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Taxonomy and distribution of recent species of the subfamily Nodosariinae (Foraminifera) in Icelandic waters

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Abstract. Taxonomy of fourteen very little known species of Nodosariinae Ehrenberg, 1838 in Icelandic waters is revised. Knowledge of these species in the North Atlantic relies mainly on studies in the late 19th and early 20th centuries, using large volume samplers. Later studies have emphasized quantitative samples of a few cm^3 where the Nodosariinae are very rare. This study analysed 879 dredging samples where Nodosariinae occurred in 492 samples, comprising 7598 specimens of about 415 000 of all picked foraminifera. Ordination analysis of species distributions reflects prominent temperature and salinity differences that exist in the sampling area (753 000 km^2) north and south of the Greenland-Scotland Ridge (GSR). Eight species are restricted to southern temperate waters (>2°C): *Dentalina mutabilis* (Costa, 1855), *Dentalina antarctica* Parr, 1950, *Dentalina antennula* d'Orbigny, 1846, *Dentalina filiformis* (d'Orbigny, 1826), *Grigelis pyrula* (d'Orbigny, 1826), *Grigelis guttifera* (d'Orbigny, 1846) comb. nov., *Grigelis semirugosus* ? (d'Orbigny, 1846) and *Nodosaria subsoluta* Cushman, 1923. Four species (*Nodosaria haliensis* Eiland & Guðmundsson, 2004, *Nodosaria incerta* Neugeboren, 1856, *Dentalina elegans* d'Orbigny, 1846 and *Dentalina frobisherensis* Loeblich & Tappan, 1953) occur mainly north of Iceland. Two species, *Dentalina obliqua* (Linnaeus,1758) and *Pseudonodosaria subannulata* (Cushman, 1923), have wide tolerance ranges for physical variables.

Keywords. Nodosariinae, taxonomy, redescriptions, biogeography, North Atlantic.

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Introduction

Throughout most of the Cenozoic, species of the subfamily Nodosariinae Ehrenberg, 1838 (Foraminifera) as well as other calcareous, elongate, and uniserial foraminifers, were among the most significant components of foraminiferal assemblages in the deep seas of the world oceans, but with a progressive and severe decline in abundance to recent times (Hayward 2002). Today, these forms are moderately diverse and constitute a minor component of modern faunas (Hayward *et al.* 2012). The world diversity of Nodosariinae comprises seventeen genera and 1580 accepted names of recent and fossil species (Hayward *et al.* 2022).

The first comprehensive account of Foraminifera in Icelandic waters reported three species of Nodosariinae (Nørvang 1945). Later studies in this area have emphasized quantitative studies of a few cm^3, where Nodosariinae and most other large foraminifera are either absent or very rare (Mackensen *et al.* 1985; Mackensen 1987; Jennings *et al.* 2004). The study of Eiland & Guðmundsson (2004) is an exception, since they analysed about one third of the dredging samples from the BIOICE project (Steingrímsson *et al.* 2020) that were then available, and reported twelve nodosariine species in Icelandic waters, but only with a preliminary note on their distributions, because of the limited number of samples available at the time. Since then, all samples of the BIOICE project have been processed, revealing fourteen species that are extant in Icelandic waters.

The objective of this study is to use the new material to review morphologic variation of species of Nodosariinae in Icelandic waters, update the taxonomy, redescribe species with high resolution photographs of local specimens, and map the geographic distributions of the species in relation to different water masses, as characterized by bottom water temperature, salinity, and water depth.

Material and methods

Samples were collected during the BIOICE program (Benthic Invertebrates of Icelandic Waters), with a general objective to investigate faunal composition of benthic invertebrates in Icelandic waters and map their distributions. The study area is the 200-mile economic zone of Iceland (758 000 km^2). Sampling proceeded during the years 1991–2004 and resulted in 1031 zoological samples, taken at 579 stations. Selection of 62% of the stations followed stratified random sampling (Palsson *et al*. 1989), and 38% were selected to sample interesting habitat types and topographic bottom features discovered during the cruises, and some were the same stations that are part of the annual ground fish survey program of the Marine and Freshwater Research Institute in Iceland (BIOICE 2005; Guðmundsson *et al.* 2014; Steingrímsson *et al.* 2020). At each station, several devices were used to sample different components of the benthos. A modified RP-sledge (Rothlisberg & Pearcy 1976; Brattegard & Fosså 1991) sampled epifauna on relatively smooth and soft bottom types; a detritus Sneli-sledge (Sneli 1998), sampled infauna of soft and mixed sediment substrates; an Agassiz trawl (McIntyre 1956) sampled megafauna on soft and even bottom; and an 80 × 80 cm triangular dredge (KCDenmark 2022) was the only device that could be applied on rough rocky bottoms. These dredging samplers were routinely towed at speed of 1 knot for 20 minutes, which amounts to about 600 m of towing length. At each station, near bottom water temperature and salinity were measured with CTD meter (Conductivity-Temperature-Depth), except for a few stations where it malfunctioned. The near bottom water temperature at the BIOICE stations ranges from -0.9°C to 9.64°C; water depth from 23 m to 3006 m, and salinity varies between 34.17‰ and 35.20‰. Detailed information on the BIOICE samples and location data is available in open access (Steingrímsson *et al.* 2020).

Samples were washed in seawater during cruises, using sieve series of mesh sizes ranging from 16 mm to 0.5 mm, and an un-sieved sediment volume of about 500 ml was preserved as a control. The washed residues were fixed in 4% borax-buffered formalin, and later transferred to 80% ethanol at the Sandgerdi

Marine Centre in Iceland. Specimens were picked and sorted by para-taxonomists to 57 major taxonomic groups, including the Foraminifera. Although the focus of the BIOICE program is biodiversity of macrofauna (>0.5 mm), smaller specimens were picked and analyzed as well, although their numbers are reduced by the washing procedure. For each sieve fraction of a sample, all foraminifers were picked to about 300 specimens, after which only specimens of very rare and unencountered species were picked. Both living and dead tests were picked and treated as a whole, but worn and damaged specimens were excluded. The multitaxon sampling objective of BIOICE prevented routine staining of whole samples to discern between living and dead foraminifera tests. Cytoplasm in formalin fixed Nodosariine has a distinct pale orange colour, clearly visible if it fills the chambers. However, in most cases the cytoplasm is shrunk and often obscure, rendering counts of living tests very unreliable. The general objective of the sorting procedure was to use limited resources to maximize sample information on species richness and relative frequency. Identified specimens were counted to about 30–32 individuals. Numbers larger than 32 were estimated in order of tens or hundreds using a gridded counting tray, since the sampling gears and the washing procedure yield at best a semi-quantitative result (Bergmann *et al.* 2009) and exact specimen count of larger numbers is uninformative. Nevertheless, the standardized sampling and sorting procedure provide an indication of relative sampling frequency of the larger Nodosariinae. A species is noted as rare in a sample if one or two specimens are found; frequent for 3 to 32 specimens; and abundant for more than 32 specimens. The consideration that a species is 'rare' in a sample when presented with one or two specimens (singletons and doubletons) is adopted from nonparametric methods used to estimate species richness (Chao *et al.* 2009; Gotelli & Chao 2013).

About 520 specimens of Nodosariinae were picked from 64 additional miscellaneous samples, most of which were collected during the MAREANO project in the Barents Sea (Buhl-Mortensen *et al.* 2015) and during a survey off Jan Mayen by the Marine and Freshwater Research Institute in Iceland (unpubl. data). These extra samples were collected with the same dredging samplers as in the BIOICE project, in addition to a large (0.25 m^2) Van Veen grab and, processed at the Sandgerdi Marine Centre in Iceland, following the same procedures used in the BIOICE project. Species records from these miscellaneous samples are excluded from the present distributional maps and geographic analysis but are listed under material examined as these specimens were used to check morphologic variation. Data on sampling locations is separated with semicolons and organized in the following sequence: • number of specimens; latitude (decimal degrees), longitude (decimal degrees); sampling gear; water depth; bottom water temperature; bottom water salinity; date of sampling; sample number; museum catalog number. Missing entries in a data sequence are mentioned as 'unknown' between two semicolons.

Picked specimens are deposited at the Icelandic Institute of Natural History (IINH). Photographs were taken with Leica DMC5400 digital camera on a motorized Leica M205C stereo microscope, using various combinations of incident light, two sided darkfield, and Rotterman Contrast™, showing changes in the refractive index within a specimen as differences in brightness. Image processing of successive layers of multiple photos (Z-Stacking) and measurements were done with the Leica LAS X software. Species descriptions were generated with the software LucidBuilder ver. 4.0 from a standardized character coding sheet, comprising 16 features and 52 states.

For identifying gradients in community structure, we used ordination analysis by non-metric multidimensional scaling (NMDS), as implemented by the metaMDS function in the vegan package for R (Oksanen *et al.* 2020). We used presence/absence-based Bray-Curtis dissimilarities between 447 samples using standard settings, but with 1000 random starting points. Only samples from RP-epibenthic and detritus sledges were used, while we excluded samples of the Agassiz and triangular dredges which sample foraminifera only sporadically because of the large mesh size of the tail bags. The NMDS ordination did not converge unless we excluded one rare species with <10 occurrences (*Grigelis semirugosus*? (d'Orbigny, 1846)). We used R ver. 4.0.3 (R Core Team 2020) for all statistical computations. Species distributions were mapped with the software QGIS 3.8.2-Zanzibar (QGIS.org 2022).

Acronyms

BIOICE	=	Benthic Invertebrates of Icelandic Waters
COBW	=	Cold Overflow Bottom Water current
DREKINN	=	Benthos survey project south off Jan Mayen
EGC	=	East Greenland Current
EIC	=	East Icelandic Current
GIN	=	Greenland-Iceland-Norwegian Seas
GSR	=	Greenland-Scotland Ridge
IC	=	Irminger Current
IFSJ	=	Iceland-Faroe Shelf Jet current
IINH	=	Icelandic Institute of Natural History
MAREANO	=	Marine Areal Database for Norwegian Coasts and Sea Areas
NAC	=	North Atlantic Current
NIJ	=	North Icelandic Jet current

Results

Taxonomy

Classification of Nodosariinae follows the World Foraminifera Database (Hayward *et al.* 2022), except that the genus *Laevidentalina* Loeblich & Tappan, 1986 is not used (Hayward *et al.* 2012). Use of open nomenclatural signs follows the recommendations of Bengtson (1988), where a question mark (?) is placed after a species name to indicate that it is uncertain. Synonymies are presented in chronological order in separate groups; first are actual or primary synonyms, which are followed by references to names mainly from the North Atlantic, and thirdly misapplied names preceded with non.

List of taxa in this study

Phylum Foraminifera d'Orbigny, 1826
Class Nodosariata Mikhalevich, 1992 emend. Rigaud *et al*. 2015
Subclass Nodosariana Mikhalevich, 1992
Order Nodosariida Calkins, 1926
Suborder Nodosariina Catkins, 1926
Superfamily Nodosarioidea Ehrenberg, 1838
Family Nodosariidae Ehrenberg, 1838

Subfamily **Nodosariinae** Ehrenberg, 1838

Diagnosis

The diagnostic characters of the family Nodosariinae are a uniserial chamber arrangement and a rectilinear to slightly arcuate test in the megalospheric generation, with a terminal aperture made of radiate slits or grooves around the margin (Hayward *et al.* 2012). The few and rarely encountered specimens of the microspheric generation of *Dentalina antarctica* Parr, 1950, *Dentalina elegans* d'Orbigny, 1846, *Dentalina obliqua* (Linnaeus,1758), and *Nodosaria incerta* Neugeboren, 1856 have rudiments of a planispiral arrangement of the very first initial chambers.

Genus ***Dentalina*** Risso, 1826

Diagnosis

Elongate, arcuate, uniserial tests; chambers cylindrical to ovate, sutures oblique; wall calcareous, hyaline radial in structure; aperture terminal and radiate. The generic distinction (Loeblich & Tappan 1986) between species with a smooth surface of *Laevidentalina* and a costate exterior of *Dentalina* is not used here, following Hayward *et al.* (2012: 109, 236). *Dentalina* differs from *Nodosaria* in having more oblique than horizontal sutures, and test shape is more arcuate than straight, and more cylindrical than nodular.

Dentalina antarctica Parr, 1950
Fig. 1

Dentalina antarctica Parr, 1950: 329, pl. 11 figs 26–27.

Laevidentalina antarctica – Eiland & Guðmundsson 2004: 198, 200, pl. 1 fig. e, pl. 3 fig. b.

Material examined

ICELANDIC WATERS • 3; 66.7592° N, 20.0878° W; RP sledge; depth 293 m; 3°C; 34.86 ppt; 9 Jul. 1992; BIOICE 2149; IINH 40405 • 1; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 40406 • 1; 63.8167° N, 24.3736° W; RP sledge; depth 296 m; 6.96°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2229; IINH 40407 • 6; 63.4528° N, 24.6875° W; RP sledge; depth 296 m; 6.92°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2237; IINH 40408 • 1; 63.2528° N, 25.8286° W; Triangle dredge; depth 852 m; 5.41°C; 34.99 ppt; 5 Sep. 1992; BIOICE 2251; IINH 40409 • 2; 63.1439° N, 24.9833° W; RP sledge; depth 313 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2273; IINH • 2; 63.2506° N, 22.7936° W; RP sledge; depth 263 m; 7.12°C; 35.13 ppt; 10 Sep. 1992; BIOICE 2308; IINH 40412 • 1; 62.7167° N, 12.7167° W; RP sledge; depth 803 m; unknown; unknown; 4 May1993; BIOICE 2334; IINH 40413 • 2; 63.25° N, 22.2° W; detr. sledge (Sneli); depth 288 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2392; IINH 40411 • 2; 63.2514° N, 22.2033° W; RP sledge; depth 291 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2393; IINH 40410 • 1; 63.1306° N, 21.9422° W; detr. sledge (Sneli); depth 511 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2400; IINH 40414 • 5; 63.175° N, 20.0692° W; RP sledge; depth 778 m; 5.5°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2427; IINH 40415 • 2; 63.1167° N, 19.95° W; detr. sledge (Sneli); depth 1072 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2429; IINH 39705 • 2; 63.1417° N, 19.9556° W; RP sledge; depth 1016 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2430; IINH 39706 • 2; 63.0689° N, 19.8592° W; detr. sledge (Sneli); depth 1207 m; 4.45°C; 34.99 ppt; 3 Jul. 1993; BIOICE 2431; IINH 40417 • 1; 63.2389° N, 19.5361° W; RP sledge; depth 965 m; 5.48°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2435; IINH 40418 • 1; 63.2667° N, 20.4° W; Triangle dredge; depth 138 m; unknown; unknown; 4 Jul. 1993; BIOICE 2442; IINH 40439 • 2; 63.1233° N, 21.6119° W; detr. sledge (Sneli); depth 647 m; 6.09°C; 35.06 ppt; 5 Jul. 1993; BIOICE 2471; IINH 40416 • 2; 64.1722° N, 27.7194° W; RP sledge; depth 1042 m; 4.2°C; 34.93 ppt; 2 Sep. 1994; BIOICE 2697; IINH 40421 • 1; 64.5167° N, 25.725° W; detr. sledge (Sneli); depth 358 m; 5.59°C; 35.04 ppt; 6 Sep. 1994; BIOICE 2716; IINH 40423 • 1; 64.3861° N, 27.3194° W; detr. sledge (Sneli); depth 711 m; 6°C; 35.05 ppt; 7 Sep. 1994; BIOICE 2726; IINH 40422 • 5; 63.4183° N, 16.8444° W; RP sledge; depth 272 m; 7.21°C; 35.15 ppt; 25 Aug. 1995; BIOICE 2830; IINH 40426 • 1; 62.8394° N, 18.0117° W; RP sledge; depth 976 m; 3.26°C; 34.98 ppt; 27 Aug. 1995; BIOICE 2849; IINH 40427 • 2; 61.8394° N, 16.8906° W; RP sledge; depth 2270 m; 2.37°C; 34.95 ppt; 29 Aug. 1995; BIOICE 2859; IINH 40425 • 1; 61.1717° N, 18.0492° W; RP sledge; depth 2400 m; 2.07°C; 34.95 ppt; 30 Aug. 1995; BIOICE 2863; IINH 40428 • 3; 64.6281° N, 27.2411° W; RP sledge; depth 554 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2873; IINH 40424 • 1; 65.1722° N, 27.0694° W; RP sledge; depth 229 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2884; IINH 40429 • 2; 65.0433° N, 25.8742° W; RP sledge; depth 163 m; 6.34°C;

35.06 ppt; 30 Aug. 1996; BIOICE 2976; IINH 40441 • 1; 64.9225° N, 25.7775° W; Triangle dredge; depth 183 m; 6.22°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2978; IINH 40440 • 1; 63.7667° N, 14.85° W; RP sledge; depth 216 m; 7.67°C; 35.16 ppt; 5 Jul. 1997; BIOICE 2994; IINH 40443 • 1; 61.3722° N, 15.3272° W; RP sledge; depth 2133 m; 3.29°C; 34.95 ppt; 7 Jul. 1997; BIOICE 3012; IINH 40431 •

