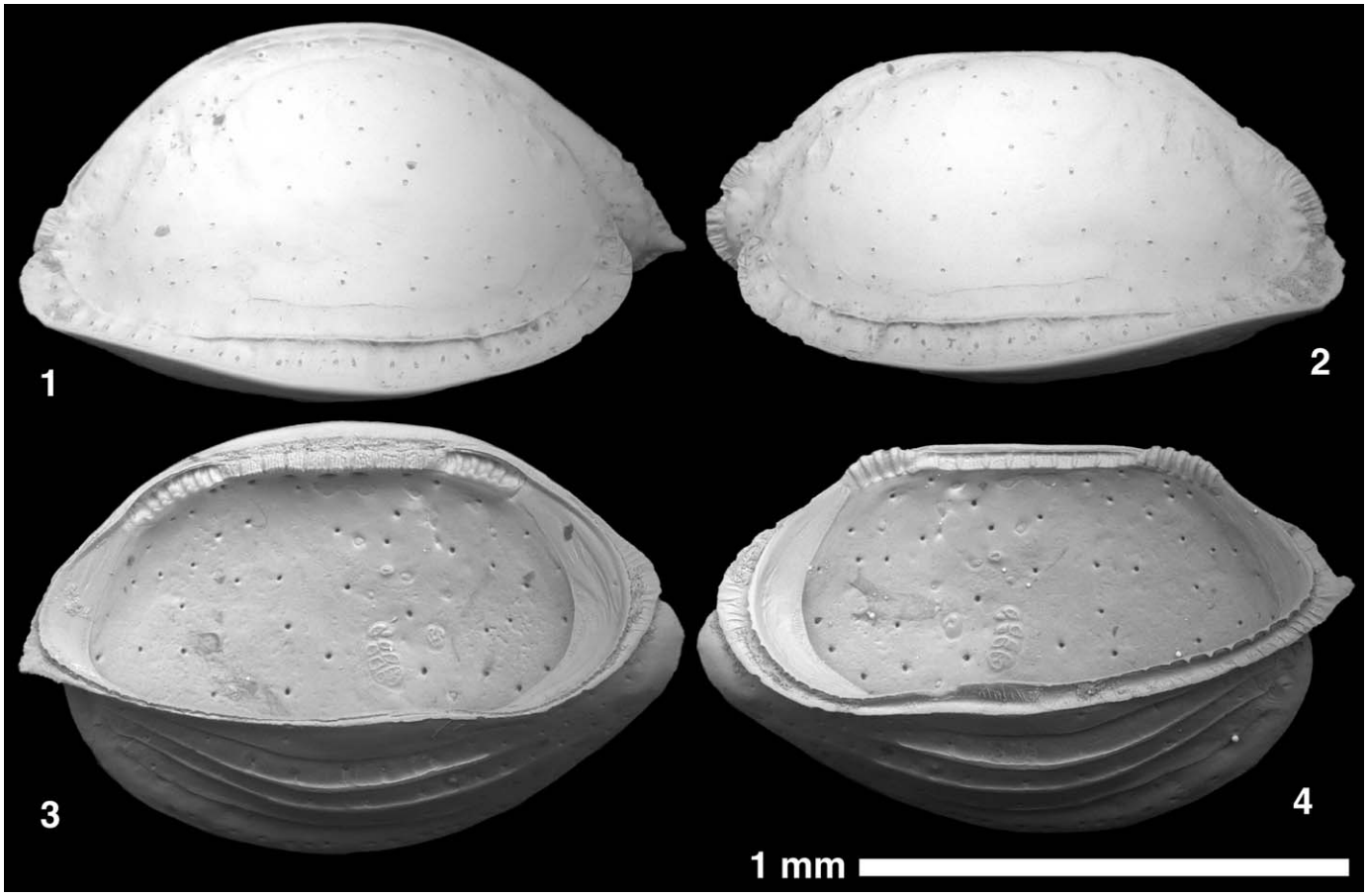

FIGURE 5—SEM images of *Pelecocythere sylvesterbradleyi* Athersuch, 1979. *1*, adult LV from 980B, 1/3/41–43 (USNM 594927); *2*, adult RV from 980B, 1/3/41–43 (USNM 594928); *3*, adult LV from 980B, 1/1/0–2 (USNM 594929); *4*, adult RV from 980B, 1/1/0–2 (USNM 594930). *1*, *2*, lateral views; *3*, *4*, internal views. Scale bar=1 mm.

developed fine ridges on ala, and better developed surface reticulation and punctation. We prefer to call this species as *Cytheropteron* cf. *aielloi* at least for now, because these differences are subtle.

CYTHEROPTERON ALATUM Sars, 1866
Figure 3.2

1866 *Cytheropteron alatum* SARS 1866, p. 81.
1826 *Cytheropteron alatum*; SARS, p. 225, pl. 104, fig. 1.
1993 *Cytheropteron alatum*; PENNEY, fig. 4n–4o.
1998 *Cytheropteron alatum*; FREIWALD AND MOSTAFAWI, p. 260, pl. 59, fig. 7.
2000 *Cytheropteron alatum*; DIDIÉ AND BAUCH, pl. 2, fig. 6.

Remarks.—Sars (1866) did not give any illustration of *Cytheropteron alatum* in his original description, however, subsequently Sars (1926) showed sketches of this species. Subsequently, two studies showed SEM images of *Cytheropteron alatum* from a topotypic locality, i.e., off Norway (Freiwald and Mostafawi, 1998; Penney, 1993). Didié and Bauch (2000) reported this species from the Rockall Plateau, eastern North Atlantic. We consider illustrations only from these four studies (Freiwald and Mostafawi, 1998; Penney, 1993; Sars, 1926; Didié and Bauch, 2000) as reliable illustrations of *Cytheropteron alatum*. Whatley and Masson (1979) provided SEM images of the species that they considered as *Cytheropteron alatum* from British waters, but did not show specific locality information of each specimen depicted. In our opinion, *Cytheropteron alatum* sensu Whatley and Masson (1979) are not conspecific with *Cytheropteron alatum*, because the former has a more elongate outline, less developed ala, and less developed spines on the posterior edge of the ala. In conclusion, reliable records of *Cytheropteron alatum* are currently from the eastern North Atlantic region only. Arctic specimens reported as *Cytheropteron alatum* are not conspecific with *Cytheropteron alatum*, and this topic will be discussed in detail in a separate paper (Yasuhara et al. in press b).