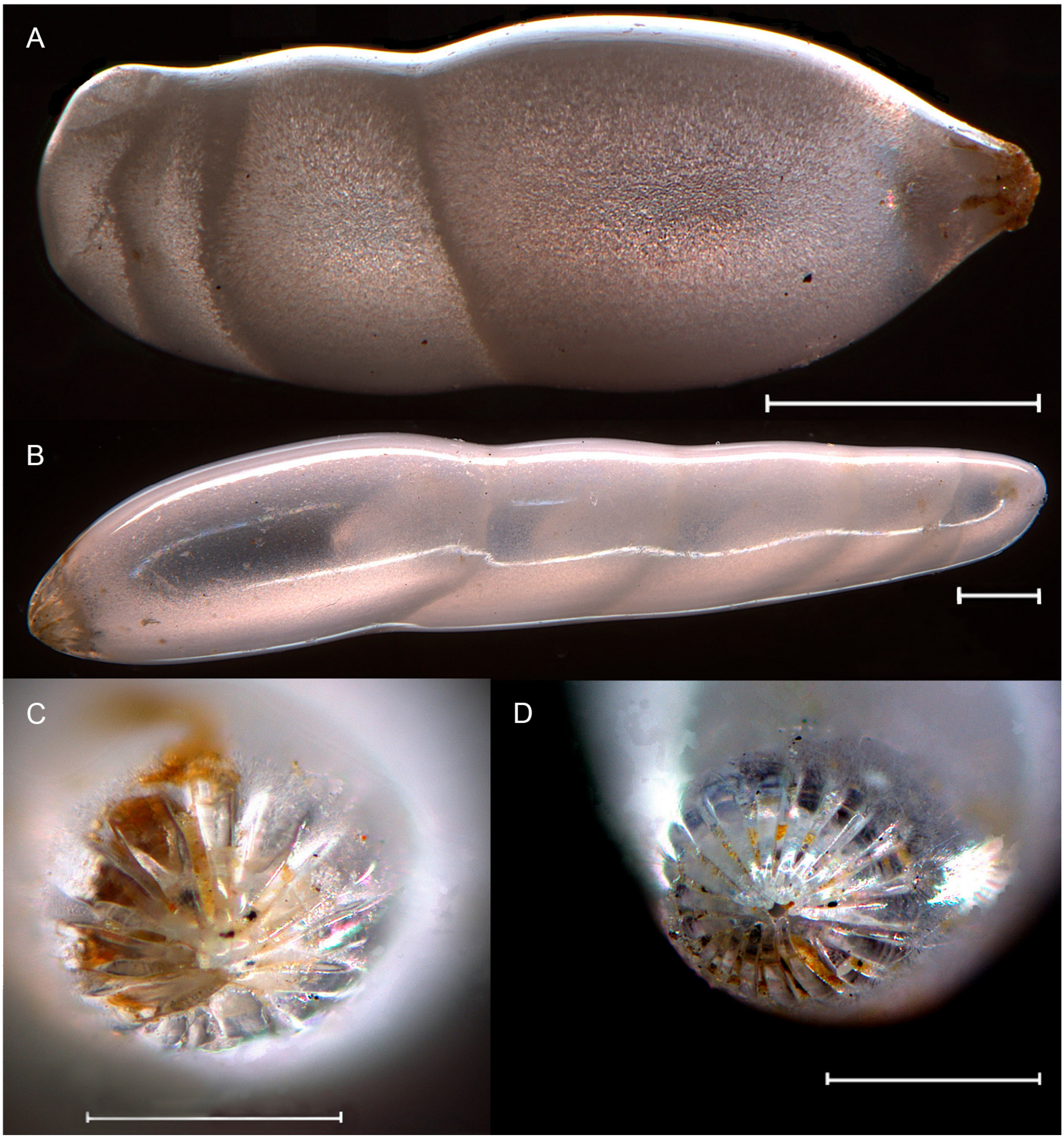

Fig. 1. *Dentalina antarctica* Parr, 1950. **A**. Side view of a young microsphere (BIOICE 2149, IINH 40405) with a spiral initial end; light source is a combination of Rotterman contrast and dark field, revealing the perforations with apparent coarse appearance. **B–C**. Side view (B), and apertural view (C) of megalosphere (BIOICE 2237, IINH 40408). **D**. Apertural view of a megalosphere (BIOICE 2697, IINH 40421). Light source in B–D is a combination of incident light and dark field. Scale bars = 0.25 mm.

4; 63.9969° N, 14.1558° W; RP sledge; depth 221 m; 7.59°C; 35.16 ppt; 10 Jul. 1997; BIOICE 3061; IINH 40438 • 1; 63.9981° N, 14.1561° W; detr. sledge (Sneli); depth 218 m; 7.59°C; 35.16 ppt; 10 Jul. 1997; BIOICE 3062; IINH 40430 • 1; 66.4911° N, 28.0678° W; Triangle dredge; depth 334 m; 0.55°C; 34.78 ppt; 26 Aug. 1999; BIOICE 3154; IINH 40432 • 2; 61.2403° N, 27.9272° W; Triangle dredge; depth 1005 m; 4.6°C; 34.97 ppt; 31 Jul. 2000; BIOICE 3183; IINH 40433 • 1; 63.3289° N, 25.265° W; RP sledge; depth 306 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3605; IINH 40436 • 1; 63.7533° N, 25.7064° W; detr. sledge (Sneli); depth 365 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3607; IINH 40434 • 1; 64.2564° N, 26.0536° W; detr. sledge (Sneli); depth 345 m; 6.95°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3613; IINH 40435.

Description

Test shape elongate, nearly cylindrical, slightly curved, rarely straight, somewhat tapering, barely nodular, initial end rounded. Length of test usually 2–3 mm, the largest 5 mm; test width commonly 0.5–0.6 mm. Chambers initially subglobular then cylindrical and more elongated as added; number of chambers often 4–6, the largest specimen has 8. Chamber arrangement rectilinear; initial 3–6 chambers in microsphere are planispiral and evolute, forming about half of a whorl (Fig. 1A). Initial chambers embrace about half of the previous chambers, later embracement is minimal; sutures are oblique. Aperture radial, nearly central, slightly raised, with variable number (11–19) of symmetrically arranged tines, sometimes partly fused in the center (Fig. 1C); rarely converging around central opening (Fig. 1D). Surface smooth, without secondary surface laminations (atelo-lamellar). Wall finely perforated, medium thick, semi-transparent, rarely thin.

Remarks

The type description states that “aperture is large and circular, with a radiate edge,” probably because the aperture is damaged. In many of the examined specimens the tip of the aperture is broken, resulting in a round opening with a jagged rim. Type description and figures conform otherwise to the present material, although type locality is the Antarctic. The citation of *Nodosaria* (*D.*) *communis* in Brady (1884) as synonym in Eiland & Guðmundsson (2004) is a mistake, as this reference is accepted as *Dentalina aphelis* (Loeblich & Tappan, 1986) (Jones 1994), which differs from *D. antarctica* in being much more tapering and curved; aperture is conical and protruding, with radial bars fused in the center (Loeblich & Tappan 1986).

The initial part in both generations of the species *Marginulina similis* d’Orbigny, 1846 is slightly but not fully coiled, and resembles *D. antarctica* in shape. The species *M. similis* was not found in the present material, although it has been recorded in the North Atlantic and off the British Isles (Cushman 1923) under the name *Marginulina glabra* d’Orbigny, 1826.

Four microspheric specimens were found among the 70 examined specimens of the present material. Diameter of proloculus in megalospheres is about 0.25 mm, but less than 0.02 mm in the microspheres.

Dentalina antennula d’Orbigny, 1846
Fig. 2

Dentalina antennula d’Orbigny, 1846: 53, pl. 2 figs 29–30.

Dentalina antennula – Papp & Schmid 1985: 33, pl. 15 figs 7–9. — Eiland & Guðmundsson 2004: 198, pl. 1 fig. p, pl. 2, fig. c.

Material examined

ICELANDIC WATERS • 1; 64.2689° N, 24.4347° W; RP sledge; depth 213 m; 6.85°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2215; IINH 40363 • 3; 63.9169° N, 25.2775° W; RP sledge; depth 240 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2221; IINH 40367 • 1; 63.9269° N, 25.2733° W; detr. sledge (Sneli); depth 242 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2222; IINH 40365 • 1; 63.2503° N, 26.4872° W; RP sledge; depth 1209 m; 4.09°C; 34.94 ppt; 5 Sep. 1992; BIOICE 2257; IINH 40366 • 1; 63.1406° N, 24.9908° W; detr. sledge (Sneli); depth 316 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2272; IINH 40364 • 1; 63.9333° N, 10° W; detr. sledge (Sneli); depth 639 m; unknown; unknown; 3 May1993; BIOICE 2321; IINH 40270 • 1; 63.75° N, 10.1833° W; RP sledge; depth 555 m; unknown; unknown; 3 May1993; BIOICE 2325; IINH 40233 • 5; 63.25° N, 22.2° W; detr. sledge (Sneli); depth 288 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2392; IINH 40271 • 1; 63.2514° N, 22.2033° W; RP sledge; depth 291 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2393; IINH 40361 • 1; 63.175° N, 21.8889° W; RP sledge; depth 346 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2398; IINH 40362 • 2; 63.1306° N, 21.9422° W; detr. sledge (Sneli); depth 511 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2400; IINH 40368 • 3; 63.1278° N, 22.9083° W; RP sledge; depth 520 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2401; IINH 40371 • 1; 63.1778° N, 20.15° W; detr. sledge (Sneli); depth 600 m; 6.46°C; 35.08 ppt; 3 Jul. 1993; BIOICE 2423; IINH 40369 • 8; 63.1742° N, 20.165° W; RP sledge; depth 495 m; 6.46°C; 35.08 ppt; 3 Jul. 1993; BIOICE 2424; IINH 40372 • 2; 63.0689° N, 19.8592° W; detr. sledge (Sneli); depth 1207 m; 4.45°C; 34.99 ppt; 3 Jul. 1993; BIOICE 2431; IINH 40373 • 5; 63.1667° N, 21.525° W; detr. sledge (Sneli); depth 448 m; 6.74°C; 35.09 ppt; 5 Jul. 1993; BIOICE 2468; IINH 40370 • 1; 64.575° N, 24.5472° W; RP sledge; depth 273 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2713; IINH 40374 • 1; 64.6833° N, 25.6072° W; detr. sledge (Sneli); depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2869; IINH 40376 • 1; 64.9225° N, 25.7775° W; Triangle dredge; depth 183 m; 6.22°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2978; IINH 40375 • 1; 62.5206° N, 17.9381° W; Agassiz trawl; depth 1528 m; 3.57°C; 35.02 ppt; 5 Sep. 2002; BIOICE 3517; IINH 40382 • 2; 62.9836° N, 18.1517° W; detr. sledge (Sneli); depth 1232 m; unknown; unknown; 12 Sep. 2002; BIOICE 3546; IINH 40378 • 1; 64.1292° N, 24.1047° W; detr. sledge (Sneli); depth 291 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3549; IINH 40379 • 7; 64.1297° N, 24.1044° W; RP sledge; depth 290 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3550; IINH 40381 • 1; 64.2086° N, 26.2211° W; detr. sledge (Sneli); depth 334 m; 6.95°C; 35.14 ppt; 2 Sep. 2003; BIOICE 3557; IINH 40380 • 1; 64.2106° N, 26.2117° W; Agassiz trawl; depth 337 m; 6.95°C; 35.14 ppt; 023 Sep. 2003; BIOICE 3559; IINH 40377 • 1; 63.32° N, 25.2569° W; detr. sledge (Sneli); depth 296 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3604; IINH 40386 • 2; 63.3289° N, 25.265° W; RP sledge; depth 306 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3605; IINH 40384 • 2; 63.7533° N, 25.7064° W; detr. sledge (Sneli); depth 365 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3607; IINH 40383 • 5; 63.7567° N, 25.7097° W; RP sledge; depth 366 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3608; IINH 40385.

Description

Test shape elongate, cylindrical, slightly curved to straight, moderately nodular; initial end rounded in megalospheres and only slightly tapering; the microsphere is gradually tapering to a pointed initial end. Length of test 4–5 mm, the largest 7 mm; test width 0.3–0.5 mm. Chambers initially globular to subglobular, becoming slightly more elongated as added; rectilinearly arranged in both generations; number of chambers 5–9 in megalospheres, 15–21 in microspheres. Chamber embracement minimal, sutures horizontal. Aperture radial, nearly central, slightly raised, sometimes protruding, with up to 12 symmetric tines that are fused in the center (Fig. 2C–D). Short costae are confined to base of chambers; initial end usually with one or more basal knobs or a short spine. Secondary surface laminations absent (atelo-lamellar). Wall medium thick, finely perforated.

Remarks

Of the 63 examined specimens, 22 were microspheres. Diameter of proloculus in the megalospheres is about 0.5 mm, but less than 0.03 mm in the microsphere. The illustration of the lectotype of *D. antennula* shows an open, rounded and crenulate aperture, but they also questioned the validity of this species, stating "that the independence of this species remains doubtful" (Papp & Schmid 1985). Judging from the illustrations it seems that the tip is worn away and it is assumed here that it originally had fused apertural tines as the present specimens. Several names of fossil forms have been erected that

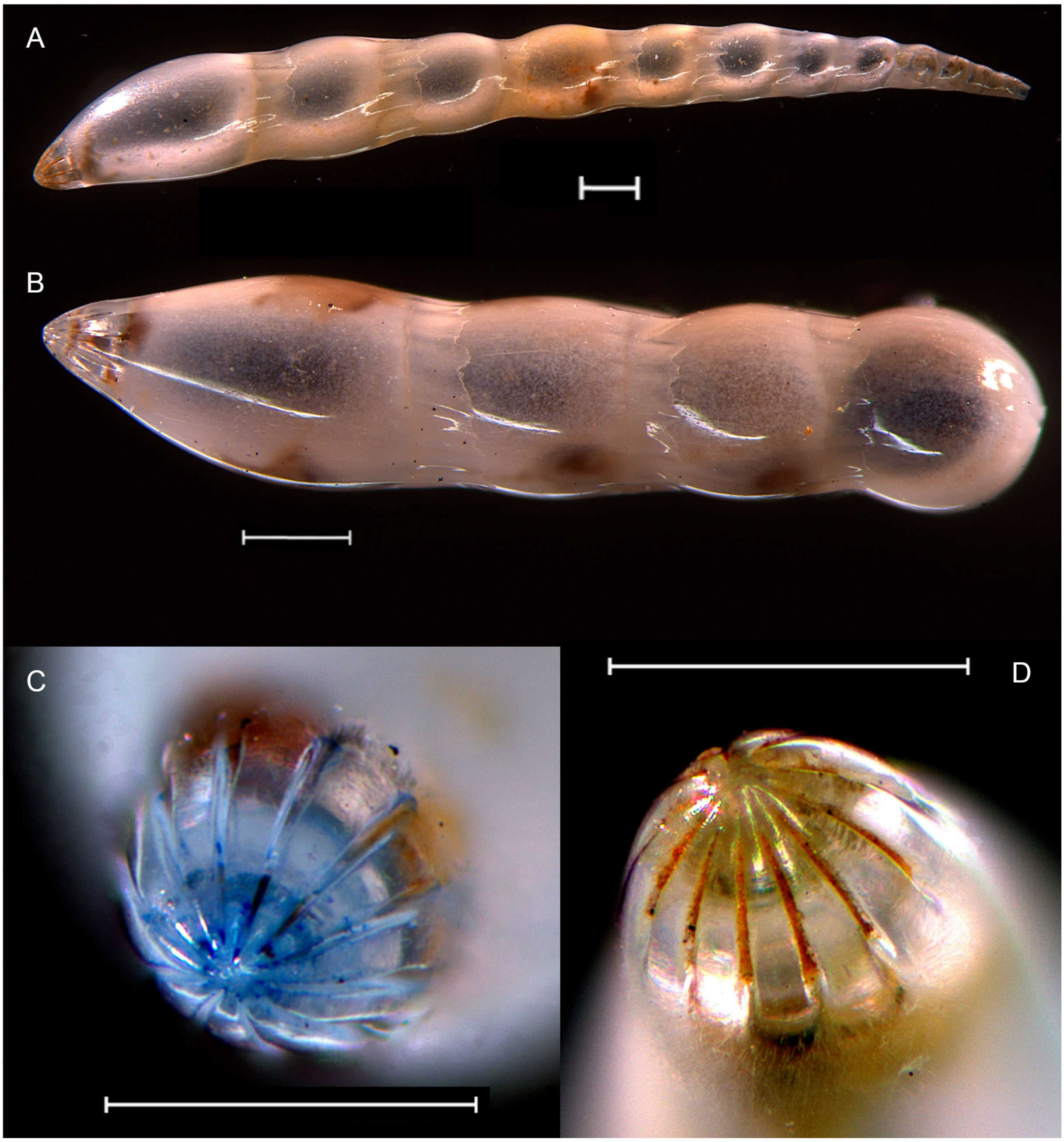

Fig. 2. *Dentalina antennula* d'Orbigny, 1846. **A, D**. Microsphere (BIOICE 2398; IINH 40362) side view (A), and aperture (D). **B–C**. Megalosphere (BIOICE 2222, IINH 40365), side view (B) and aperture (C), stained with indigo blue. Light source incident light and dark field. Scale bars = 0.25 mm.

seem very similar to *D. antennula*, like *Dentalina capitata* (Boll, 1846) described from the Oligocene by Boll (1846: 177, pl. 2 fig. 13a–b); *Dentalina buchi* from the Eocene described by Reuss (1851: 60, pl. 3 fig. 6); and *Dentalina philippii* also from the Eocene and erected by Reuss (1851: 60, pl. 3, fig. 5).

Dentalina elegans d'Orbigny, 1846
Fig. 3

Dentalina elegans d'Orbigny, 1846: 45, pl. 1 figs 52–56.
Dentalina pauperata d'Orbigny, 1846: 46, pl. 1 figs 57–58.

Nodosaria pauperata – Goës 1894 (part): 68–69, pl. 12 figs 673, 677–684, 688 (only). — Cushman 1923: 72, pl. 14 fig. 13.
Dentalina elegans – Papp & Schmid 1985: 28 (nr. 21), pl. 10 figs 1–5.
Dentalina pauperata – Papp & Schmid 1985: 28–29 (nr. 22), pl. 10 figs 6–8. — Loeblich & Tappan 1953: 57, pl. 9 figs 7–9.

non *Nodosaria communis* (d'Orbigny, 1826) – Cushman 1923: 73–74, pl. 12 figs 3–4, 15–17.
non *Laevidentalina frobisherensis* (Loeblich & Tappan, 1953) – Eiland & Guðmundsson 2004 (part): 200, 202, pl. 1 fig. d, pl. 4 figs f–j, pl. 5 figs b–d (only).
non *Laevidentalina baggi* (Galloway & Wissler, 1927) – Eiland & Guðmundsson 2004: 198, pl. 1 fig. a, pl. 3 fig. a.