CYTHEROPTERON DEMENOCALI Yasuhara, Okahashi, and Cronin, 2009
Figure 3.3, 3.4

?2000 *Cytheropteron porterae* Whatley and Coles; DIDIÉ AND BAUCH, p. 113, pl. 2, fig. 20 (non figs. 19, 21).
2009 *Cytheropteron demenocali* YASUHARA ET AL., p. 900, pl. 7, figs. 8–10.

Remarks.—These juvenile specimens seems to be conspecific with *Cytheropteron demenocali*. This is the first record of this species from the eastern North Atlantic.

CYTHEROPTERON MASSONI Whatley and Coles, 1987
Figure 3.5, 3.6

1987 *Cytheropteron massoni* WHATLEY AND COLES, p. 63, pl. 2, figs. 15–17.
2000 *Cytheropteron massoni* DIDIÉ AND BAUCH, p. 113, pl. 2, fig. 11.

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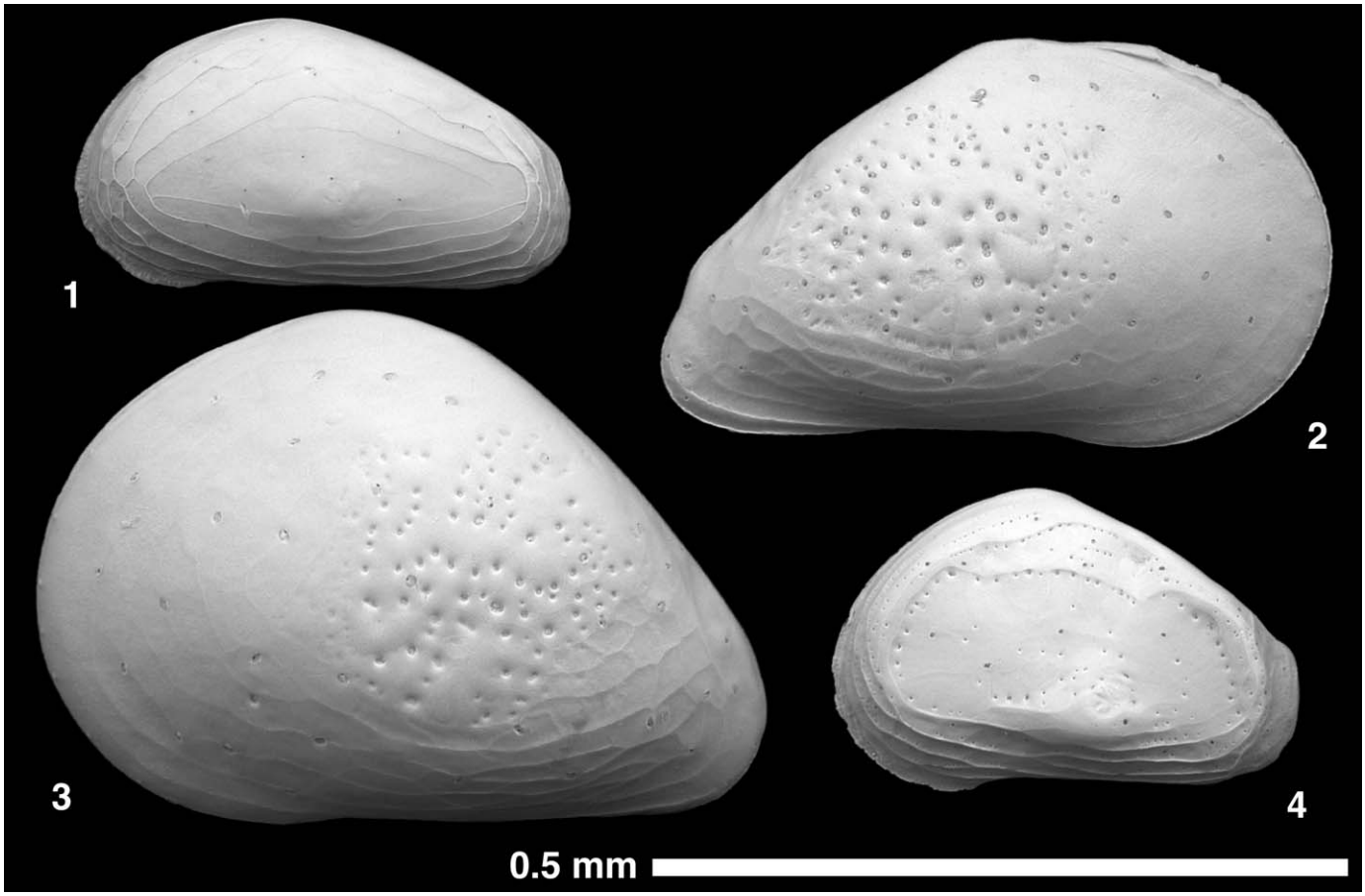

FIGURE 6—SEM images of *Eucythere* species. *1*, *Eucythere pubera* Bonaduce, Ciampo, and Masoli, 1976, juvenile LV from 980B, 1/3/41–43 (USNM 594931); *2*, *3*, *Eucythere triangula* Whatley and Coles, 1987: *2*, adult RV from 980B, 6/5/120–122 (USNM 594932); *3*, adult LV from 980B, 1/3/41–43 (USNM 594933); *4*, *Eucythere* sp. A, juvenile LV from 980C, 2/3/0–2 (USNM 594934). All lateral views. Scale bar=0.5 mm.

2009 *Cytheropteron massoni* YASUHARA ET AL., p. 904, p. 6, figs. 7, 10, 13.

Remarks.—This species is widely distributed both in the eastern and western North Atlantic Ocean (Didié and Bauch, 2000; Whatley and Coles, 1987; Yasuhara et al., 2009).

CYTHEROPTERON MEDIOTUMIDUM Zhao, Whatley, and Zhou, 2000
Figure 4.3

1996 *Cytheropteron* gr. *punctatum* Brady; COLES ET AL., p. 136, pl. 3, figs. 5, 6 (non 7, 8).
1996 *Cytheropteron* sp. 32; ZHAO AND ZHENG, p. 72, pl. 2, fig. 27.
2000 *Cytheropteron mediotumidum* ZHAO, WHATLEY, AND ZHOU, p. 272, pl. 2, figs. 15–19.
2007 *Cytheropteron mediotumidum*; HOU AND GOU, p. 300, pl. 121, figs. 16–20.

Remarks.—*Cytheropteron mediotumidum* Zhao, Whatley, and Zhou, 2000 has been reported from the eastern North Atlantic and northwestern Pacific Oceans.

CYTHEROPTERON PARAMASSONI new species
Figure 3.7, 3.9

Diagnosis.—A small, moderately calcified *Cytheropteron* species with almost smooth lateral surface, distinct arched and sinuous ridge along posterodorsal margin, and small ala.

Description.—Carapace moderately calcified, small, highest at middle. Outline rhomboidal-shaped in lateral view; anterior margin smooth and rounded; caudal process prominent, pointed at mid-height; dorsal margin arched; ala small, slightly arched, not extending below ventral margin, having a small spine at its apex. Anterodorsal and posterodorsal margins smooth, without cardinal angles. Lateral surface almost smooth, weakly reticulate in central area. Arched and sinuous ridge extends along posterodorsal margin and to subcenter of each valve, and has short branches along its length. Internal features as for genus.

Etymology.—With reference to similarity to *Cytheropteron massoni*.

Types.—Holotype, USNM 594918, L=0.407, H=0.223; paratype, USNM 594916.

Occurrence.—ODP 980C, 2/3/81–83.

Remarks.—This new species is similar to *Cytheropteron massoni* Whatley and Coles, 1987, but the latter has a sinuous dorsal margin, better developed reticulation, and less developed posterodorsal marginal ridge.

CYTHEROPTERON PERLARIA Hao, 1988 (*in* Ruan and Hao, 1988)
Figure 4.2

1988 *Cytheropteron perlaria* HAO (*in* Ruan and Hao 1988), p. 280, pl. 47, figs. 4–9.
1999 *Cytheropteron perlaria*; SWANSON AND AYRESS, p. 155, pl. 1, figs. 7–13; pl. 2, figs. 1–3.
2006 *Cytheropteron perlaria*; STEPANOVA, p. S163, pl. 3, figs. 8–10.

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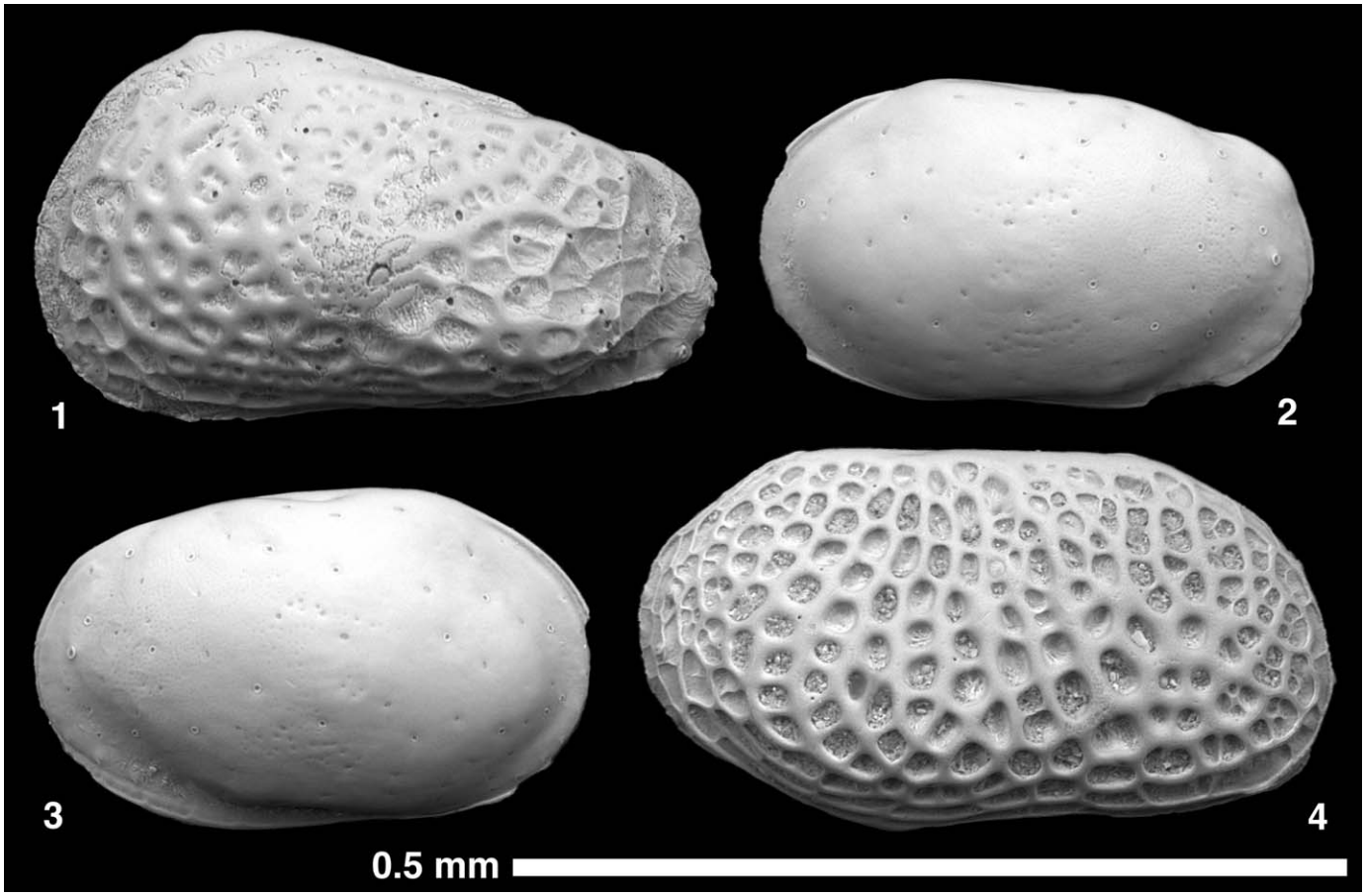