Material examined

BARENTS SEA • 2; 81.6667° N, 26.0339° W; epibenthic dredge; depth 2400 m; unknown; unknown; 19 Jul. 1980; Ymer 80 MB10; IINH 21165 • 3; 82.3522° N, 25.3186° W; epibenthic dredge; depth 3920 m; unknown; unknown; 16 Jul. 1980; Ymer 80 MB8; IINH 21158 • 17; 81.8347° N, 26.5692° W; epibenthic dredge; depth 3270 m; unknown; unknown; 18 Jul. 1980; Ymer 80 MB9; IINH 21154.

ICELANDIC WATERS • 1; 65.5061° N, 11.3958° W; RP sledge; depth 619 m; -0.36°C; unknown; 20 Jul. 1991; BIOICE 2010; IINH 39510 • 1; 65.5856° N, 11.2839° W; detr. sledge (Sneli); depth 769 m; -0.42°C; unknown; 20 Jul. 1991; BIOICE 2012; IINH 39511 • 15; 65.6953° N, 11.0106° W; RP sledge; depth 978 m; -0.41°C; unknown; 20 Jul. 1991; BIOICE 2014; IINH 39606 • 1; 65.9853° N, 10.7419° W; RP sledge; depth 1195 m; -0.79°C; unknown; 21 Jul. 1991; BIOICE 2015; IINH 39512 • 15; 66.5769° N, 11.2303° W; RP sledge; depth 1390 m; -0.82°C; unknown; 21 Jul. 1991; BIOICE 2018; IINH 39513 • 2; 66.5547° N, 12.1989° W; RP sledge; depth 1253 m; -0.86°C; unknown; 21 Jul. 1991; BIOICE 2019; IINH 39605 • 9; 66.6278° N, 12.1542° W; detr. sledge (Sneli); depth 1314 m; -0.86°C; unknown; 22 Jul. 1991; BIOICE 2020; IINH 39514 • 5; 67.2061° N, 13.3494° W; RP sledge; depth 1648 m; -0.76°C; unknown; 23 Jul. 1991; BIOICE 2027; IINH 39604 • 4; 67.0581° N, 13.4239° W; RP sledge; depth 931 m; -0.56°C; unknown; 23 Jul. 1991; BIOICE 2029; IINH 39603 • 1; 67.0081° N, 13.4403° W; RP sledge; depth 831 m; -0.55°C; unknown; 23 Jul. 1991; BIOICE 2030; IINH 39602 • 2; 66.9225° N, 13.5181° W; RP sledge; depth 552 m; -0.54°C; unknown; 23 Jul. 1991; BIOICE 2033; IINH 39601 • 12; 66.3647° N, 13.4856° W; RP sledge; depth 310 m; 1.3°C; unknown; 24 Jul. 1991; BIOICE 2040; IINH 39600 • 6; 65.7792° N, 13.9722° W; detr. sledge (Sneli); depth 229 m; 2.6°C; unknown; 24 Jul. 1991; BIOICE 2045; IINH 39599 • 4; 65.7781° N, 13.8894° W; RP sledge; depth 236 m; 2.6°C; unknown; 25 Jul. 1991; BIOICE 2046; IINH 39598 • 12; 65.7025° N, 12.8833° W; RP sledge; depth 272 m; 1.96°C; unknown; 25 Jul. 1991; BIOICE 2047; IINH 39597 • 1; 65.6531° N, 12.3583° W; RP sledge; depth 247 m; 1.2°C; unknown; 25 Jul. 1991; BIOICE 2049; IINH 39596 • 2; 65.3003° N, 13.7408° W; RP sledge; depth 82 m; 4.1°C; unknown; 25 Jul. 1991; BIOICE 2053; IINH 39595 • 6; 66.4583° N, 16.8906° W; detr. sledge (Sneli); depth 243 m; unknown; unknown; 2 Jul. 1992; BIOICE 2057; IINH 39594 • 8; 66.1586° N, 17.6069° W; detr. sledge (Sneli); depth 198 m; 3.8°C; 34.85 ppt; 2 Jul. 1992;

BIOICE 2065; IINH 39515 • 4; 66.5708° N, 17.73° W; detr. sledge (Sneli); depth 485 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2069; IINH 39516 • 45; 66.5711° N, 17.7425° W; RP sledge; depth 489 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2070; IINH 39517 • 2; 67.2014° N, 17.5344° W; detr. sledge (Sneli); depth 563 m; -0.42°C; 34.7 ppt; 3 Jul. 1992; BIOICE 2075; IINH 39593 • 8; 67.6808° N, 17.1772° W; RP sledge; depth 1048 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2077; IINH 39592 • 9; 67.6719° N, 17.2008° W; detr. sledge (Sneli); depth 1046 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2079; IINH 39750 • 10; 67.375° N, 17.3847° W; RP sledge; depth 893 m; -0.55°C; 34.84 ppt; 4 Jul. 1992; BIOICE 2081; IINH 39518 • 11; 67.3675° N, 17.4092° W; detr. sledge (Sneli); depth 894 m; -0.55°C; 34.84 ppt; 4 Jul. 1992; BIOICE 2082; IINH 39519 • 4; 67.2756° N, 17.4272° W; detr. sledge (Sneli); depth 755 m; -0.41°C; 34.86 ppt; 4 Jul. 1992; BIOICE 2086; IINH 39520 • 18; 67.2614° N, 17.455° W; RP sledge; depth 735 m; -0.41°C; 34.86 ppt; 4 Jul. 1992; BIOICE 2087; IINH 39521 • 3; 67.1939° N, 17.7789° W; RP sledge; depth 405 m; -0.31°C; 34.86 ppt; 5 Jul. 1992; BIOICE 2091; IINH 39522 • 1; 67.2069° N, 17.7583° W; detr. sledge (Sneli); depth 407 m; -0.31°C; 34.86 ppt; 5 Jul. 1992; BIOICE 2093; IINH 39523 • 1; 67.0342° N, 17.5717° W; detr. sledge (Sneli); depth 303 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2094; IINH 39749 • 8; 68.0017° N, 19.4239° W; RP sledge; depth 1141 m; -0.58°C; 34.88 ppt; 6 Jul. 1992; BIOICE 2100; IINH 39524 • 2; 67.8372° N, 19.5581° W; RP sledge; depth 905 m; -0.55°C; 34.87 ppt; 6 Jul. 1992; BIOICE 2107; IINH 39752 • 3; 67.7253° N, 19.5083° W; detr. sledge (Sneli); depth 588 m; -0.54°C; 34.86 ppt; 6 Jul. 1992; BIOICE 2111; IINH 39525 • 16; 67.7292° N, 19.4722° W; RP sledge; depth 603 m; -0.54°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2113; IINH 39526 • 15; 67.7047° N, 19.4669° W; RP sledge; depth 489 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2114; IINH 39529 • 26; 67.7° N, 19.4397° W; detr. sledge (Sneli); depth 495 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2116; IINH 39753 • 32; 67.4756° N, 19.5386° W; detr. sledge (Sneli); depth 405 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2117; IINH 39527 • 3; 67.4897° N, 19.5528° W; RP sledge; depth 393 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2118; IINH 39531 • 7; 67.1189° N, 19.8775° W; RP sledge; depth 284 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2119; IINH 39532 • 25; 67.1275° N, 19.9042° W; detr. sledge (Sneli); depth 280 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2121; IINH 39530 • 24; 67.1858° N, 19.5672° W; detr. sledge (Sneli); depth 346 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2122; IINH 39533 • 26; 67.1839° N, 19.5736° W; RP sledge; depth 347 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2124; IINH 39617 • 15; 66.7744° N, 18.7042° W; detr. sledge (Sneli); depth 678 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2129; IINH 39618 • 15; 66.7661° N, 18.7081° W; RP sledge; depth 660 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2131; IINH 39619 • 7; 66.7514° N, 18.925° W; RP sledge; depth 492 m; 0.12°C; 34.85 ppt; 8 Jul. 1992; BIOICE 2132; IINH 39620 • 2; 66.7436° N, 18.9589° W; detr. sledge (Sneli); depth 418 m; 0.58°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2135; IINH 39534 • 1; 66.7322° N, 18.9556° W; RP sledge; depth 417 m; 0.58°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2136; IINH 39754 • 8; 66.7197° N, 19.3303° W; RP sledge; depth 297 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2137; IINH 39535 • 3; 66.7128° N, 19.3186° W; detr. sledge (Sneli); depth 300 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2139; IINH 39528 • 10; 66.8586° N, 20.1614° W; RP sledge; depth 399 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2143; IINH 39536 • 11; 66.8581° N, 20.1603° W; detr. sledge (Sneli); depth 398 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2145; IINH 39537 • 3; 66.7592° N, 20.0878° W; RP sledge; depth 293 m; 3°C; 34.86 ppt; 9 Jul. 1992; BIOICE 2149; IINH 39538 • 4; 66.45° N, 19.5969° W; detr. sledge (Sneli); depth 294 m; 4.51°C; 34.93 ppt; 9 Jul. 1992; BIOICE 2162; IINH 39539 • 10; 66.4369° N, 18.8214° W; RP sledge; depth 437 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2172; IINH 39540 • 3; 66.4436° N, 18.8192° W; detr. sledge (Sneli); depth 425 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2174; IINH 39541 • 1; 66.3758° N, 18.3069° W; RP sledge; depth 100 m; 5.5°C; 34.82 ppt; 10 Jul. 1992; BIOICE 2178; IINH 39542 • 1; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 39755 • 5; 64.1° N, 9.05° W; detr. sledge (Sneli); depth 991 m; unknown; unknown; 2 May1993; BIOICE 2315; IINH 39446 • 2; 64.1167° N, 9.05° W; RP sledge; depth 996 m; unknown; unknown; 2 May1993; BIOICE 2317; IINH 39544 • 2; 64.0333° N, 9.6167° W; detr. sledge (Sneli); depth 772 m; unknown; unknown; 2 May1993; BIOICE 2318; IINH 39545 • 2; 64.0167° N, 9.6167° W; RP sledge; depth 776 m; unknown;

unknown; 2 May1993; BIOICE 2319; IINH 39629 • 6; 63.9333° N, 10° W; detr. sledge (Sneli); depth 639 m; unknown; unknown; 3 May1993; BIOICE 2321; IINH 39546 • 2; 63.75° N, 10.1833° W; RP sledge; depth 555 m; unknown; unknown; 3 May1993; BIOICE 2325; IINH 39547 • 3; 63.0833° N, 11.35° W; detr. sledge (Sneli); depth 453 m; unknown; unknown; 3 May1993; BIOICE 2329; IINH 39548 • 6; 63.0833° N, 11.3333° W; RP sledge; depth 453 m; unknown; unknown; 3 May1993; BIOICE 2330; IINH 39549 • 5; 62.7167° N, 12.7167° W; RP sledge; depth 803 m; unknown; unknown; 4 May 1993; BIOICE 2334; IINH 39550 • 1; 62.4667° N, 12.9° W; detr. sledge (Sneli); depth 1105 m; unknown; unknown; 5 May 1993; BIOICE 2335; IINH 39551 • 1; 62.1333° N, 13.3333° W; RP sledge; depth 1302 m; unknown; unknown; 5 May 1993; BIOICE 2340; IINH 39552 • 1; 64.2833° N, 10.8333° W; detr. sledge (Sneli); depth 394 m; unknown; unknown; 7 May 1993; BIOICE 2359; IINH 39553 • 12; 64.2833° N, 10.8167° W; RP sledge; depth 391 m; unknown; unknown; 7 May 1993; BIOICE 2360; IINH 39554 • 3; 64.45° N, 10.45° W; detr. sledge (Sneli); depth 498 m; unknown; unknown; 7 May 1993; BIOICE 2361; IINH 39555 • 8; 64.4833° N, 10.4333° W; RP sledge; depth 495 m; unknown; unknown; 7 May 1993; BIOICE 2362; IINH 39556 • 3; 64.75° N, 10.5167° W; detr. sledge (Sneli); depth 449 m; unknown; unknown; 8 May 1993; BIOICE 2371; IINH 39557 • 5; 64.8667° N, 11.4333° W; detr. sledge (Sneli); depth 476 m; unknown; unknown; 9 May 1993; BIOICE 2372; IINH 39558 • 1; 65.0167° N, 12° W; Triangle dredge; depth 195 m; unknown; unknown; 10 May1993; BIOICE 2373; IINH 39559 • 1; 64.3167° N, 12.4833° W; Triangle dredge; depth 310 m; unknown; unknown; 10 May1993; BIOICE 2379; IINH 39560 • 1; 64.3333° N, 12.45° W; Triangle dredge; depth 403 m; unknown; unknown; 10 May1993; BIOICE 2380; IINH 39561 • 1; 63.0417° N, 21.8556° W; detr. sledge (Sneli); depth 802 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2404; IINH 39633 • 1; 62.7556° N, 21.5667° W; RP sledge; depth 1171 m; 4.17°C; 34.98 ppt; 2 Jul. 1993; BIOICE 2413; IINH 39562 • 1; 63.175° N, 20.0692° W; RP sledge; depth 778 m; 5.5°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2427; IINH 39669 • 5; 63.1167° N, 19.95° W; detr. sledge (Sneli); depth 1072 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2429; IINH 39636 • 2; 63.1417° N, 19.9556° W; RP sledge; depth 1016 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2430; IINH 39635 • 1; 63.0686° N, 21.5911° W; detr. sledge (Sneli); depth 791 m; 5.54°C; 35.03 ppt; 5 Jul. 1993; BIOICE 2474; IINH 39632 • 2; 63.0722° N, 21.5917° W; RP sledge; depth 842 m; 5.54°C; 35.03 ppt; 5 Jul. 1993; BIOICE 2475; IINH 39634 • 2; 66.6094° N, 23.9836° W; detr. sledge (Sneli); depth 226 m; 5.61°C; 35.01 ppt; 13 Jul. 1993; BIOICE 2526; IINH 39543 • 7; 66.2728° N, 22.9525° W; Triangle dredge; depth 77 m; 4.83°C; 34.6 ppt; 14 Jul. 1993; BIOICE 2551; IINH 39564 • 1; 67.0522° N, 23.9881° W; detr. sledge (Sneli); depth 370 m; -0.15°C; 34.85 ppt; 15 Jul. 1993; BIOICE 2570; IINH 39565 • 7; 67.1014° N, 24.0992° W; detr. sledge (Sneli); depth 495 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2572; IINH 39566 • 10; 67.1097° N, 24.085° W; RP sledge; depth 489 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2573; IINH 39567 • 1; 67.1042° N, 24.7242° W; RP sledge; depth 996 m; -0.58°C; 34.87 ppt; 15 Jul. 1993; BIOICE 2579; IINH 39568 • 1; 67.6083° N, 22.3897° W; RP sledge; depth 605 m; -0.54°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2583; IINH 39563 • 11; 67.4214° N, 22.4072° W; RP sledge; depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2585; IINH 39569 • 3; 67.4181° N, 22.4347° W; detr. sledge (Sneli); depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2586; IINH 39570 • 7; 67.3406° N, 22.5425° W; detr. sledge (Sneli); depth 356 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2588; IINH 39571 • 8; 67.3381° N, 22.5525° W; RP sledge; depth 355 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2589; IINH 39572 • 2; 67.2147° N, 22.4294° W; RP sledge; depth 333 m; 0.12°C; 34.84 ppt; 16 Jul. 1993; BIOICE 2591; IINH 39638 • 5; 67.0028° N, 22.5714° W; RP sledge; depth 203 m; 5.41°C; 34.99 ppt; 16 Jul. 1993; BIOICE 2595; IINH 39637 • 1; 66.6539° N, 20.9364° W; Agassiz trawl; depth 335 m; 1.49°C; 34.76 ppt; 17 Jul. 1993; BIOICE 2601; IINH 39573 • 38; 66.9417° N, 17.9389° W; detr. sledge (Sneli); depth 433 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2603; IINH 39574 • 27; 66.9344° N, 17.9397° W; RP sledge; depth 435 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2606; IINH 39575 • 4; 67.1375° N, 17.0306° W; RP sledge; depth 362 m; -0.36°C; 34.89 ppt; 11 Jul. 1994; BIOICE 2613; IINH 39660 • 3; 67.2761° N, 16.6592° W; detr. sledge (Sneli); depth 597 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2618; IINH 39661 • 13; 67.5758° N, 16.5406° W; RP sledge; depth 894 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2622; IINH 39663 • 2; 67.4331° N, 16.1753° W; detr. sledge (Sneli); depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2626; IINH 39576 • 70; 67.4286° N, 16.1703° W; RP sledge; depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2627; IINH 39654 • 4; 67.3364° N, 16.1194° W; detr. sledge (Sneli); depth 602 m; -0.55°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2629; IINH 39577 • 18; 67.3894° N, 15.9775° W; detr. sledge (Sneli); depth 699 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2631; IINH 39578 • 6; 67.5044° N, 15.8069° W; detr. sledge (Sneli); depth 795 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2634; IINH 39662 • 4; 67.8189° N, 15.505° W; RP sledge; depth 1009 m; -0.59°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2638; IINH 39659 • 2; 67.9364° N, 15.3725° W; detr. sledge (Sneli); depth 1097 m; -0.61°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2640; IINH 39579 • 2; 67.9419° N, 15.3581° W; RP sledge; depth 1098 m; -0.61°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2642; IINH 39664 • 5; 68.0208° N, 15.2519° W; RP sledge; depth 1202 m; -0.64°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2644; IINH 39580 • 5; 68.0922° N, 15.3258° W; detr. sledge (Sneli); depth 1304 m; -0.72°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2647; IINH 39581 • 25; 68.0858° N, 15.3181° W; RP sledge; depth 1306 m; -0.72°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2648; IINH 39582 • 13; 67.6103° N, 15.1283° W; RP sledge; depth 910 m; -0.57°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2652; IINH 39665 • 25; 67.3° N, 14.9581° W; RP sledge; depth 549 m; -0.55°C; 34.9 ppt; 14 Jul. 1994; BIOICE 2655; IINH 39583 • 1; 67.2389° N, 15.4706° W; detr. sledge (Sneli); depth 262 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2659; IINH 39584 • 4; 67.2447° N, 15.4783° W; RP sledge; depth 277 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2660; IINH 39653 • 3; 67.2258° N, 16.1578° W; detr. sledge (Sneli); depth 350 m; -0.03°C; 34.87 ppt; 15 Jul. 1994; BIOICE 2662; IINH 39658 • 20; 67.0561° N, 16.2747° W; detr. sledge (Sneli); depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2664; IINH 39585 • 5; 67.0528° N, 16.2847° W; Agassiz trawl; depth 384 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2665; IINH 39586 • 15; 67.0575° N, 16.2675° W; RP sledge; depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2666; IINH 39657 • 5; 66.9989° N, 15.7606° W; detr. sledge (Sneli); depth 187 m; 2.55°C; 34.87 ppt; 15 Jul. 1994; BIOICE 2668; IINH 39656 • 2; 66.8389° N, 16.2706° W; RP sledge; depth 227 m; 2.78°C; 34.89 ppt; 15 Jul. 1994; BIOICE 2673; IINH 39655 • 4; 66.2558° N, 17.3339° W; detr. sledge (Sneli); depth 178 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2681; IINH 39589 • 1; 66.2594° N, 17.3356° W; RP sledge; depth 181 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2682; IINH 39590 • 6; 67.0908° N, 20.1411° W; RP sledge; depth 284 m; -0.01°C; 34.86 ppt; 30 Jul. 1995; BIOICE 2736; IINH 39732 • 7; 67.3208° N, 19.7114° W; detr. sledge (Sneli); depth 352 m; -0.38°C; 34.88 ppt; 30 Jul. 1995; BIOICE 2737; IINH 39729 • 7; 67.6439° N, 20.2722° W; detr. sledge (Sneli); depth 503 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2740; IINH 39727 • 11; 67.6583° N, 20.2411° W; RP sledge; depth 514 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2741; IINH 39725 • 3; 67.7775° N, 20.7875° W; detr. sledge (Sneli); depth 778 m; -0.58°C; 34.89 ppt; 31 Jul. 1995; BIOICE 2747; IINH 39723 • 3; 68.0203° N, 20.6578° W; detr. sledge (Sneli); depth 970 m; -0.57°C; 34.89 ppt; 31 Jul. 1995; BIOICE 2749; IINH 39721 • 6; 67.93° N, 17.7072° W; RP sledge; depth 1130 m; -0.53°C; 34.89 ppt; 1 Aug. 1995; BIOICE 2762; IINH 39717 • 4; 68.1083° N, 17.5347° W; RP sledge; depth 1220 m; -0.52°C; 34.89 ppt; 1 Aug. 1995; BIOICE 2765; IINH 39719 • 7; 69.2614° N, 14.2172° W; detr. sledge (Sneli); depth 1633 m; -0.86°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2772; IINH 39728 • 20; 69.2581° N, 14.2811° W; RP sledge; depth 1629 m; -0.86°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2773; IINH 39724 • 1; 68.6028° N, 14.6756° W; detr. sledge (Sneli); depth 1553 m; -0.78°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2776; IINH 39722 • 6; 68.6222° N, 14.6861° W; RP sledge; depth 1556 m; -0.78°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2777; IINH 39730 • 8; 68.345° N, 15.7858° W; RP sledge; depth 1413 m; -0.74°C; 34.89 ppt; 4 Aug. 1995; BIOICE 2779; IINH 39726 • 25; 67.4156° N, 18.2417° W; RP sledge; depth 693 m; -0.41°C; 34.88 ppt; 5 Aug. 1995; BIOICE 2786; IINH 39718 • 3; 67.36° N, 18.3344° W; RP sledge; depth 561 m; -0.29°C; 34.87 ppt; 5 Aug. 1995; BIOICE 2787; IINH 39731 • 2; 67.2547° N, 18.8669° W; Agassiz trawl; depth 480 m; 0.01°C; 34.85 ppt; 5 Aug. 1995; BIOICE 2792; IINH 39720 • 5; 62.3472° N, 16.9917° W; RP sledge; depth 2074 m; 2.34°C; 34.96 ppt; 29 Aug. 1995; BIOICE 2856; IINH 39591 • 1; 65.3908° N, 28.3575° W; RP sledge; depth 1057 m; 4.78°C; 34.98 ppt; 24 Aug. 1996; BIOICE 2904; IINH 39807 • 10; 67.3264° N, 21.1819° W; RP sledge; depth 314 m; 0.23°C; 34.86 ppt; 21 Aug. 1999; BIOICE 3104; IINH 39811 • 3; 67.3219° N, 20.7528° W; RP sledge; depth 328 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3108;