FIGURE 7—SEM images of ostracode species. *1*, *Finmarchinella finmarchica* (Sars, 1866), juvenile LV from 980C, 2/4/0–2 (USNM 594935); *2*, *3*, *Loxoconchidea minima* Bonaduce, Ciampo, and Masoli, 1976: *2*, adult LV from 980B, 1/3/41–43 (USNM 594936); *3*, adult RV from 980B, 1/3/41–43 (USNM 594937); *4*, *Arcacythere enigmatica* (Whatley, Frame, and Whittaker, 1978), juvenile RV from 980C, 2/4/0–2 (USNM 594938). All lateral views. Scale bar=0.5 mm.

2007 *Cytheropteron testudo* Sars; HOU AND GOU, p. 290, pl. 120, figs. 9, 10.
2009 *Cytheropteron perlaria*; ALVAREZ ZARIKIAN, p. 4, pl. P3, figs. 1, 2.
2009 *Cytheropteron perlaria*; YASUHARA ET AL., p. 904, pl. 7, figs. 12, 13.
2011 *Cytheropteron perlaria*; ZHAO ET AL., p. 27, pl. 1, fig. 26.

Remarks.—Comprehensive synonymy is found in Yasuhara et al. (2009), Swanson and Ayress (1999), and Stepanova (2006) and supplemented here. This species has often been misidentified as *Cytheropteron testudo* Sars 1869, but the former has more elongate and triangular lateral outline (see, Swanson and Ayress, 1999 for details).

CYTHEROPTERON PHEROZIGZAG Whatley, Ayress, and Downing, 1986
Figure 4.1

1986 *Cytheropteron pherozigzag* WHATLEY, AYRESS, AND DOWNING, p. 32, pl. 1, figs. 6–20.
1988 *Cytheropteron pherozigzag*; WHATLEY AND AYRESS, pl. 2, fig. 3a–3b.
1996 *Cytheropteron pherozigzag*; ZHAO AND ZHENG, p. 72, pl. 2, fig. 3.
2000 *Cytheropteron pherozigzag*; ZHAO ET AL., p. 263, pl. 1, fig. 20.
2005 *Cytheropteron pherozigzag*; ZHAO, p. 39, pl. 2, fig. 15.
2007 *Lobosocytheropteron pherozigzag* (Whatley, Ayress, and Downing); HOU AND GOU, p. 309, pl. 125, fig. 17.
2009 *Cytheropteron pherozigzag*; YASUHARA ET AL., p. 906, pl. 5, figs. 6–8, 10.

Remarks.—This species is widely distributed in the eastern and western North Atlantic and northwestern Pacific Oceans.

CYTHEROPTERON PYRAMIDALE Brady 1868
Figure 3.8

1868 *Cytheropteron pyramidale* BRADY, p. 34, p. 5, figs. 11–14.
1979 *Cytheropteron pyramidale*; WHATLEY AND MASSON, p. 250, p. 6, figs. 1, 2, 4, 8.
1998 *Cytheropteron pyramidale* FREIWALD AND MOSTAFAWI, p. 260, pl. 59, fig. 6.

Remarks.—Comprehensive synonymy is found in Whatley and Masson (1979). *Cytheropteron pyramidale* Brady, 1868 is mainly reported from shallow-marine environments (Whatley and Masson, 1979), and thus is probably a shallow-water contaminated species transported by downslope processes or ice rafting (Didié and Bauch, 2000; Yasuhara et al., 2008).