IINH 39820 • 25; 67.5253° N, 20.1039° W; RP sledge; depth 439 m; -0.51°C; 34.89 ppt; 21 Aug. 1999; BIOICE 3110; IINH 39822 • 2; 67.705° N, 19.7986° W; RP sledge; depth 611 m; -0.57°C; 34.89 ppt; 22 Aug. 1999; BIOICE 3115; IINH 39812 • 1; 68.0736° N, 18.1103° W; detr. sledge (Sneli); depth 748 m; -0.28°C; 34.88 ppt; 22 Aug. 1999; BIOICE 3121; IINH 39816 • 15; 68.1561° N, 17.9856° W; RP sledge; depth 875 m; -0.48°C; 34.89 ppt; 22 Aug. 1999; BIOICE 3124; IINH 39814 • 3; 68.7325° N, 16.5853° W; RP sledge; depth 1715 m; unknown; unknown; 23 Aug. 1999; BIOICE 3127; IINH 39810 • 6; 68.2575° N, 20.0189° W; RP sledge; depth 1112 m; unknown; unknown; 24 Aug. 1999; BIOICE 3136; IINH 39818 • 4; 67.875° N, 22.2581° W; RP sledge; depth 768 m; -0.46°C; 34.89 ppt; 25 Aug. 1999; BIOICE 3140; IINH 40094 • 1; 67.2194° N, 24.9389° W; detr. sledge (Sneli); depth 1223 m; unknown; unknown; 25 Aug. 1999; BIOICE 3146; IINH 39821 • 1; 66.8842° N, 26.9342° W; detr. sledge (Sneli); depth 434 m; 0.06°C; 34.86 ppt; 26 Aug. 1999; BIOICE 3149; IINH 39819 • 1; 62.6189° N, 23.3719° W; RP sledge; depth 1250 m; 3.61°C; 34.99 ppt; 25 Jul. 2000; BIOICE 3161; IINH 39817 • 1; 60.9264° N, 22.7897° W; detr. sledge (Sneli); depth 1898 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3166; IINH 39813 • 2; 60.9244° N, 22.7906° W; RP sledge; depth 1897 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3167; IINH 39815 • 15; 65.6508° N, 9.1203° W; detr. sledge (Sneli); depth 818 m; -0.58°C; 34.9 ppt; 7 Jul. 2001; BIOICE 3194; IINH 39809 • 30; 65.5139° N, 8.525° W; RP sledge; depth 935 m; -0.63°C; 34.9 ppt; 8 Jul. 2001; BIOICE 3198; IINH 39808 • 7; 64.8508° N, 7.8686° W; Agassiz trawl; depth 2612 m; -0.83°C; 34.91 ppt; 8 Jul. 2001; BIOICE 3203; IINH 39825 • 3; 66.235° N, 6.8714° W; RP sledge; depth 2544 m; -0.87°C; 34.91 ppt; 9 Jul. 2001; BIOICE 3210; IINH 39823 • 2; 67.1072° N, 7.4533° W; RP sledge; depth 2014 m; -0.86°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3216; IINH 39824 • 25; 67.2553° N, 8.4683° W; RP sledge; depth 1642 m; -0.82°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3219; IINH 39827 • 4; 67.9047° N, 8.1094° W; RP sledge; depth 1525 m; -0.83°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3222; IINH 39826 • 1; 68.5794° N, 8.2653° W; RP sledge; depth 1993 m; -0.86°C; 34.91 ppt; 12 Jul. 2001; BIOICE 3225; IINH 39828 • 1; 62.4331° N, 19.7708° W; RP sledge; depth 1780 m; 2.93°C; 35 ppt; 4 Sep. 2002; BIOICE 3514; IINH 39829 • 1; 63.5061° N, 29.6444° W; RP sledge; depth 2233 m; 3.14°C; 34.92 ppt; 5 Sep. 2003; BIOICE 3571; IINH 39830 • 3; 66.4942° N, 9.7556° W; RP sledge; depth 1475 m; -0.78°C; 34.9 ppt; 14 Jul. 2004; BIOICE 3621; IINH 39846 • 5; 66.9967° N, 8.8203° W; RP sledge; depth 1628 m; -0.82°C; 34.9 ppt; 14 Jul. 2004; BIOICE 3624; IINH 39840 • 3; 66.9842° N, 8.8017° W; Agassiz trawl; depth 1630 m; -0.82°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3625; IINH 39841 • 5; 67.3369° N, 9.5583° W; Agassiz trawl; depth 1616 m; -0.81°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3627; IINH 39842 • 5; 67.3314° N, 9.5544° W; RP sledge; depth 1609 m; -0.81°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3628; IINH 39848 • 2; 67.9378° N, 8.2747° W; RP sledge; depth 1481 m; -0.84°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3629; IINH 39847 • 2; 68.0133° N, 9.2539° W; Agassiz trawl; depth 1859 m; -0.82°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3631; IINH 39845 • 5; 68.0256° N, 9.255° W; RP sledge; depth 1727 m; -0.82°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3632; IINH 39843 • 7; 68.4589° N, 10.1542° W; RP sledge; depth 2069 m; -0.8°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3637; IINH 39849 • 2; 67.9675° N, 10.0503° W; RP sledge; depth 1915 m; -0.82°C; 34.9 ppt; 18 Jul. 2004; BIOICE 3640; IINH 39850 • 3; 66.9856° N, 10.7206° W; RP sledge; depth 1450 m; -0.77°C; 34.92 ppt; 19 Jul. 2004; BIOICE 3641; IINH 39835 • 4; 67.4061° N, 10.6831° W; RP sledge; depth 1703 m; -0.81°C; 34.91 ppt; 21 Jul. 2004; BIOICE 3645; IINH 39837 • 7; 68.9528° N, 10.5556° W; RP sledge; depth 2215 m; -0.79°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3648; IINH 39844 • 5; 69.0667° N, 13.5736° W; RP sledge; depth 1678 m; -0.81°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3652; IINH 39836 • 5; 68.6933° N, 14.3206° W; RP sledge; depth 1489 m; -0.8°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3655; IINH 39832 • 2; 68.7864° N, 15.3186° W; RP sledge; depth 1492 m; -0.72°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3656; IINH 39834 • 4; 68.005° N, 18.8106° W; RP sledge; depth 1018 m; -0.6°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3658; IINH 39838 • 1; 67.6583° N, 20.0344° W; Triangle dredge; depth 505 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3662; IINH 39833 • 4; 67.6561° N, 20.0778° W; RP sledge; depth 493 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3663; IINH 39831

Description

Test shape elongate, cylindrical, somewhat tapering, slightly nodular, more so in the latest chambers, initial end rounded, distinctly curved, rarely almost straight. Length of test 3–4 mm, the largest 5 mm; test width 0.4–0.6 mm. Chambers subglobular, sometimes slightly cylindrical in later chambers, rectilinearly arranged, embracement minimal, distinctly to slightly curved; number of chambers usually

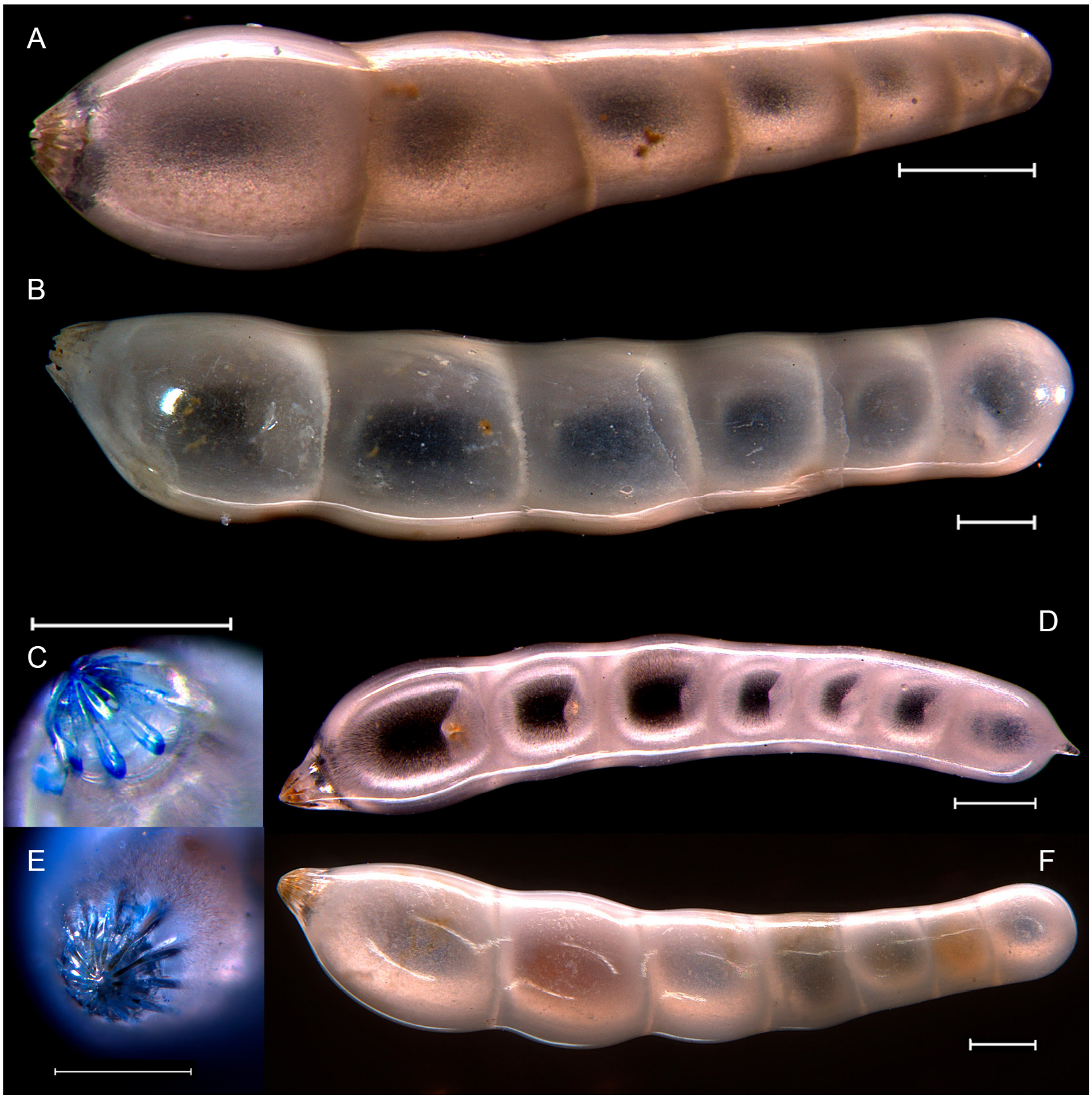

Fig. 3. *Dentalina elegans* d'Orbigny, 1846. **A**. Microsphere (BIOICE 2542, IINH 39684) with a spiral chamber arrangement at initial end; light source a combination of Rotterman contrast and dark field, resulting in a coarse appearance. **B**. Megalosphere (Biocie 2362, IINH 39758), side view showing surface edges of the secondary surface laminations. **C–D**. Megalosphere (BIOICE 3627, IINH 39842) aperture (C) stained with indigo blue and same specimen with a short spine at initial end (D). **E–F**. Megalosphere (BIOICE 2049, IINH 39697), aperture (E) stained with indigo blue and side view (F). Light source in B–F is a combination of incident light and dark field. Scale bars = 0.25 mm.

4–7, at most 9. In microspheres, the initial 3–5 chambers are wound in about half of an evolute planispiral (Fig. 3A). Sutures horizontal. About 90% of the specimens have a basal knob or short spine, exterior otherwise smooth. Secondary surface laminations cover the whole test (ortho-lamellar) or only part of the test (plesio-lamellar). Aperture radial, nearly central, slightly raised or protruding, with up to 12 symmetrically arranged tines, that are fused in the center. Wall thick and finely perforated.

Remarks

Of the 1364 examined specimens of *D. elegans*, 6 were microspheres. Diameter of proloculus in the megalospheres is 0.2–0.4 mm, but < 0.05 mm in the microsphere. *Dentalina elegans* was tacitly considered to be a megalospheric form of *D. frobisherensis* (Grønlund & Hansen 1976), since the morphology of the adult chambers is very similar. The species *Dentalina baggi* was distinguished from *Dentalina elegans* (Eiland & Guðmundsson 2004), stating that the test of the former had less inflated chambers, and that it lacks a prolocular spine, but noted though that about 10% of *D. elegans* also had no prolocular spine. The added material from the BIOICE renders this distinction arbitrary for the material at hand, as variation in test width and chamber inflation overlaps in specimens with or without a prolocular spine. It seems that forms identified here as *D. elegans* are relatively common in the North Atlantic and may have been reported under several names. The species *Nodosaria advena*, first described by Cushman (1923) off the northeast coast of USA seems to have a nearly identical morphology as the present *D. elegans* but differs only in being much larger viz up to 7 mm in length. Specimens under the name *Nodosaria advena* have been reported from the North Sea (Gabel 1971), off Scotland and the Faroe Islands (Cushman 1923) and in Late Quaternary deposits in the Oslofjord area, Norway (Feyling-Hanssen 1964).

Dentalina filiformis (d'Orbigny, 1826)
Fig. 4

Nodosaria (*Nodosaire*) *filiformis* d'Orbigny, 1826: 35, no.14.

Dentalina filiformis – Parker *et al.* 1871: 156, pl. 9 fig. 48. (cit. "Orthocera filiforma aut capillaria" Soldani, Testographia vol. 2, 1798: 35, fig. e). — Jones 1994 (part): 74, pl. 63 fig. 4 (only).
Nodosaria filiformis – Cushman 1913: 55, pl. 27 figs 1–4; 1923: 76–77, pl. 12 figs 1–2.
Laevidentalia filiformis – Eiland & Guðmundsson 2004: 200, pl. 1 fig. b, pl. 3 fig. c.

Material examined

BARENTS SEA • 1; 71.5908° N, 17.7586°E; large Van Veen grab; depth 293 m; 6.4°C; 35.191 ppt; 23 Sep. 2009; MAREANO-2009111 R457-141; IINH 40459.

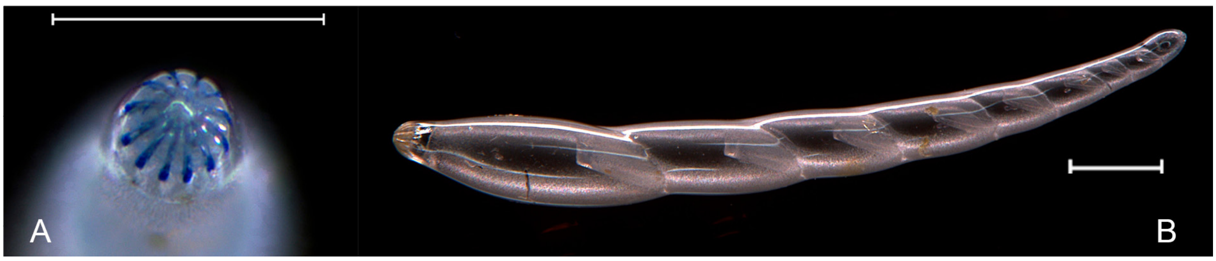

Fig. 4. *Dentalina filiformis* (d'Orbigny, 1826). **A–B**. Megalosphere (BIOICE 3600, IINH 40457), side view (B) and aperture (A) stained with indigo blue. Scale bars = 0.25 mm.

ICELANDIC WATERS • 1; 63.72° N, 24.4217° W; RP sledge; depth 209 m; 6.98°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2233; IINH 40445 • 1; 63.1514° N, 25.2683° W; RP sledge; depth 546 m; 6.52°C; 35.09 ppt; 8 Sep. 1992; BIOICE 2265; IINH 40419 • 1; 63.7583° N, 22.3528° W; RP sledge; depth 104 m; 7.05°C; 35.03 ppt; 30 Jun. 1993; BIOICE 2385; IINH 40446 • 1; 63.25° N, 22.2° W; detr. sledge (Sneli); depth 288 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2392; IINH 40420 • 1; 63.2514° N, 22.2033° W; RP sledge; depth 291 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2393; IINH 40442 • 1; 63.175° N, 21.8889° W; RP sledge; depth 346 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2398; IINH 40444 • 1; 63.1333° N, 20.6667° W; detr. sledge (Sneli); depth 300 m; 7.02°C; 35.11 ppt; 2 Jul. 1993; BIOICE 2420; IINH 40360 • 1; 63.2611° N, 21.2389° W; RP sledge; depth 180 m; 7.24°C; 35.11 ppt; 5 Jul. 1993; BIOICE 2466; IINH 40449 • 2; 63.1233° N, 21.6119° W; detr. sledge (Sneli); depth 647 m; 6.09°C; 35.06 ppt; 5 Jul. 1993; BIOICE 2471; IINH 40447 • 2; 63.4167° N, 16.8458° W; detr. sledge (Sneli); depth 277 m; 7.21°C; 35.15 ppt; 25 Aug. 1995; BIOICE 2829; IINH 40451 • 1; 62.8394° N, 18.0117° W; RP sledge; depth 976 m; 3.26°C; 34.98 ppt; 27 Aug. 1995; BIOICE 2849; IINH 40452 • 1; 64.5767° N, 27.6106° W; detr. sledge (Sneli); depth 775 m; 6.05°C; 35.03 ppt; 22 Aug. 1996; BIOICE 2876; IINH 40460 • 3; 65.1722° N, 27.0694° W; RP sledge; depth 229 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2884; IINH 40450 • 1; 65.1333° N, 23.6° W; Triangle dredge; depth 121 m; 7.97°C; 34.93 ppt; 30 Aug. 1996; BIOICE 2965; IINH 40453 • 1; 63.7667° N, 14.85° W; RP sledge; depth 216 m; 7.67°C; 35.16 ppt; 5 Jul. 1997; BIOICE 2994; IINH 40454 • 1; 63.5747° N, 14.9247° W; Triangle dredge; depth 682 m; 4.73°C; 35.02 ppt; 5 Jul. 1997; BIOICE 3001; IINH 40456 • 1; 64.0397° N, 13.5747° W; RP sledge; depth 135 m; 7.84°C; 35.13 ppt; 9 Jul. 1997; BIOICE 3046; IINH 40455 • 1; 62.7019° N, 25.4619° W; detr. sledge (Sneli); depth 622 m; 7.11°C; 35.14 ppt; 10 Sep. 2003; BIOICE 3600; IINH 40457 • 1; 62.7039° N, 25.4561° W; RP sledge; depth 624 m; 7.11°C; 35.14 ppt; 11 Sep. 2003; BIOICE 3601; IINH 40458

Description

Test shape elongate cylindrical and slender; distinctly curved, slightly nodular, and evenly tapering in a rounded but narrow end. Length of test 2–3 mm, the longest is 4.5 mm; test width 0.15–0.25 mm. Chambers initially cylindrical, becoming slightly inflated and more elongated as added. Chamber arrangement rectilinear, minimal embracement; number of chambers commonly 6–11, or up to 14. Initial chambers in microsphere are rectilinear. Sutures oblique. Aperture radial, nearly central and usually protruding, with up to 16 symmetrically arranged tines that are fused in the center. Surface smooth without ornamentation; secondary surface laminations absent (atelo-lamellar). Wall finely perforated, thin, and transparent.

Remarks

Of the 24 examined specimens, 14 had an intact initial end, with prolocular size that varied nearly continuously from less than 0.05 to about 0.12 mm, presumably including both generations with rectilinear chamber arrangement of the initial part.

Dentalina frobisherensis Loeblich & Tappan, 1953
Fig. 5

Dentalina frobisherensis Loeblich & Tappan, 1953: 55, pl. 10 figs 1–9.

Laevidentalina frobisherensis – Eiland & Guðmundsson 2004 (part): 200, 202, pl. 1 fig. c, pl. 4 figs a–e, pl. 5 figs c, e (only).

non *Nodosaria communis* (d'Orbigny, 1840) – Goës 1894 (part): 67–68, pl. 12 figs 668–670 (only).
non *Nodosaria pauperata* (d'Orbigny, 1846) – Goës 1894 (part): 68–69, pl. 12 figs 672, 674–676 (only). — Cushman 1923: 72, pl. 14 fig. 13.

non *Nodosaria mucronata* (Neugeboren, 1856) – Cushman 1923 (part): 80. pl. 12 figs 5–7, pl. 13 figs 7–8 (only).

Material examined

BARENTS SEA • 12; 82.3522° N, 25.3186°E; epibenthic dredge; depth 3920 m; unknown; unknown; 16 Jul. 1980; Ymer 80 MB8; IINH 21157 • 42; 81.8347° N, 26.5692°E; epibenthic dredge; depth 3270 m; unknown; unknown; 18 Jul. 1980; Ymer 80 MB9; IINH 21153

ICELANDIC WATERS • 1; 65.3558° N, 13.3342° W; RP sledge; depth 177 m; 2.8°C; unknown; 19 Jul. 1991; BIOICE 2004; IINH 39509 • 1; 65.5836° N, 11.2881° W; RP sledge; depth 768 m; -0.42°C; unknown; 20 Jul. 1991; BIOICE 2011; IINH 39429 • 3; 65.6953° N, 11.0106° W; RP sledge; depth 978 m; -0.41°C; unknown; 20 Jul. 1991; BIOICE 2014; IINH 39428 • 1; 66.5089° N, 11.2278° W; detr. sledge (Sneli); depth 1395 m; -0.82°C; unknown; 21 Jul. 1991; BIOICE 2017; IINH 39430 • 11; 66.5769° N, 11.2303° W; RP sledge; depth 1390 m; -0.82°C; unknown; 21 Jul. 1991; BIOICE 2018; IINH 39431 • 6; 66.6278° N, 12.1542° W; detr. sledge (Sneli); depth 1314 m; -0.86°C; unknown; 22 Jul. 1991; BIOICE 2020; IINH 39432 • 1; 67.2061° N, 13.3494° W; RP sledge; depth 1648 m; -0.76°C; unknown; 23 Jul. 1991; BIOICE 2027; IINH 39607 • 1; 67.0581° N, 13.4239° W; RP sledge; depth 931 m; -0.56°C; unknown; 23 Jul. 1991; BIOICE 2029; IINH 39608 • 8; 66.9225° N, 13.5181° W; RP sledge; depth 552 m; -0.54°C; unknown; 23 Jul. 1991; BIOICE 2033; IINH 39609 • 6; 66.3647° N, 13.4856° W; RP sledge; depth 310 m; 1.3°C; unknown; 24 Jul. 1991; BIOICE 2040; IINH 39610 • 4; 65.7792° N, 13.9722° W; detr. sledge (Sneli); depth 229 m; 2.6°C; unknown; 24 Jul. 1991; BIOICE 2045; IINH 39611 • 1; 65.7025° N, 12.8833° W; RP sledge; depth 272 m; 1.96°C; unknown; 25 Jul. 1991; BIOICE 2047; IINH 39612 • 1; 65.6531° N, 12.3583° W; RP sledge; depth 247 m; 1.2°C; unknown; 25 Jul. 1991; BIOICE 2049; IINH 39613 • 5; 66.1586° N, 17.6069° W; detr. sledge (Sneli); depth 198 m; 3.8°C; 34.85 ppt; 2 Jul. 1992; BIOICE 2065; IINH 39433 • 1; 66.5708° N, 17.73° W; detr. sledge (Sneli); depth 485 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2069; IINH 39434 • 9; 66.5711° N, 17.7425° W; RP sledge; depth 489 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2070; IINH 39435 • 5; 67.2014° N, 17.5344° W; detr. sledge (Sneli); depth 563 m; -0.42°C; 34.7 ppt; 3 Jul. 1992; BIOICE 2075; IINH 39614 • 4; 67.6808° N, 17.1772° W; RP sledge; depth 1048 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2077; IINH 39615 • 3; 67.6719° N, 17.2008° W; detr. sledge (Sneli); depth 1046 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2079; IINH 39616 • 6; 67.375° N, 17.3847° W; RP sledge; depth 893 m; -0.55°C; 34.84 ppt; 4 Jul. 1992; BIOICE 2081; IINH 39436 • 7; 67.3675° N, 17.4092° W; detr. sledge (Sneli); depth 894 m; -0.55°C; 34.84 ppt; 4 Jul. 1992; BIOICE 2082; IINH 39438 • 13; 67.2614° N, 17.455° W; RP sledge; depth 735 m; -0.41°C; 34.86 ppt; 4 Jul. 1992; BIOICE 2087; IINH 39437 • 1; 67.2422° N, 17.8614° W; RP sledge; depth 617 m; -0.44°C; 34.87 ppt; 4 Jul. 1992; BIOICE 2088; IINH 39439 • 3; 67.1939° N, 17.7789° W; RP sledge; depth 405 m; -0.31°C; 34.86 ppt; 5 Jul. 1992; BIOICE 2091; IINH 39440 • 3; 67.2069° N, 17.7583° W; detr. sledge (Sneli); depth 407 m; -0.31°C; 34.86 ppt; 5 Jul. 1992; BIOICE 2093; IINH 39442 • 1; 67.0342° N, 17.5717° W; detr. sledge (Sneli); depth 303 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2094; IINH 39443 • 1; 67.0194° N, 17.585° W; RP sledge; depth 300 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2096; IINH 39441 • 1; 67.8372° N, 19.5581° W; RP sledge; depth 905 m; -0.55°C; 34.87 ppt; 6 Jul. 1992; BIOICE 2107; IINH 39444 • 1; 67.7644° N, 19.4839° W; RP sledge; depth 749 m; -0.53°C; 34.86 ppt; 6 Jul. 1992; BIOICE 2108; IINH 39447 • 3; 67.7253° N, 19.5083° W; detr. sledge (Sneli); depth 588 m; -0.54°C; 34.86 ppt; 6 Jul. 1992; BIOICE 2111; IINH 39445 • 2; 67.7292° N, 19.4722° W; RP sledge; depth 603 m; -0.54°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2113; IINH 39448 • 35; 67.7047° N, 19.4669° W; RP sledge; depth 489 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2114; IINH 39449 • 14; 67.7° N, 19.4397° W; detr. sledge (Sneli); depth 495 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2116; IINH 39450 • 32; 67.4756° N, 19.5386° W; detr. sledge (Sneli); depth 405 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2117; IINH 39451 • 6; 67.1189° N, 19.8775° W; RP sledge; depth 284 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2119; IINH 39453 • 12; 67.1275° N, 19.9042° W; detr. sledge (Sneli); depth 280 m; 0.5°C; 34.82 ppt;

7 Jul. 1992; BIOICE 2121; IINH 39459 • 27; 67.1858° N, 19.5672° W; detr. sledge (Sneli); depth 346 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2122; IINH 39454 • 35; 67.1839° N, 19.5736° W; RP sledge; depth 347 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2124; IINH 39452 • 25; 66.7744° N, 18.7042° W; detr. sledge (Sneli); depth 678 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2129; IINH 39622 • 3; 66.7661° N, 18.7081° W; RP sledge; depth 660 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2131; IINH 39623 • 35; 66.7514° N, 18.925° W; RP sledge; depth 492 m; 0.12°C; 34.85 ppt; 8 Jul. 1992; BIOICE 2132; IINH 39624 • 16; 66.7197° N, 19.3303° W; RP sledge; depth 297 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2137; IINH 39455 • 3; 66.7128° N, 19.3186° W; detr. sledge (Sneli); depth 300 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2139; IINH 39625 • 18; 66.8586° N, 20.1614° W; RP sledge; depth 399 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2143; IINH 39456 • 3; 66.8581° N, 20.1603° W; detr. sledge (Sneli); depth 398 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2145; IINH 39457 • 9; 66.7592° N, 20.0878° W; RP sledge; depth 293 m; 3°C; 34.86 ppt; 9 Jul. 1992; BIOICE 2149; IINH 39458 • 7; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 39460 • 7; 64.1° N, 9.05° W; detr. sledge (Sneli); depth 991 m; unknown; unknown; 2 May1993; BIOICE 2315; IINH 39461 • 2; 64.0333° N, 9.6167° W; detr. sledge (Sneli); depth 772 m; unknown; unknown; 2 May1993; BIOICE 2318; IINH 39626 • 4; 64.0167° N, 9.6167° W; RP sledge; depth 776 m; unknown; unknown; 2 May1993; BIOICE 2319; IINH 39627 • 10; 63.9333° N, 10° W; detr. sledge (Sneli); depth 639 m; unknown; unknown; 3 May1993; BIOICE 2321; IINH 39462 • 5; 63.75° N, 10.1833° W; RP sledge; depth 555 m; unknown; unknown; 3 May1993; BIOICE 2325; IINH 39463 • 1; 63.35° N, 10.85° W; detr. sledge (Sneli); depth 430 m; unknown; unknown; 3 May1993; BIOICE 2327; IINH 39464 • 1; 63.0833° N, 11.35° W; detr. sledge (Sneli); depth 453 m; unknown; unknown; 3 May1993; BIOICE 2329; IINH 39465 • 8; 63.0833° N, 11.3333° W; RP sledge; depth 453 m; unknown; unknown; 3 May1993; BIOICE 2330; IINH 39466 • 3; 62.7167° N, 12.7167° W; RP sledge; depth 803 m; unknown; unknown; 4 May 1993; BIOICE 2334; IINH 39467 • 2; 62.4667° N, 12.9° W; detr. sledge (Sneli); depth 1105 m; unknown; unknown; 5 May 1993; BIOICE 2335; IINH 39468 • 1; 62.45° N, 12.8833° W; Agassiz trawl; depth 1090 m; unknown; unknown; 5 May 1993; BIOICE 2336; IINH 39469 • 1; 62.1333° N, 13.3333° W; RP sledge; depth 1302 m; unknown; unknown; 5 May 1993; BIOICE 2340; IINH 39470 • 1; 63.7833° N, 11.85° W; detr. sledge (Sneli); depth 355 m; unknown; unknown; 6 May 1993; BIOICE 2351; IINH 39628 • 8; 64.2833° N, 10.8167° W; RP sledge; depth 391 m; unknown; unknown; 7 May 1993; BIOICE 2360; IINH 39471 • 3; 64.45° N, 10.45° W; detr. sledge (Sneli); depth 498 m; unknown; unknown; 7 May 1993; BIOICE 2361; IINH 39472 • 5; 64.4833° N, 10.4333° W; RP sledge; depth 495 m; unknown; unknown; 7 May 1993; BIOICE 2362; IINH 39473 • 1; 64.6333° N, 9.7167° W; RP sledge; depth 719 m; unknown; unknown; 8 May 1993; BIOICE 2367; IINH 39474 • 2; 64.6667° N, 9.5667° W; detr. sledge (Sneli); depth 920 m; unknown; unknown; 8 May 1993; BIOICE 2369; IINH 39475 • 2; 64.75° N, 10.5167° W; detr. sledge (Sneli); depth 449 m; unknown; unknown; 8 May 1993; BIOICE 2371; IINH 39476 • 6; 64.8667° N, 11.4333° W; detr. sledge (Sneli); depth 476 m; unknown; unknown; 9 May 1993; BIOICE 2372; IINH 39477 • 1; 64.9167° N, 11.6333° W; Triangle dredge; depth 305 m; unknown; unknown; 10 May1993; BIOICE 2375; IINH 39478 • 2; 64.3333° N, 12.45° W; Triangle dredge; depth 403 m; unknown; unknown; 10 May1993; BIOICE 2380; IINH 39479 • 1; 63.1417° N, 19.9556° W; RP sledge; depth 1016 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2430; IINH 39631 • 1; 63.0689° N, 19.8592° W; detr. sledge (Sneli); depth 1207 m; 4.45°C; 34.99 ppt; 3 Jul. 1993; BIOICE 2431; IINH 39630 • 1; 66.2728° N, 22.9525° W; Triangle dredge; depth 77 m; 4.83°C; 34.6 ppt; 14 Jul. 1993; BIOICE 2551; IINH 39480 • 1; 67.0522° N, 23.9881° W; detr. sledge (Sneli); depth 370 m; -0.15°C; 34.85 ppt; 15 Jul. 1993; BIOICE 2570; IINH 39481 • 16; 67.1014° N, 24.0992° W; detr. sledge (Sneli); depth 495 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2572; IINH 39482 • 11; 67.1097° N, 24.085° W; RP sledge; depth 489 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2573; IINH 39483 • 3; 67.4214° N, 22.4072° W; RP sledge; depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2585; IINH 39484 • 2; 67.4181° N, 22.4347° W; detr. sledge (Sneli); depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2586; IINH 39485 • 16; 67.3406° N, 22.5425° W; detr. sledge (Sneli); depth 356 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2588; IINH 39486 • 2;