CYTHEROPTERON RICHARDDINGLEI Yasuhara, Okahashi, and Cronin, 2009
Figure 4.4

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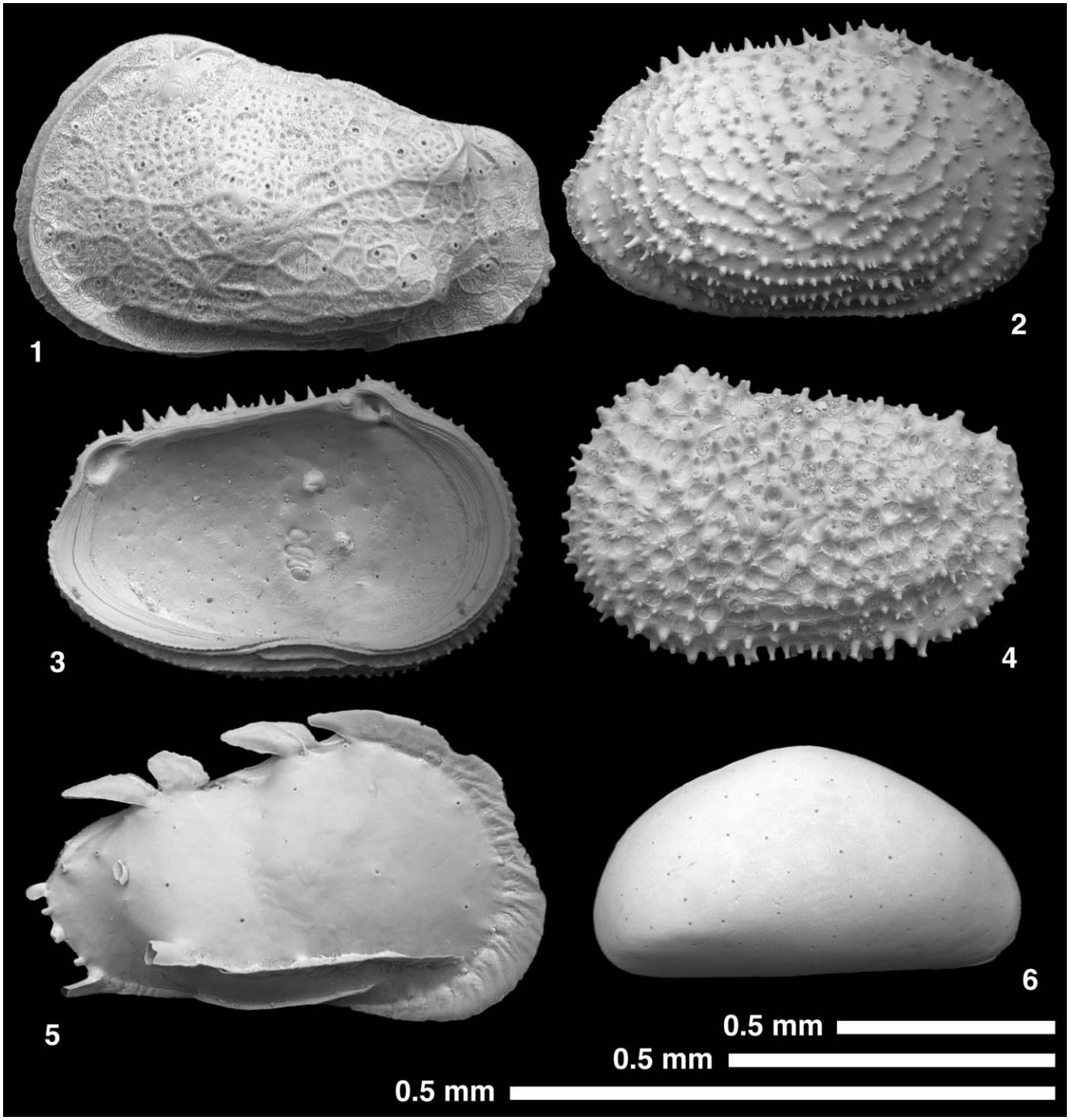

FIGURE 8—SEM images of ostracode species. *1*, *Thaerocythere crenulata* (Sars, 1866), juvenile LV from 980C, 2/4/0–2 (USNM 594939); *2*, *3*, *Echinocythereis echinata* (Sars, 1866): *2*, adult RV from 980B, 1/1/121–123 (USNM 594940); *3*, adult LV from 980B, 1/1/121–123 (USNM 594941); *4*, *Henryhowella asperrima* (Reuss, 1850), juvenile LV from 980B, 1/1/121–123 (USNM 594942); *5*, *Pterygocythereis mucronata* (Sars, 1866), juvenile RV from 980C, 2/5/0–2 (USNM 594943); *6*, *Xestoleberis* sp. A, juvenile RV from 980C, 2/4/0–2 (UNM 594944). *1*, *2*, *4–6*, lateral views; *3*, internal view. Scale bars=0.5 mm. Top scale for *2*, *3*. Middle scale for *4*. Bottom scale for *1*, *5*, *6*.

2009 *Cytheropteron richarddinglei* YASUHARA, OKAHASHI, AND CRONIN, p. 906, pl. 9, figs. 11, 12, pl. 10, figs. 1, 2.

Remarks.—This species is very similar to *Cytheropteron abyssorum* Brady 1880, but the latter has shorter and thicker ala (see Passlow and Ayress, 1994).

CYTHEROPTERON sp. A
Figure 4.8

Remarks.—This species is similar to *Cytheropteron* sp. p of Yasuhara et al. (2009), but the latter has primary reticulation.

Genus EUCYTHERURA Müller, 1894

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

Eucytherura calabra (Colalongo and Pasini, 1980)
Figure 4.7

1980 *Typhloeucytherura calabra* Colalongo and Pasini, p. 122, pl. 20, figs. 1–8, pl. 21, figs. 1, 2.
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 calabra* Whatley and Ayress, pl. 1, fig. 9a, 9b.
1995 *Eucytherura calabra* Ayress et al., p. 211, fig. 3A–3D.
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. 104, pl. 1, figs. 9, 10.

Remarks.—This species is similar to *Eucytherura spinicorona* Yasuhara, Okahashi, and Cronin, 2009, but the latter has a more straight dorsal margin and triangular outline. *Eucytherura spinicorona* is distributed in the western North Atlantic and *Eucytherura calabra* seems to be globally distributed.

Eucytherura zehali new name

2009 *Eucytherura hazeli* Yasuhara, Okahashi, and Cronin, p. 908, pl. 13, figs. 3–6.

Etymology.—Anagram of original specific name "hazeli".

Remarks.—Dr. Eugen K. Kempf kindly informed MY that *Eucytherura hazeli* Yasuhara, Okahashi, and Cronin, 2009 is a junior homonym of *Eucytherura hazeli* Brouwers, 1994. Thus, here we give a new name *Eucytherura zehali* for *Eucytherura hazeli* Yasuhara, Okahashi, and Cronin, 2009.

Genus Pelecocythere Athersuch, 1979

Type species.—*Pelecocythere sylvesterbradleyi* Athersuch, 1979.

Pelecocythere sylvesterbradleyi Athersuch, 1979
Figure 5.1–5.4

1979 *Pelecocythere sylvesterbradleyi* Athersuch, p. 13, pls. 6–14, 6–16, 6–18, 6–20, text-figs. 1, 2.
1987 *Pelecocythere sylvesterbradleyi*; Whatley and Coles, p. 90, pl. 3, fig. 20.
1988 *Pelecocythere purii* Neale, p. 709, pl. 1, figs. 1–4, text-figs. 1–3.
1988 *Pelecocythere sylvesterbradleyi*; Whatley and Ayress, pl. 2, fig. 7a, 7b.
2001 *Pelecocythere sylvesterbradleyi*; Didié and Bauch (as erratum of Didié and Bauch, 2000), p. 103, pl. 1, fig. 8.
2002 *Pelecocythere sylvesterbradleyi*; Cronin et al., p. 103, fig. 2H.
2003 *Pelecocythere sylvesterbradleyi*; Cronin and Dwyer, p. 263, pl. 2, fig. m.
2009 *Pelecocythere sylvesterbradleyi*; Alvarez Zarikian, p. 4, pl. P5, fig. 4.

Remarks.—This species has been reported from the eastern North Atlantic Ocean. There is a very similar species *Pelecocythere purii* Neale, 1988. According to Neale (1988), *Pelecocythere sylvesterbradleyi* Athersuch, 1979 is distinguishable from *Pelecocythere purii* by having a small, distinct posteroventral spine in the right valve and subdivided adductor muscle scars. *Pelecocythere purii* bears a posteroventral spine in the left valve and has undivided adductor muscle scars. Our specimens show intermediate carapace morphology, that is posteroventral spine in left valve and divided adductor muscle scars. So, we take a wider species concept and consider *Pelecocythere purii* as a junior synonym of *Pelecocythere sylvesterbradleyi*. Although Neale (1988) reported several differences in soft parts, Neale's drawings of soft parts seem not to be very precise and do not provide robust evidence to evaluate whether these two species are distinct from soft parts (Simone N. Brandão, personal commun., 2013).

Family Eucytheridae Puri, 1954
Genus Eucythere Brady, 1868

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

Remarks.—We consider *Pseudeucythere* Hartmann, 1989 as a junior synonym of *Eucythere* Brady, 1868 in disagreement with Jellinek and Swanson (2003) who considered *Pseudeucythere* as valid, distinct genus. Hartmann (1989) erected *Pseudeucythere* for species having an almost triangular shape, only a weak lateral inflation, an ornamentation consisting of extremely fine, hairline-like ribs, and a merodont type hingement (Jellinek and Swanson, 2003). In contrast, *Eucythere* typically has lophodont hingement (Horne and Whittaker, 1985). However, many species with intermediate morphology exist for all of these characteristics of shape, lateral inflation, ornamentation, and hingement. For example: *Eucythere pubera* Bonaduce, Ciampo, and Masoli, 1976 has somewhat triangular outline but we will not say that this species has "almost triangular shape". Lateral inflation of *Eucythere pubera* is relatively weak but not as flat as the type species of *Pseudeucythere* (Bonaduce et al., 1976; Hartmann, 1989). Ornamentation of *Eucythere pubera* consists of extremely fine, hairline-like ribs (typical of *Pseudeucythere*), but many other *Eucythere* species have fine ribs to a greater or lesser extent, e.g., *Eucythere triangula* Whatley and Coles, 1987 (see Yasuhara et al., 2009) and even the type species of *Eucythere declivis* (Norman, 1867) (see Horne and Whittaker, 1985). Hingement of *Eucythere pubera* is intermediate between merodont type and lophodont (see Bonaduce et al., 1976). Subcentral muscle scars are very similar among above-mentioned species, that are typically composed of an arcuate row of four adductor scars (lowermost one relatively large and crescent-shaped) with a V-shaped frontal scar (Bonaduce et al., 1976; Horne and Whittaker, 1985; Whatley and Downing, 1983; Yasuhara et al., 2009).

Eucythere pubera Bonaduce, Ciampo, and Masoli, 1976
Figure 6.1

1976 *Eucythere pubera* Bonaduce, Ciampo, and Masoli, p. 64, pl. 37, figs. 1–8, text-fig. 28.
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, 4b.
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.
2009 *Eucythere pubera*; Alvarez Zarikian, p. 4, pl. P6, fig. 3.

Remarks.—*Eucythere pubera* Bonaduce, Ciampo, and Masoli, 1976 is known from the eastern North Atlantic, the Mediterranean, the northwestern Pacific, and the Southern Ocean regions. We consider *Eucythere parapubera* Whatley and Downing, 1983

as a junior synonym of *Eucythere pubera* at least for now, because these two species have merely subtle difference in arrangement of fine ridges on valve surfaces that could be an intraspecific variation (Bonaduce et al., 1976; Whatley and Downing, 1983). Additional high-resolution SEM images of well-preserved specimens of both species from type localities are needed for further evaluation.

EUCYTHERE TRIANGULA Whatley and Coles, 1987
Figure 6.2, 6.3

1987 *Eucythere triangula* WHATLEY AND COLES, p. 74, pl. 4, figs. 16–18.
2000 *Eucythere triangula*; DIDIÉ AND BAUCH, p. 114, pl. 3, fig. 21.
2009 *Eucythere triangula*; ALVAREZ ZARIKIAN, p. 4, pl. P6, fig. 4.
2009 *Eucythere triangula*; YASUHARA ET AL., p. 920, pl. 17, figs. 2–7.

Remarks.—This species is widely distributed in the eastern and western North Atlantic.

EUCYTHERE sp. A
Figure 6.4

Remarks.—*Eucythere* sp. A is similar to *Eucythere* sp. 1 of Ruan and Hao (1988), but the former has better developed punctation and fine ridges on valve surface.