67.3381° N, 22.5525° W; RP sledge; depth 355 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2589; IINH 39639 • 3; 67.2147° N, 22.4294° W; RP sledge; depth 333 m; 0.12°C; 34.84 ppt; 16 Jul. 1993; BIOICE 2591; IINH 39640 • 1; 67.0028° N, 22.5714° W; RP sledge; depth 203 m; 5.41°C; 34.99 ppt; 16 Jul. 1993; BIOICE 2595; IINH 39641 • 4; 66.6539° N, 20.9364° W; Agassiz trawl; depth 335 m; 1.49°C; 34.76 ppt; 17 Jul. 1993; BIOICE 2601; IINH 39642 • 17; 66.9417° N, 17.9389° W; detr. sledge (Sneli); depth 433 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2603; IINH 39487 • 21; 66.9344° N, 17.9397° W; RP sledge; depth 435 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2606; IINH 39488 • 3; 67.1375° N, 17.0306° W; RP sledge; depth 362 m; -0.36°C; 34.89 ppt; 11 Jul. 1994; BIOICE 2613; IINH 39649 • 2; 67.1894° N, 16.8589° W; detr. sledge (Sneli); depth 528 m; -0.52°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2615; IINH 39489 • 6; 67.2761° N, 16.6592° W; detr. sledge (Sneli); depth 597 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2618; IINH 39650 • 2; 67.2906° N, 16.6381° W; RP sledge; depth 600 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2619; IINH 39651 • 3; 67.5758° N, 16.5406° W; RP sledge; depth 894 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2622; IINH 39652 • 3; 67.4331° N, 16.1753° W; detr. sledge (Sneli); depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2626; IINH 39490 • 19; 67.4286° N, 16.1703° W; RP sledge; depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2627; IINH 39491 • 4; 67.3364° N, 16.1194° W; detr. sledge (Sneli); depth 602 m; -0.55°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2629; IINH 39492 • 4; 67.3894° N, 15.9775° W; detr. sledge (Sneli); depth 699 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2631; IINH 39493 • 3; 67.5044° N, 15.8069° W; detr. sledge (Sneli); depth 795 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2634; IINH 39648 • 2; 67.9364° N, 15.3725° W; detr. sledge (Sneli); depth 1097 m; -0.61°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2640; IINH 39643 • 3; 67.9419° N, 15.3581° W; RP sledge; depth 1098 m; -0.61°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2642; IINH 39647 • 5; 68.0208° N, 15.2519° W; RP sledge; depth 1202 m; -0.64°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2644; IINH 39494 • 5; 68.0922° N, 15.3258° W; detr. sledge (Sneli); depth 1304 m; -0.72°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2647; IINH 39495 • 8; 68.0858° N, 15.3181° W; RP sledge; depth 1306 m; -0.72°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2648; IINH 39496 • 6; 67.6103° N, 15.1283° W; RP sledge; depth 910 m; -0.57°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2652; IINH 39646 • 18; 67.3° N, 14.9581° W; RP sledge; depth 549 m; -0.55°C; 34.9 ppt; 14 Jul. 1994; BIOICE 2655; IINH 39497 • 1; 67.2389° N, 15.4706° W; detr. sledge (Sneli); depth 262 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2659; IINH 39498 • 4; 67.2447° N, 15.4783° W; RP sledge; depth 277 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2660; IINH 39499 • 5; 67.2258° N, 16.1578° W; detr. sledge (Sneli); depth 350 m; -0.03°C; 34.87 ppt; 15 Jul. 1994; BIOICE 2662; IINH 39645 • 12; 67.0561° N, 16.2747° W; detr. sledge (Sneli); depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2664; IINH 39500 • 2; 67.0575° N, 16.2675° W; RP sledge; depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2666; IINH 39501 • 1; 66.8389° N, 16.2706° W; RP sledge; depth 227 m; 2.78°C; 34.89 ppt; 15 Jul. 1994; BIOICE 2673; IINH 39644 • 2; 66.2558° N, 17.3339° W; detr. sledge (Sneli); depth 178 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2681; IINH 39503 • 3; 66.2594° N, 17.3356° W; RP sledge; depth 181 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2682; IINH 39504 • 12; 67.0908° N, 20.1411° W; RP sledge; depth 284 m; -0.01°C; 34.86 ppt; 30 Jul. 1995; BIOICE 2736; IINH 39745 • 5; 67.3208° N, 19.7114° W; detr. sledge (Sneli); depth 352 m; -0.38°C; 34.88 ppt; 30 Jul. 1995; BIOICE 2737; IINH 39743 • 2; 67.6439° N, 20.2722° W; detr. sledge (Sneli); depth 503 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2740; IINH 39741 • 8; 67.6583° N, 20.2411° W; RP sledge; depth 514 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2741; IINH 39739 • 1; 68.0203° N, 20.6578° W; detr. sledge (Sneli); depth 970 m; -0.57°C; 34.89 ppt; 31 Jul. 1995; BIOICE 2749; IINH 39738 • 2; 67.9206° N, 18.3222° W; Triangle dredge; depth 610 m; -0.39°C; 34.88 ppt; 1 Aug. 1995; BIOICE 2756; IINH 39736 • 5; 67.93° N, 17.7072° W; RP sledge; depth 1130 m; -0.53°C; 34.89 ppt; 1 Aug. 1995; BIOICE 2762; IINH 39734 • 4; 69.2614° N, 14.2172° W; detr. sledge (Sneli); depth 1633 m; -0.86°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2772; IINH 39735 • 9; 69.2581° N, 14.2811° W; RP sledge; depth 1629 m; -0.86°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2773; IINH 39737 • 6; 68.6222° N, 14.6861° W; RP sledge; depth 1556 m; -0.78°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2777; IINH 39740 • 15; 68.345° N, 15.7858° W; RP sledge; depth 1413 m; -0.74°C; 34.89 ppt; 4 Aug. 1995; BIOICE 2779; IINH 39733 • 14; 67.4156° N, 18.2417° W; RP sledge; depth 693 m; -0.41°C; 34.88 ppt;

5 Aug. 1995; BIOICE 2786; IINH 39744 • 2; 67.36° N, 18.3344° W; RP sledge; depth 561 m; -0.29°C; 34.87 ppt; 5 Aug. 1995; BIOICE 2787; IINH 39742 • 1; 63.4167° N, 16.8458° W; detr. sledge (Sneli); depth 277 m; 7.21°C; 35.15 ppt; 25 Aug. 1995; BIOICE 2829; IINH 39746 • 1; 62.3472° N, 16.9917° W; RP sledge; depth 2074 m; 2.34°C; 34.96 ppt; 29 Aug. 1995; BIOICE 2856; IINH 39505 • 3; 61.7286° N, 16.9633° W; RP sledge; depth 2295 m; 2.6°C; 34.96 ppt; 30 Aug. 1995; BIOICE 2860; IINH 39506 • 1; 61.1717° N, 18.0492° W; RP sledge; depth 2400 m; 2.07°C; 34.95 ppt; 30 Aug. 1995; BIOICE 2863; IINH 39507 • 5; 67.1442° N, 22.7658° W; detr. sledge (Sneli); depth 290 m; 0.5°C; 34.87 ppt; 20 Aug. 1999; BIOICE 3094; IINH 39760 • 2; 67.1839° N, 21.7689° W; RP sledge; depth 230 m; 1.3°C; 34.87 ppt; 21 Aug. 1999; BIOICE 3099; IINH 39761 • 12; 67.3264° N, 21.1819° W; RP sledge; depth 314 m; 0.23°C; 34.86 ppt; 21 Aug. 1999; BIOICE 3104; IINH 39775 • 3; 67.3219° N, 20.7528° W; RP sledge; depth 328 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3108; IINH 39774 • 3; 67.5253° N, 20.1039° W; RP sledge; depth 439 m; -0.51°C; 34.89 ppt; 21 Aug. 1999; BIOICE 3110; IINH 39773 • 2; 67.705° N, 19.7986° W; RP sledge; depth 611 m; -0.57°C; 34.89 ppt; 22 Aug. 1999; BIOICE 3115; IINH 39772 • 2; 68.0736° N, 18.1103° W; detr. sledge (Sneli); depth 748 m; -0.28°C; 34.88 ppt; 22 Aug. 1999; BIOICE 3121; IINH 39771 • 11; 68.1561° N, 17.9856° W; RP sledge; depth 875 m; -0.48°C; 34.89 ppt; 22 Aug. 1999; BIOICE 3124; IINH 39770 • 2; 68.7325° N, 16.5853° W; RP sledge; depth 1715 m; unknown; unknown; 23 Aug. 1999; BIOICE 3127; IINH 39769 • 1; 68.2575° N, 20.0189° W; RP sledge; depth 1112 m; unknown; unknown; 24 Aug. 1999; BIOICE 3136; IINH 39768 • 1; 67.875° N, 22.2581° W; RP sledge; depth 768 m; -0.46°C; 34.89 ppt; 25 Aug. 1999; BIOICE 3140; IINH 40093 • 1; 66.6647° N, 27.7208° W; detr. sledge (Sneli); depth 345 m; 0.23°C; 34.8 ppt; 26 Aug. 1999; BIOICE 3151; IINH 39767 • 1; 60.9264° N, 22.7897° W; detr. sledge (Sneli); depth 1898 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3166; IINH 39766 • 1; 60.9244° N, 22.7906° W; RP sledge; depth 1897 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3167; IINH 39765 • 1; 61.2403° N, 27.9272° W; Triangle dredge; depth 1005 m; 4.6°C; 34.97 ppt; 31 Jul. 2000; BIOICE 3183; IINH 39764 • 8; 65.6508° N, 9.1203° W; detr. sledge (Sneli); depth 818 m; -0.58°C; 34.9 ppt; 7 Jul. 2001; BIOICE 3194; IINH 39763 • 6; 65.5139° N, 8.525° W; RP sledge; depth 935 m; -0.63°C; 34.9 ppt; 8 Jul. 2001; BIOICE 3198; IINH 39762 • 17; 64.8508° N, 7.8686° W; Agassiz trawl; depth 2612 m; -0.83°C; 34.91 ppt; 8 Jul. 2001; BIOICE 3203; IINH 39779 • 2; 65.7425° N, 7.0264° W; RP sledge; depth 2002 m; -0.87°C; 34.91 ppt; 9 Jul. 2001; BIOICE 3208; IINH 39777 • 9; 66.235° N, 6.8714° W; RP sledge; depth 2544 m; -0.87°C; 34.91 ppt; 9 Jul. 2001; BIOICE 3210; IINH 39778 • 22; 67.1072° N, 7.4533° W; RP sledge; depth 2014 m; -0.86°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3216; IINH 39780 • 55; 67.2553° N, 8.4683° W; RP sledge; depth 1642 m; -0.82°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3219; IINH 39782 • 3; 67.9047° N, 8.1094° W; RP sledge; depth 1525 m; -0.83°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3222; IINH 39776 • 1; 68.5794° N, 8.2653° W; RP sledge; depth 1993 m; -0.86°C; 34.91 ppt; 12 Jul. 2001; BIOICE 3225; IINH 39781 • 1; 62.6478° N, 14.2531° W; detr. sledge (Sneli); depth 1596 m; 2.64°C; 34.99 ppt; 9 Sep. 2002; BIOICE 3535; IINH 39783 • 1; 63.3803° N, 29.9236° W; RP sledge; depth 2359 m; 3.06°C; 34.92 ppt; 5 Sep. 2003; BIOICE 3573; IINH 39784 • 9; 66.4942° N, 9.7556° W; RP sledge; depth 1475 m; -0.78°C; 34.9 ppt; 14 Jul. 2004; BIOICE 3621; IINH 39803 • 5; 66.9967° N, 8.8203° W; RP sledge; depth 1628 m; -0.82°C; 34.9 ppt; 14 Jul. 2004; BIOICE 3624; IINH 39801 • 1; 66.9842° N, 8.8017° W; Agassiz trawl; depth 1630 m; -0.82°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3625; IINH 39804 • 7; 67.3369° N, 9.5583° W; Agassiz trawl; depth 1616 m; -0.81°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3627; IINH 39802 • 3; 67.3314° N, 9.5544° W; RP sledge; depth 1609 m; -0.81°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3628; IINH 39797 • 2; 68.0133° N, 9.2539° W; Agassiz trawl; depth 1859 m; -0.82°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3631; IINH 39796 • 20; 68.0256° N, 9.255° W; RP sledge; depth 1727 m; -0.82°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3632; IINH 39805 • 1; 68.42° N, 8.97° W; RP sledge; depth 1952 m; -0.84°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3633; IINH 39798 • 5; 68.8364° N, 9.245° W; RP sledge; depth 1844 m; -0.81°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3636; IINH 39800 • 1; 68.4589° N, 10.1542° W; RP sledge; depth 2069 m; -0.8°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3637; IINH 39799 • 2; 68.4508° N, 10.1828° W; Agassiz trawl; depth 2065 m; -0.8°C; 34.9 ppt; 18 Jul. 2004; BIOICE 3638; IINH 39785 • 6; 67.9675° N, 10.0503° W; RP sledge; depth 1915 m; -0.82°C; 34.9 ppt; 18 Jul. 2004; BIOICE 3640;

IINH 39787 • 5; 66.9856° N, 10.7206° W; RP sledge; depth 1450 m; -0.77°C; 34.92 ppt; 19 Jul. 2004; BIOICE 3641; IINH 39788 • 4; 67.4061° N, 10.6831° W; RP sledge; depth 1703 m; -0.81°C; 34.91 ppt; 21 Jul. 2004; BIOICE 3645; IINH 39790 • 7; 68.9528° N, 10.5556° W; RP sledge; depth 2215 m; -0.79°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3648; IINH 39786 • 1; 68.9231° N, 12.6275° W; detr. sledge (Sneli); depth 1900 m; -0.81°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3650; IINH 39795 • 3; 69.0667° N, 13.5736° W; RP sledge; depth 1678 m; -0.81°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3652; IINH 39794 • 1; 68.7033° N, 14.3086° W; Agassiz trawl; depth 1492 m; -0.8°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3654; IINH 39792 • 2; 68.6933° N, 14.3206° W; RP sledge; depth 1489 m; -0.8°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3655; IINH 39806 • 1; 68.7864° N, 15.3186° W; RP sledge; depth 1492 m; -0.72°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3656; IINH 39789 • 2; 67.6583° N, 20.0344° W; Triangle dredge; depth 505 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3662; IINH 39791 • 5; 67.6561° N, 20.0778° W; RP sledge; depth 493 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3663; IINH 39793

Description

Test shape elongate, cylindrical, distinctly to slightly curved, evenly tapering to a pointed end; slightly nodular in latest chambers. Length of test 2–3 mm, the largest nearly 4 mm; test width 0.3–0.5 mm. Chambers subglobular, sometimes slightly cylindrical in the latest chambers, rectilinearly arranged,