Family HEMICYTHERIDAE Puri, 1953
Genus FINMARCHINELLA Swain, 1963

Type species.—*Cythereis finmarchica* Sars, 1866.

FINMARCHINELLA FINMARCHICA (Sars, 1866)
Figure 7.1

1866 *Cythereis finmarchica* SARS, p. 41.
1925 *Hemicythere finmarchica* (Sars); SARS, p. 185, pl. 85, fig. 3.
1974 *Finmarchinella* (*F.*) *finmarchica* (Sars); NEALE, p. 84, pl. 1, figs. 6, 7, pl. 2, figs. 1, 5, 11.
1988 *Finmarchinella finmarchica* (Sars); CRONIN, p. 130, pl. 1, figs. 3, 4.
1991 *Finmarchinella finmarchica* CRONIN, p. 784, fig. 14.9, 14.12.
1993 *Finmarchinella* (*Finmarchinella*) *finmarchica* (Sars); BROUWERS, p. 14, pl. 4, figs. 3, 4, pl. 6, figs. 1–10, text-figs. 14, 15.
1998 *Finmarchinella finmarchica* FREIWALD AND MOSTAFAWI, p. 258, pl. 58, fig. 11.
2000 *Finmarchinella finmarchica* DIDIÉ AND BAUCH, p. 116, pl. 4, fig. 1.
2009 *Finmarchinella finmarchica* ALVAREZ ZARIKIAN, p. 5, pl. P6, figs. 6, 7.

Remarks.—Comprehensive synonymy is found in Brouwers (1993). *Finmarchinella finmarchica* (Sars, 1866) is well-known subpolar shallow-marine species (Brouwers, 1993) and thus is shallow-water contaminated species transported by downslope processes or ice rafting (Didié and Bauch, 2000; Yasuhara et al., 2008).

Family KRITHIDAE Mandelstam, 1958 (*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. We followed the taxonomy of Coles et al. (1994). *Krithe* in this core are mainly composed of *Krithe trinidadensis* van den Bold, 1958, *Krithe dolichodeira* van den Bold, 1946, *Krithe ayressi* Coles et al., 1994, *Krithe minima* Coles et al., 1994, and *Krithe sinuosa* Ciampo, 1986. Detailed taxonomy of North Atlantic species of this genus will be discussed in a separate paper.

Family LOXOCONCHIDAE Sars, 1926
Genus LOXOCONCHIDEA Bonaduce, Ciampo, and Masoli, 1976

Type species.—*Loxoconchidea minima* Bonaduce, Ciampo, and Masoli, 1976.

LOXOCONCHIDEA MINIMA Bonaduce, Ciampo, and Masoli, 1976
Figure 7.2, 7.3

1976 *Loxoconchidea minima* BONADUCE, CIAMPO, AND MASOLI, p. 112, pl. 59, figs. 1–7, text-fig. 43.
2004 *Loxoconchidea minima*; AIELLO AND SZCZECHURA, p. 35, pl. 7, figs. 1–3.
2006 *Loxoconchidea minima*; BERGUE ET AL., p. 206, fig. 6E.
2008 *Loxoconchidea minima*; BERGUE AND COIMBRA, p. 115, pl. 1, fig. 16.
2009 *Loxoconchidea minima*; YASUHARA ET AL., p. 920, pl. 17, figs. 8–11.

Remarks.—Comprehensive synonymy is found in Aiello and Szczechura (2004) and Yasuhara et al. (2009). This species is widely distributed in the Atlantic and Mediterranean regions.

Family ROCKALLIIDAE Whatley, Uffenorde, Harlow, Downing, and Kesler, 1982
Genus ARCACYTHERE Hornibrook, 1952

Type species.—*Arcacythere chapmani* Hornibrook, 1952.

Remarks.—We agree with Ayress (1991) and consider *Rockallia* Whatley, Frame, and Whittaker 1978 as a junior synonym of *Arcacythere* Hornibrook, 1952. We disagree with Mazzini (2005) who considered *Rockallia* and *Arcacythere* as distinct genera. Diagnostic features indicated by Mazzini (2005) to distinguish the genera are all subtle differences in external carapace morphology and are not enough to separate genera in our opinion.

ARCACYTHERE ENIGMATICA (Whatley, Frame, and Whittaker, 1978)
Figure 7.4

1978 *Rockallia enigmatica* WHATLEY, FRAME, AND WHITTAKER, p. 137, pls. 5–138, 5–140, 5–142, 5–144, text-fig. 1.
1979 Indet. Gen. 3; DUCASSE AND PEYPOUQUET, pl. 5, fig. 9.
1982 *Rockallia enigmatica*; WHATLEY ET AL., p. 3, pl. 1, figs. 1, 4.
1987 *Rockallia enigmatica*; WHATLEY AND COLES, p. 80, pl. 2, figs. 3, 4.
1987 *Rockallia* sp.; WHATLEY AND COLES, p. 89, pl. 2, fig. 5.
1988 *Rockallia enigmatica*; RUAN AND HAO, p. 377, pl. 70, figs. 2–4.
1988 *Rockallia inceptiocelata* Whatley, Uffenorde, Harlow, Downing, and Kesler; RUAN AND HAO, p. 377, pl. 70, figs. 5–7.
1990 *Rockallia enigmatica*; MALZ, p. 143, fig. 4.2.
2000 *Rockallia enigmatica*; DIDIÉ AND BAUCH, p. 116, pl. 3, figs. 13, 14.
2003 *Rockallia enigmatica*; CRONIN AND DWYER, p. 263, pl. 2, fig. n.
2005 *Rockallia enigmatica*; MAZZINI, p. 86, figs. 50P, 51B.
2007 *Rockallia enigmatica*; HOU AND GOU, p. 509, pl. 198, figs. 1–4.
2007 *Rockallia inceptiocelata*; HOU AND GOU, p. 509, pl. 198, figs. 5, 8 (?6, ?7).

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2009 *Rockallia enigmatica*; Alvarez Zarikian, p. 5, pl. P9, fig. 5.

Remarks.—*Arcacythere enigmatica* (Whatley, Frame, and Whittaker, 1978) has been reported from the eastern North Atlantic and northwestern Pacific Oceans. The specimens reported as *Rockallia inceptiocelata* Whatley, Uffenorde, Harlow, Downing, and Kesler, 1982 from the Quaternary northwestern Pacific by Ruan and Hao (1988) are probably juveniles of *Arcacythere enigmatica*.

Family Thaerocytheridae Hazel, 1967
Genus Thaerocythere Hazel, 1967

Type species.—*Cythereis crenulata* Sars, 1866.

Thaerocythere crenulata (Sars, 1866)
Figure 8.1

1866 *Cythereis crenulata* Sars, p. 39.
1967 *Thaerocythere crenulata* (Sars); Hazel, p. 25, pl. 4, figs. 2–5, 8, pl. 9, fig. 4.
1972 *Thaerocythere crenulata* Benson, pl. 2, fig. 3.
1991 *Thaerocythere* (*Thaerocythere*) *crenulata* (Sars); Liebau, p. 158, pl. 91, figs. 1–5, pl. 92, figs. 1, 7, text-figs. 85, 99.6.
1993 *Thaerocythere crenulata* Penney, fig. 4r.
1996 *Thaerocythere crenulata* Whatley et al., p. 22, pl. 4, figs. 10, 11, 15.
1997 *Thaerocythere crenulata* Wood and Whatley, p. 11, pl. 2, fig. 5.

Remarks.—Further synonymy is found in Wood and Whatley (1997), Liebau (1991), and Hazel (1967). *Thaerocythere crenulata* (Sars, 1866) has been reported from shelf and uppermost bathyal depths of the subpolar North Atlantic regions (Penney, 1993) and thus is probably shallow-water contaminated species transported by downslope processes or ice rafting (Didié and Bauch, 2000; Yasuhara et al., 2008).

Family Trachyleberididae Sylvester-Bradley, 1948
Genus Echinocythereis Puri, 1954

Type species.—*Cythere margaritifera* Brady, 1870 [=*Cythereis garretti* Howe and McGuirt, 1935 (*in* Howe and graduate students, 1935); see Hazel, 1967]

Echinocythereis echinata (Sars, 1866)
Figure 8.2, 8.3

1866 *Cythereis echinata* Sars, p. 44.
1880 *Cythere irpex* Brady, p. 107, pl. 17, fig. 2a–2d.
?1967 *Echinocythereis echinata* (Sars); Hazel, p. 37, pl. 6, figs. 10, 11.
1969 *Cythereis echinata* Elofson, p. 71.
1976 *Cythere irpex* Puri and Hulings, p. 278, pl. 11, figs. 1–9.
1990 *Echinocythereis whatleyi* Dingle, Lord, and Boomer, p. 303, figs. 35B–35F, 36E–36G, 36I, 36J.
2000 *Echinocythereis echinata* Barra and Bonaduce, p. 214, pl. 1, figs. 1–10, text-fig. 1.
2004 *Echinocythereis echinata* Ayress et al., p. 35, pl. 3, fig. 9.
2009 *Echinocythereis echinata* Alvarez Zarikian, p. 6, pl. P9, figs. 3, 4.
2009 *Echinocythereis echinata* Yasuhara et al., p. 926, pl. 21, figs. 6–9.

Remarks.—Comprehensive synonymy and detailed discussion are found in Yasuhara et al. (2009) and references therein. This species is widely distributed in the Atlantic and Southern Oceans.

Genus Henryhowella Puri, 1957

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

Henryhowella asperrima (Reuss, 1850)
Figure 8.4

1850 *Cypridina asperrima* Reuss, p. 74, pl. 10, fig. 5a, 5b.
2005 *Henryhowella asperrima* (Reuss); Mazzini, p. 50, figs. 26A–26I, 27B.
2009 *Henryhowella dasyderma* (Brady); Alvarez Zarikian, p. 6, pl. 9, figs. 6–8.
2009 *Henryhowella* cf. *asperrima* (Reuss); 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.
2011 *Henryhowella asperrima* Pirkenseer and Berger 2011, p. 54, pl. 7, figs. 6a–6c, 7a–7c, pl. 8, figs. 1a–1c, 2a–2c, 3a–3c.

Remarks.—Comprehensive synonymy and detailed discussion will be shown in a separate paper.

Genus Pterygocythereis Blake, 1933

Type species.—*Cythereis jonesii* Baird, 1850.

Pterygocythereis mucronata (Sars, 1866)
Figure 8.5

1866 *Cythereis mucronata* Sars, p. 48.
1925 *Cythereis mucronata*; Sars, p. 198, pl. 92, figs. 1–13.
1993 *Pterygocythereis mucronata* (Sars); Penney, p. 245, fig. 4m.
1998 *Pterygocythereis mucronata* Freiwald and Mostafawi, p. 260, pl. 59, fig. 2.

Remarks.—This specimen is an early juvenile of *Pterygocythereis mucronata* (Sars, 1866). *Pterygocythereis mucronata* has been reported from shelf and uppermost bathyal depths of the subpolar North Atlantic regions (Penney, 1993) and thus is probably shallow-water contaminated species transported by downslope processes or ice rafting (Didié and Bauch, 2000; Yasuhara et al., 2008).

Family Xestoleberididae Sars, 1928
Genus Xestoleberis Sars, 1866

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

Xestoleberis sp. A
Figure 8.6

Remarks.—*Xestoleberis* sp. A is similar to *Xestoleberis abyssoris* Whatley and Coles, 1987, but the former has much more slender outline.

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