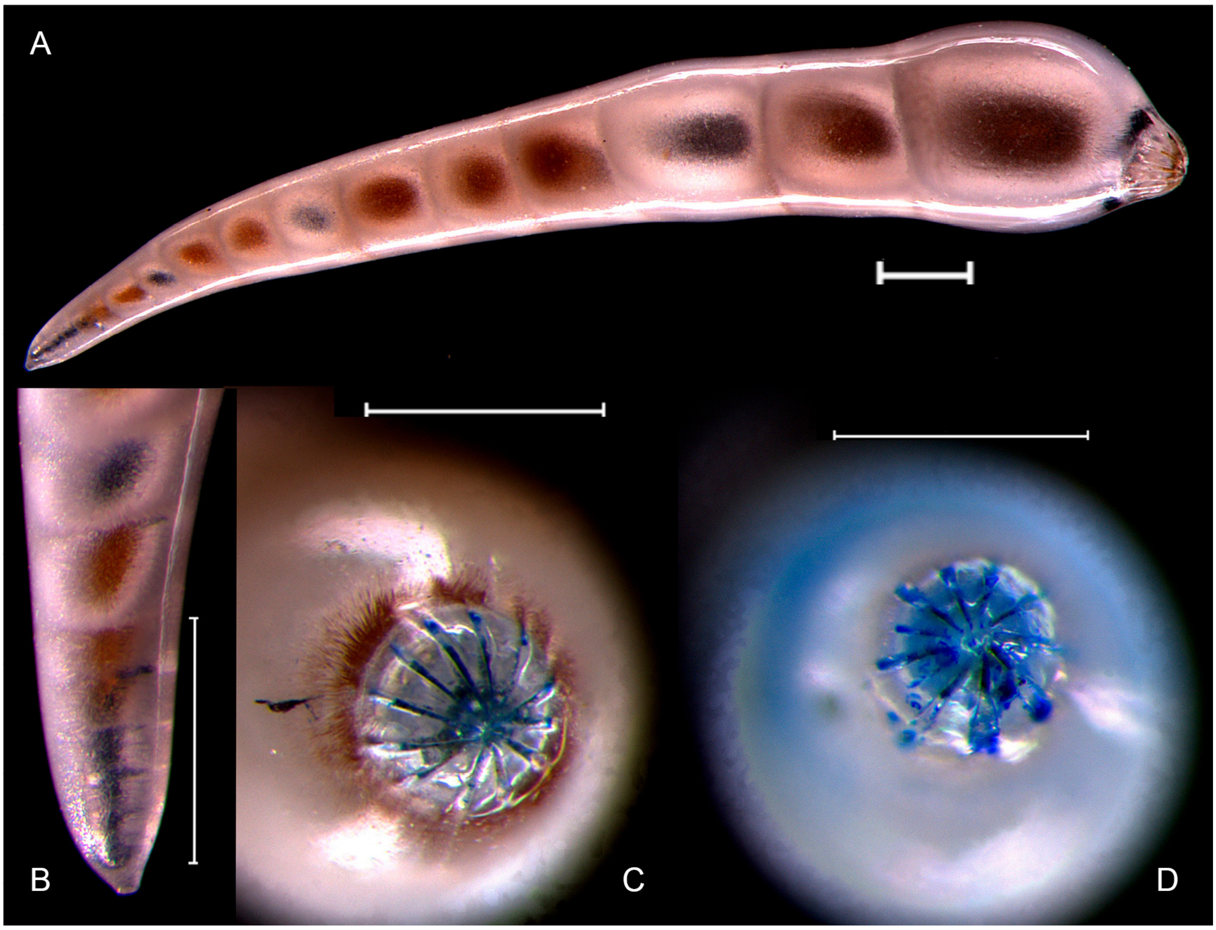

Fig. 5. *Dentalina frobisherensis* Loeblich & Tappan, 1953. **A–C**. Megalosphere (BIOICE 3104, IINH 39775), side view (A), details of initial end (B) and aperture (C) stained with indigo blue. **D**. Megalosphere (BIOICE 3108, IINH 39774), aperture stained with indigo blue. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

minimally embracing; number of chambers 9–14, sometimes up to 21. Initial chambers in microsphere are rectilinear. Sutures horizontal. Aperture radial, nearly central, slightly raised, sometimes protruding, comprising up to 12 tines, symmetrically arranged, usually fused in the center, sometimes only partly fused. Surface smooth, except for a very short basal knob or spine. Secondary surface laminations cover the whole test (ortho-lamellar) or partially (plesio-lamellar), wall finely perforated and thick.

Remarks

Prolocular size is commonly around 0.1 mm, but ranges continuously from about 0.03 to 0.14 mm. The secondary laminations result in successive thickening of the whole test as new chambers are added (Eiland & Guðmundsson 2004), which partially levels out the originally nodular character of the initial part of the test as new chambers and laminations are added.

Dentalina obliqua (Linnaeus, 1758)
Fig. 6

Nautilus obliqvus Linnaeus, 1758: 710. pl. 19 figs N–n.

Nodosaria obliqua – Goës 1894 (part): 70, pl. 12 figs 695–696 (only).
Dentalina obliqua – Eiland & Guðmundsson 2004: 197–198, pl. 1 fig. n, pl. 2 fig. b.

Material examined

BARENTS SEA • 7; 70.2403° N, 16.7878° W; large Van Veen grab; depth 1427 m; unknown; unknown; 3 Jun. 2008; MAREANO-2008104 R198-12A; IINH 14818 • 4; 70.2406° N, 16.7892° W; large Van Veen grab; depth 1422 m; unknown; unknown; 3 Jun. 2008; MAREANO-2008104 R198-12B; IINH 14806 • 1; 69.8728° N, 16.8231° W; large Van Veen grab; depth 351 m; unknown; unknown; 4 Jun. 2008; MAREANO-2008104 R205-14A; IINH 14810 • 2; 69.8725° N, 16.8228° W; large Van Veen grab; depth 351 m; unknown; unknown; 4 Jun. 2008; MAREANO-2008104 R205-16A; IINH 14848 • 1; 69.1478° N, 13.6917° W; Van Veen grab Large; depth 1119 m; unknown; unknown; 11 Jun. 2008; MAREANO-2008104 R229-25A; IINH 14811 • 1; 69.1478° N, 11.2764° W; large Van Veen grab; depth 1116 m; unknown; unknown; 11 Jun. 2008; MAREANO-2008104 R229-27B; IINH 14828 • 4; 69.1469° N, 13.715° W; Beam trawl; depth 1034 m; unknown; unknown; 11 Jun. 2008; MAREANO-2008104 R229-8A; IINH 14809 • 1; 69.2614° N, 14.3283° W; Beam trawl; depth 1221 m; unknown; unknown; 12 Jun. 2008; MAREANO-2008104 R231-10A; IINH 14819 • 7; 69.2714° N, 13.6194° W; RP-sledge; depth 1337 m; unknown; unknown; 12 Jun. 2008; MAREANO-2008104 R231-14A; IINH 14821 • 1; 69.2617° N, 14.3336° W; large Van Veen grab; depth 1238 m; unknown; unknown; 12 Jun. 2008; MAREANO-2008104 R231-31B; IINH 14845 • 3; 69.4136° N, 14.6019° W; Beam trawl; depth 1217 m; unknown; unknown; 13 Jun. 2008; MAREANO-2008104 R232-12B; IINH 14805 • 3; 69.4119° N, 14.7067° W; large Van Veen grab; depth 1409 m; unknown; unknown; 14 Jun. 2008; MAREANO-2008104 R232-16B; IINH 14808 • 3; 69.4119° N, 14.7067° W; large Van Veen grab; depth 1409 m; unknown; unknown; 14 Jun. 2008; MAREANO-2008104 R232-33A; IINH 14829 • 1; 68.5872° N, 13.7275° W; RP-sledge; depth 137 m; unknown; unknown; 18 Jun. 2008; MAREANO-2008104 R243-17A; IINH 14820 • 4; 68.5897° N, 13.7158° W; large Van Veen grab; depth 142 m; unknown; unknown; 18 Jun. 2008; MAREANO-2008104 R243-36A; IINH 14825 • 2; 68.5897° N, 13.7158° W; large Van Veen grab; depth 142 m; unknown; unknown; 18 Jun. 2008; MAREANO-2008104 R243-37B; IINH 14826 • 20; 68.7931° N, 12.535° W; RP-sledge; depth 1304 m; unknown; unknown; 19 Jun. 2008; MAREANO-2008104 R248-20A; IINH 14841 • 2; 69.7936° N, 12.5386° W; large Van Veen grab; depth 1305 m; unknown; unknown; 19 Jun. 2008; MAREANO-2008104 R248-38A; IINH 14827 • 1; 68.7939° N, 12.5386° W; Beam trawl; depth 1304 m; unknown; unknown; 19 Jun. 2008; MAREANO-2008104 R248-39B; IINH 14815 • 1; 69.1325° N, 14.115° W; Beam trawl; depth 1407 m; unknown; unknown; 23 Jun. 2008; MAREANO-2008104 R257-18A; IINH 14824 • 1; 69.1342° N, 14.1206° W; RP-sledge; depth 1068 m; unknown; unknown; 23 Jun. 2008; MAREANO-2008114 R257-25B; IINH 14816 • 25; 69.1322° N, 14.1125° W; large Van Veen grab; depth 1046 m; unknown; unknown; 22 Jun. 2008; MAREANO-2008104 R257-42A; IINH 14822 • 35; 69.1322° N, 14.1125° W; large Van Veen grab; depth 1045 m; unknown; unknown; 22 Jun. 2008; MAREANO-2008104 R257-43B; IINH 14804 • 1; 69.1856° N, 13.9672° W; RP-sledge; depth 1899 m; unknown; unknown; 22 Jun. 2008; MAREANO-2008104 R259-23B; IINH 14837 • 1; 69.1842° N, 13.9828° W; large Van Veen grab; depth 1359 m; unknown; unknown; 21 Jun. 2008; MAREANO-2008104 R259-41B; IINH 14823 • 8; 68.4819° N, 10.9767° W; large Van Veen grab; depth 1314 m; unknown; unknown; 7 Oct. 2008; MAREANO-2008104 R276-333A; IINH 14847 • 35; 68.4819° N, 10.9767° W; large Van Veen grab; depth 1314 m; -0.87°C; 34.9 ppt; 8 Oct. 2008; MAREANO-2008114 R276-334B; IINH 14814 • 2; 68.1392° N, 12.3006° W; Van Veen. large; depth 230 m; 7.6°C; 35.16 ppt; 9 Oct. 2008; MAREANO-2008114 R280-335A; IINH 14817 • 2; 68.1392° N, 12.3006° W; large Van Veen grab; depth 230 m; 7.6°C; 35.16 ppt; 9 Oct. 2008; MAREANO-2008114 R280-337A; IINH 14842 • 14; 68.1397° N, 12.3086° W; large Van Veen grab; depth 229 m; 7.6°C; 35.16 ppt; 9 Oct. 2008; MAREANO-2008114 R280-339B; IINH 14803 • 2; 68.1381° N, 12.3039° W; RP-sledge; depth 229 m; 7.6°C; 35.16 ppt; 9 Oct. 2008; MAREANO-2008114 R280-33B; IINH 14813 • 1; 68.1397° N, 12.3086° W; 0; depth 228 m; 7.6°C; 35.16 ppt; 9 Oct. 2008; MAREANO-2008114 R280-340B; IINH 14844 • 3; 68.6136° N, 15.2653° W; large Van Veen grab; depth 140 m; 6.3°C; 34.15 ppt; 11 Oct. 2008; MAREANO-2008114 R291-341A; IINH 14812 • 1; 68.6247° N, 12.6936° W; Large Van Veen; depth 199 m; unknown; unknown; 30 Oct. 2008; MAREANO-2008114 R296-343A; IINH 14840 • 2; 68.6247° N, 12.6939° W; Large Van Veen grab; depth 199 m; unknown; unknown; 13 Oct. 2008; MAREANO-2008114 R296-345B; IINH 14839 • 3; 68.6547° N, 11.9131° W; Large Van Veen grab; depth 807 m; unknown; unknown; 14 Oct. 2008; MAREANO-2008114 R297-346; IINH 14843 • 2; 68.6556° N, 11.9086° W; RP-sledge; depth 815 m; unknown; unknown; 14 Oct. 2008; MAREANO-2008114 R297-36A; IINH 14846 • 40; 68.9106° N, 12.6789° W; Van Veen grab large; depth 1240 m; -0.79°C; 34.9 ppt; 17 Oct. 2008; MAREANO-2008114 R311-350A; IINH 14830 • 1; 68.9025° N, 12.6625° W; RP-sledge; depth 1340 m; unknown; unknown; 17 Oct. 2008; MAREANO-2008104 R311-40B; IINH 14807 • 1; 71.7481° N, 15.2439° W; large Van Veen grab; depth 993 m; -0.73°C; 34.898 ppt; 20 Sep. 2009; MAREANO-2009111 R444-137; IINH 14838.

ICELANDIC WATERS • 1; 65.3606° N, 13.6158° W; RP sledge; depth 64 m; 5.17°C; unknown; 19 Jul. 1991; BIOICE 2003; IINH 39508 • 5; 65.5836° N, 11.2881° W; RP sledge; depth 768 m; -0.42°C; unknown; 20 Jul. 1991; BIOICE 2011; IINH 14717 • 9; 65.5856° N, 11.2839° W; detr. sledge (Sneli); depth 769 m; -0.42°C; unknown; 20 Jul. 1991; BIOICE 2012; IINH 14718 • 9; 66.5547° N, 12.1989° W; RP sledge; depth 1253 m; -0.86°C; unknown; 21 Jul. 1991; BIOICE 2019; IINH 39867 • 3; 66.6278° N, 12.1542° W; detr. sledge (Sneli); depth 1314 m; -0.86°C; unknown; 22 Jul. 1991; BIOICE 2020; IINH 14719 • 5; 67.0581° N, 13.4239° W; RP sledge; depth 931 m; -0.56°C; unknown; 23 Jul. 1991; BIOICE 2029; IINH 39866 • 3; 66.6347° N, 13.8078° W; Triangle dredge; depth 146 m; 2.67°C; unknown; 24 Jul. 1991; BIOICE 2037; IINH 14720 • 5; 66.3647° N, 13.4856° W; RP sledge; depth 310 m; 1.3°C; unknown; 24 Jul. 1991; BIOICE 2040; IINH 39869 • 1; 65.8322° N, 14.5594° W; detr. sledge (Sneli); depth 105 m; 3.1°C; unknown; 24 Jul. 1991; BIOICE 2042; IINH 14721 • 1; 65.7792° N, 13.9722° W; detr. sledge (Sneli); depth 229 m; 2.6°C; unknown; 24 Jul. 1991; BIOICE 2045; IINH 39870 • 6; 65.7025° N, 12.8833° W; RP sledge; depth 272 m; 1.96°C; unknown; 25 Jul. 1991; BIOICE 2047; IINH 39871 • 1; 67.375° N, 17.3847° W; RP sledge; depth 893 m; -0.55°C; 34.84 ppt; 4 Jul. 1992; BIOICE 2081; IINH 14722 • 1; 67.2686° N, 17.4447° W; Agassiz trawl; depth 754 m; -0.41°C; 34.86 ppt; 4 Jul. 1992; BIOICE 2085; IINH 14723 • 1; 67.2756° N, 17.4272° W; detr. sledge (Sneli); depth 755 m; -0.41°C; 34.86 ppt; 4 Jul. 1992; BIOICE 2086; IINH 14724 • 5; 67.2614° N, 17.455° W; RP sledge; depth 735 m; -0.41°C; 34.86 ppt; 4 Jul. 1992; BIOICE 2087; IINH 37851 • 6; 67.0342° N, 17.5717° W; detr. sledge (Sneli); depth 303 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2094; IINH 14725 • 1; 67.8344° N, 19.5575° W; detr. sledge (Sneli); depth 905 m; -0.55°C; 34.87 ppt; 6 Jul. 1992; BIOICE

2103; IINH 39872 • 1; 67.7697° N, 19.4975° W; detr. sledge (Sneli); depth 762 m; -0.53°C; 34.86 ppt; 6 Jul. 1992; BIOICE 2110; IINH 14726 • 7; 67.7253° N, 19.5083° W; detr. sledge (Sneli); depth 588 m; -0.54°C; 34.86 ppt; 6 Jul. 1992; BIOICE 2111; IINH 14727 • 1; 67.7292° N, 19.4722° W; RP sledge; depth 603 m; -0.54°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2113; IINH 14728 • 4; 67.7047° N, 19.4669° W; RP sledge; depth 489 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2114; IINH 14729 • 4; 67.7° N, 19.4397° W; detr. sledge (Sneli); depth 495 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2116; IINH 14730 • 10; 67.4756° N, 19.5386° W; detr. sledge (Sneli); depth 405 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2117; IINH 14731 • 2; 67.4897° N, 19.5528° W; RP sledge; depth 393 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2118; IINH 14732 • 6; 67.1189° N, 19.8775° W; RP sledge; depth 284 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2119; IINH 14733 • 31; 67.1275° N, 19.9042° W; detr. sledge (Sneli); depth 280 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2121; IINH 14734 • 35; 67.1858° N, 19.5672° W; detr. sledge (Sneli); depth 346 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2122; IINH 14735 • 35; 67.1839° N, 19.5736° W; RP sledge; depth 347 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2124; IINH 14737 • 2; 66.7322° N, 18.9556° W; RP sledge; depth 417 m; 0.58°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2136; IINH 14738 • 3; 66.7197° N, 19.3303° W; RP sledge; depth 297 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2137; IINH 14739 • 1; 66.8586° N, 20.1614° W; RP sledge; depth 399 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2143; IINH 14740 • 6; 66.8581° N, 20.1603° W; detr. sledge (Sneli); depth 398 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2145; IINH 14741 • 2; 66.4436° N, 18.8192° W; detr. sledge (Sneli); depth 425 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2174; IINH 14743 • 1; 63.9836° N, 23.5703° W; detr. sledge (Sneli); depth 137 m; 7.29°C; 35.07 ppt; 3 Sep. 1992; BIOICE 2209; IINH 14744 • 1; 63.9889° N, 23.5694° W; RP sledge; depth 136 m; 7.29°C; 35.07 ppt; 3 Sep. 1992; BIOICE 2210; IINH 37854 • 1; 64.1508° N, 23.9794° W; detr. sledge (Sneli); depth 256 m; 7.04°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2212; IINH 14745 • 3; 64.1583° N, 23.9744° W; RP sledge; depth 260 m; 7.04°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2213; IINH 14746 • 1; 64.2686° N, 24.4386° W; detr. sledge (Sneli); depth 214 m; 6.85°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2216; IINH 14747 • 2; 64.2128° N, 25.2931° W; detr. sledge (Sneli); depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2218; IINH 14748 • 6; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 14749 • 5; 63.9169° N, 25.2775° W; RP sledge; depth 240 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2221; IINH 14751 • 3; 63.9269° N, 25.2733° W; detr. sledge (Sneli); depth 242 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2222; IINH 14752 • 5; 63.7578° N, 24.9397° W; RP sledge; depth 426 m; 5.88°C; 35.06 ppt; 3 Sep. 1992; BIOICE 2226; IINH 14753 • 2; 63.8167° N, 24.3736° W; RP sledge; depth 296 m; 6.96°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2229; IINH 14754 • 3; 63.72° N, 24.4217° W; RP sledge; depth 209 m; 6.98°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2233; IINH 39278 • 2; 63.6517° N, 24.4328° W; Triangle dredge; depth 189 m; unknown; unknown; 4 Sep. 1992; BIOICE 2234; IINH • 15; 63.4528° N, 24.6875° W; RP sledge; depth 296 m; 6.92°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2237; IINH 3535 • 1; 63.1444° N, 24.9881° W; Triangle dredge; depth 312 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2271; IINH 14633 • 11; 63.1439° N, 24.9833° W; RP sledge; depth 313 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2273; IINH 14756 • 1; 63.1447° N, 23.9331° W; detr. sledge (Sneli); depth 390 m; 7.09°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2281; IINH 14757 • 1; 63.1406° N, 23.9336° W; RP sledge; depth 390 m; 7.09°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2282; IINH 14758 • 17; 63.2506° N, 22.7936° W; RP sledge; depth 263 m; 7.12°C; 35.13 ppt; 10 Sep. 1992; BIOICE 2308; IINH 14759 • 1; 63.5692° N, 22.7203° W; detr. sledge (Sneli); depth 172 m; 7.3°C; 35.13 ppt; 11 Sep. 1992; BIOICE 2310; IINH 14636 • 6; 64.0167° N, 9.6167° W; RP sledge; depth 776 m; unknown; unknown; 2 May1993; BIOICE 2319; IINH 14760 • 2; 62.7167° N, 12.8167° W; detr. sledge (Sneli); depth 800 m; unknown; unknown; 4 May 1993; BIOICE 2333; IINH 14761 • 5; 62.7167° N, 12.7167° W; RP sledge; depth 803 m; unknown; unknown; 4 May 1993; BIOICE 2334; IINH 14762 • 1; 62.4667° N, 12.9° W; detr. sledge (Sneli); depth 1105 m; unknown; unknown; 5 May 1993; BIOICE 2335; IINH 14763 • 1; 62.1833° N, 13.3167° W; detr. sledge (Sneli); depth 1290 m; unknown; unknown; 5 May 1993; BIOICE 2338; IINH 14764 • 1; 62.85° N, 13.2667° W; detr. sledge (Sneli); depth 846 m; unknown; unknown; 6 May 1993; BIOICE 2342; IINH 14765 • 1; 64.8667° N, 11.4333° W; detr. sledge (Sneli); depth 476 m; unknown; unknown;

9 May 1993; BIOICE 2372; IINH 14766 • 3; 63.4619° N, 22.0769° W; detr. sledge (Sneli); depth 182 m; 7.11°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2390; IINH 14767 • 5; 63.25° N, 22.2° W; detr. sledge (Sneli); depth 288 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2392; IINH 14768 • 5; 63.2514° N, 22.2033° W; RP sledge; depth 291 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2393; IINH 14769 • 1; 63.175° N, 21.8889° W; RP sledge; depth 346 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2398; IINH 14770 • 1; 63.1306° N, 21.9422° W; detr. sledge (Sneli); depth 511 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2400; IINH 14771 • 1; 63.1758° N, 21.2022° W; RP sledge; depth 256 m; 7.08°C; 35.11 ppt; 2 Jul. 1993; BIOICE 2418; IINH 14772 • 3; 63.1333° N, 20.6667° W; detr. sledge (Sneli); depth 300 m; 7.02°C; 35.11 ppt; 2 Jul. 1993; BIOICE 2420; IINH 14773 • 1; 63.2667° N, 20.4° W; Triangle dredge; depth 138 m; unknown; unknown; 4 Jul. 1993; BIOICE 2442; IINH 14742 • 8; 63.4278° N, 21.6747° W; detr. sledge (Sneli); depth 133 m; 7.12°C; 35.08 ppt; 5 Jul. 1993; BIOICE 2463; IINH 14736 • 4; 63.2556° N, 21.2389° W; detr. sledge (Sneli); depth 180 m; 7.24°C; 35.11 ppt; 5 Jul. 1993; BIOICE 2465; IINH 4760 • 2; 63.2611° N, 21.2389° W; RP sledge; depth 180 m; 7.24°C; 35.11 ppt; 5 Jul. 1993; BIOICE 2466; IINH 37623 • 3; 66.6261° N, 25.5664° W; detr. sledge (Sneli); depth 749 m; -0.53°C; 34.87 ppt; 13 Jul. 1993; BIOICE 2518; IINH 14774 • 2; 67.1097° N, 24.085° W; RP sledge; depth 489 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2573; IINH 14775 • 3; 67.1042° N, 24.7242° W; RP sledge; depth 996 m; -0.58°C; 34.87 ppt; 15 Jul. 1993; BIOICE 2579; IINH 14776 • 10; 67.7222° N, 22.5794° W; RP sledge; depth 719 m; -0.5°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2581; IINH 14777 • 2; 67.6083° N, 22.3897° W; RP sledge; depth 605 m; -0.54°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2583; IINH 39179 • 4; 67.4214° N, 22.4072° W; RP sledge; depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2585; IINH 14778 • 1; 67.4181° N, 22.4347° W; detr. sledge (Sneli); depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2586; IINH 14779 • 1; 67.3406° N, 22.5425° W; detr. sledge (Sneli); depth 356 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2588; IINH 14780 • 6; 67.3381° N, 22.5525° W; RP sledge; depth 355 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2589; IINH 14781 • 1; 67.0028° N, 22.5714° W; RP sledge; depth 203 m; 5.41°C; 34.99 ppt; 16 Jul. 1993; BIOICE 2595; IINH 14851 • 3; 66.9417° N, 17.9389° W; detr. sledge (Sneli); depth 433 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2603; IINH 39181 • 1; 66.9344° N, 17.9397° W; RP sledge; depth 435 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2606; IINH 14849 • 2; 67.1375° N, 17.0306° W; RP sledge; depth 362 m; -0.36°C; 34.89 ppt; 11 Jul. 1994; BIOICE 2613; IINH 39182 • 2; 67.1939° N, 16.8444° W; RP sledge; depth 535 m; -0.52°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2616; IINH 39183 • 3; 67.2761° N, 16.6592° W; detr. sledge (Sneli); depth 597 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2618; IINH 39184 • 1; 67.2906° N, 16.6381° W; RP sledge; depth 600 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2619; IINH 39185 • 5; 67.5758° N, 16.5406° W; RP sledge; depth 894 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2622; IINH 39186 • 6; 67.4286° N, 16.1703° W; RP sledge; depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2627; IINH 39187 • 8; 67.3364° N, 16.1194° W; detr. sledge (Sneli); depth 602 m; -0.55°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2629; IINH 39188 • 5; 67.3894° N, 15.9775° W; detr. sledge (Sneli); depth 699 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2631; IINH 14782 • 5; 67.5044° N, 15.8069° W; detr. sledge (Sneli); depth 795 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2634; IINH 39189 • 1; 68.0208° N, 15.2519° W; RP sledge; depth 1202 m; -0.64°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2644; IINH 14783 • 1; 68.0922° N, 15.3258° W; detr. sledge (Sneli); depth 1304 m; -0.72°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2647; IINH 14784 • 5; 67.6103° N, 15.1283° W; RP sledge; depth 910 m; -0.57°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2652; IINH 39190 • 5; 67.3° N, 14.9581° W; RP sledge; depth 549 m; -0.55°C; 34.9 ppt; 14 Jul. 1994; BIOICE 2655; IINH 14785 • 1; 67.2447° N, 15.4783° W; RP sledge; depth 277 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2660; IINH 14786 • 1; 66.9989° N, 15.7606° W; detr. sledge (Sneli); depth 187 m; 2.55°C; 34.87 ppt; 15 Jul. 1994; BIOICE 2668; IINH 39192 • 7; 66.8389° N, 16.2706° W; RP sledge; depth 227 m; 2.78°C; 34.89 ppt; 15 Jul. 1994; BIOICE 2673; IINH 39193 • 1; 64.575° N, 24.5222° W; detr. sledge (Sneli); depth 250 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2712; IINH 14787 • 5; 64.575° N, 24.5472° W; RP sledge; depth 273 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2713; IINH 14788 • 4; 67.0908° N, 20.1411° W; RP sledge; depth 284 m; -0.01°C; 34.86 ppt; 30 Jul. 1995; BIOICE 2736; IINH 39197 • 2; 67.3208° N, 19.7114° W; detr. sledge (Sneli); depth 352 m; -0.38°C; 34.88 ppt;

30 Jul. 1995; BIOICE 2737; IINH 39198 • 15; 67.6583° N, 20.2411° W; RP sledge; depth 514 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2741; IINH 39199 • 3; 67.7775° N, 20.7875° W; detr. sledge (Sneli); depth 778 m; -0.58°C; 34.89 ppt; 31 Jul. 1995; BIOICE 2747; IINH 39200 • 3; 67.9206° N, 18.3222° W; Triangle dredge; depth 610 m; -0.39°C; 34.88 ppt; 1 Aug. 1995; BIOICE 2756; IINH 39201 • 3; 68.1083° N, 17.5347° W; RP sledge; depth 1220 m; -0.52°C; 34.89 ppt; 1 Aug. 1995; BIOICE 2765; IINH 39202 • 5; 68.5883° N, 16.9397° W; Triangle dredge; depth 519 m; -0.37°C; 34.86 ppt; 2 Aug. 1995; BIOICE 2769; IINH 39203 • 1; 68.345° N, 15.7858° W; RP sledge; depth 1413 m; -0.74°C; 34.89 ppt; 4 Aug. 1995; BIOICE 2779; IINH 39204 • 1; 67.6017° N, 17.8781° W; RP sledge; depth 1017 m; -0.49°C; 34.89 ppt; 4 Aug. 1995; BIOICE 2783; IINH 39207 • 13; 67.4156° N, 18.2417° W; RP sledge; depth 693 m; -0.41°C; 34.88 ppt; 5 Aug. 1995; BIOICE 2786; IINH 39206 • 2; 67.2547° N, 18.8669° W; Agassiz trawl; depth 480 m; 0.01°C; 34.85 ppt; 5 Aug. 1995; BIOICE 2792; IINH 39205 • 1; 63.2511° N, 17.8528° W; RP sledge; depth 206 m; 7.18°C; 35.14 ppt; 25 Aug. 1995; BIOICE 2818; IINH 39213 • 1; 63.5033° N, 17.7019° W; RP sledge; depth 120 m; 7.24°C; 35.13 ppt; 25 Aug. 1995; BIOICE 2824; IINH 39875 • 1; 63.3206° N, 16.9172° W; Triangle dredge; depth 246 m; 7.06°C; 35.14 ppt; 26 Aug. 1995; BIOICE 2839; IINH 39217 • 1; 62.9833° N, 17.8361° W; RP sledge; depth 947 m; 3.48°C; 34.98 ppt; 27 Aug. 1995; BIOICE 2846; IINH 39216 • 1; 64.6928° N, 25.6061° W; RP sledge; depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2868; IINH 39215 • 1; 64.6833° N, 25.6072° W; detr. sledge (Sneli); depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2869; IINH 39218 • 1; 64.9278° N, 27.2494° W; detr. sledge (Sneli); depth 367 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2880; IINH 14789 • 2; 65.1764° N, 27.0556° W; detr. sledge (Sneli); depth 242 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2883; IINH 39214 • 2; 63.7667° N, 14.85° W; RP sledge; depth 216 m; 7.67°C; 35.16 ppt; 5 Jul. 1997; BIOICE 2994; IINH 39223 • 8; 63.6389° N, 14.7306° W; detr. sledge (Sneli); depth 264 m; 7.76°C; 35.19 ppt; 5 Jul. 1997; BIOICE 2998; IINH 39222 • 5; 63.6389° N, 14.7333° W; RP sledge; depth 269 m; 7.76°C; 35.19 ppt; 5 Jul. 1997; BIOICE 2999; IINH 39221 • 1; 63.3153° N, 14.3614° W; detr. sledge (Sneli); depth 1642 m; 2.78°C; 34.97 ppt; 6 Jul. 1997; BIOICE 3005; IINH 39226 • 9; 63.9969° N, 14.1558° W; RP sledge; depth 221 m; 7.59°C; 35.16 ppt; 10 Jul. 1997; BIOICE 3061; IINH 39225 • 7; 63.9981° N, 14.1561° W; detr. sledge (Sneli); depth 218 m; 7.59°C; 35.16 ppt; 10 Jul. 1997; BIOICE 3062; IINH 39224 • 5; 67.3264° N, 21.1819° W; RP sledge; depth 314 m; 0.23°C; 34.86 ppt; 21 Aug. 1999; BIOICE 3104; IINH 39227 • 1; 67.3219° N, 20.7528° W; RP sledge; depth 328 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3108; IINH 39228 • 3; 67.705° N, 19.7986° W; RP sledge; depth 611 m; -0.57°C; 34.89 ppt; 22 Aug. 1999; BIOICE 3115; IINH 39229 • 9; 68.7325° N, 16.5853° W; RP sledge; depth 1715 m; unknown; unknown; 23 Aug. 1999; BIOICE 3127; IINH 39249 • 7; 67.875° N, 22.2581° W; RP sledge; depth 768 m; -0.46°C; 34.89 ppt; 25 Aug. 1999; BIOICE 3140; IINH 39231 • 2; 67.5211° N, 24.1675° W; RP sledge; depth 1012 m; unknown; unknown; 25 Aug. 1999; BIOICE 3143; IINH 39232 • 2; 67.2194° N, 24.9389° W; detr. sledge (Sneli); depth 1223 m; unknown; unknown; 25 Aug. 1999; BIOICE 3146; IINH 39233 • 1; 66.8842° N, 26.9342° W; detr. sledge (Sneli); depth 434 m; 0.06°C; 34.86 ppt; 26 Aug. 1999; BIOICE 3149; IINH 39234 • 1; 66.4911° N, 28.0678° W; Triangle dredge; depth 334 m; 0.55°C; 34.78 ppt; 26 Aug. 1999; BIOICE 3154; IINH 39274 • 17; 65.6508° N, 9.1203° W; detr. sledge (Sneli); depth 818 m; -0.58°C; 34.9 ppt; 7 Jul. 2001; BIOICE 3194; IINH 39230 • 6; 64.1292° N, 24.1047° W; detr. sledge (Sneli); depth 291 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3549; IINH 39235 • 15; 64.1297° N, 24.1044° W; RP sledge; depth 290 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3550; IINH 39236 • 2; 64.2872° N, 25.6994° W; RP sledge; depth 304 m; 7.19°C; 35.16 ppt; 2 Sep. 2003; BIOICE 3554; IINH 39237 • 1; 64.2086° N, 26.2211° W; detr. sledge (Sneli); depth 334 m; 6.95°C; 35.14 ppt; 2 Sep. 2003; BIOICE 3557; IINH 39238 • 2; 63.3289° N, 25.265° W; RP sledge; depth 306 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3605; IINH 39239 • 1; 63.7533° N, 25.7064° W; detr. sledge (Sneli); depth 365 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3607; IINH 39240 • 1; 63.7567° N, 25.7097° W; RP sledge; depth 366 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3608; IINH 39241 • 2; 64.2569° N, 26.0578° W; RP sledge; depth 342 m; 6.95°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3615; IINH 39243 • 2; 64.67° N, 26.4761° W; RP sledge; depth 270 m; 6.99°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3617; IINH 39244 • 1;

67.6583° N, 20.0344° W; Triangle dredge; depth 505 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3662; IINH 39242 • 1; 67.6561° N, 20.0778° W; RP sledge; depth 493 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3663; IINH 39874 • 25; 67.8519° N, 9.4192° W; RP sleði / RP sledge; depth 915 m; unknown; unknown; 6 Aug. 2008; DREKINN B13-2008-413; IINH 14790 • 1; 68.0767° N, 8.3386° W; Agassiz troll / Agassiz trawl; depth 1154 m; unknown; unknown; 19 Aug. 2008; DREKINN B13-2008-437; IINH 14791 • 11; 68.0881° N, 8.4175° W; Agassiz troll / Agassiz trawl; depth 938 m; unknown; unknown; 19 Aug. 2008; DREKINN B13-2008-438; IINH 14792 • 25; 68.0925° N, 8.4267° W; RP sleði / RP sledge; depth 951 m; unknown; unknown; 19 Aug. 2008; DREKINN B13-2008-439; IINH 14793 • 19; 68.0964° N, 8.4636° W; RP sleði / RP sledge; depth 1081 m; unknown; unknown; 19 Aug. 2008; DREKINN B13-2008-441; IINH 14794 • 4; 68.2703° N, 8.8097° W; Agassiz troll / Agassiz trawl; depth 773 m; unknown; unknown; 20 Aug. 2008; DREKINN B13-2008-449; IINH 14850 • 9; 68.2578° N, 8.9033° W; Skrapa / Triangle dredge; depth 899 m; unknown; unknown; 21 Aug. 2008; DREKINN B13-2008-455; IINH 14795 • 5; 68.2031° N, 9.0125° W; Triangle dredge; depth 990 m; unknown; unknown; 21 Aug. 2008; DREKINN B13-2008-461; IINH 14796 • 11; 68.0861° N, 8.355° W; RP sleði / RP sledge;

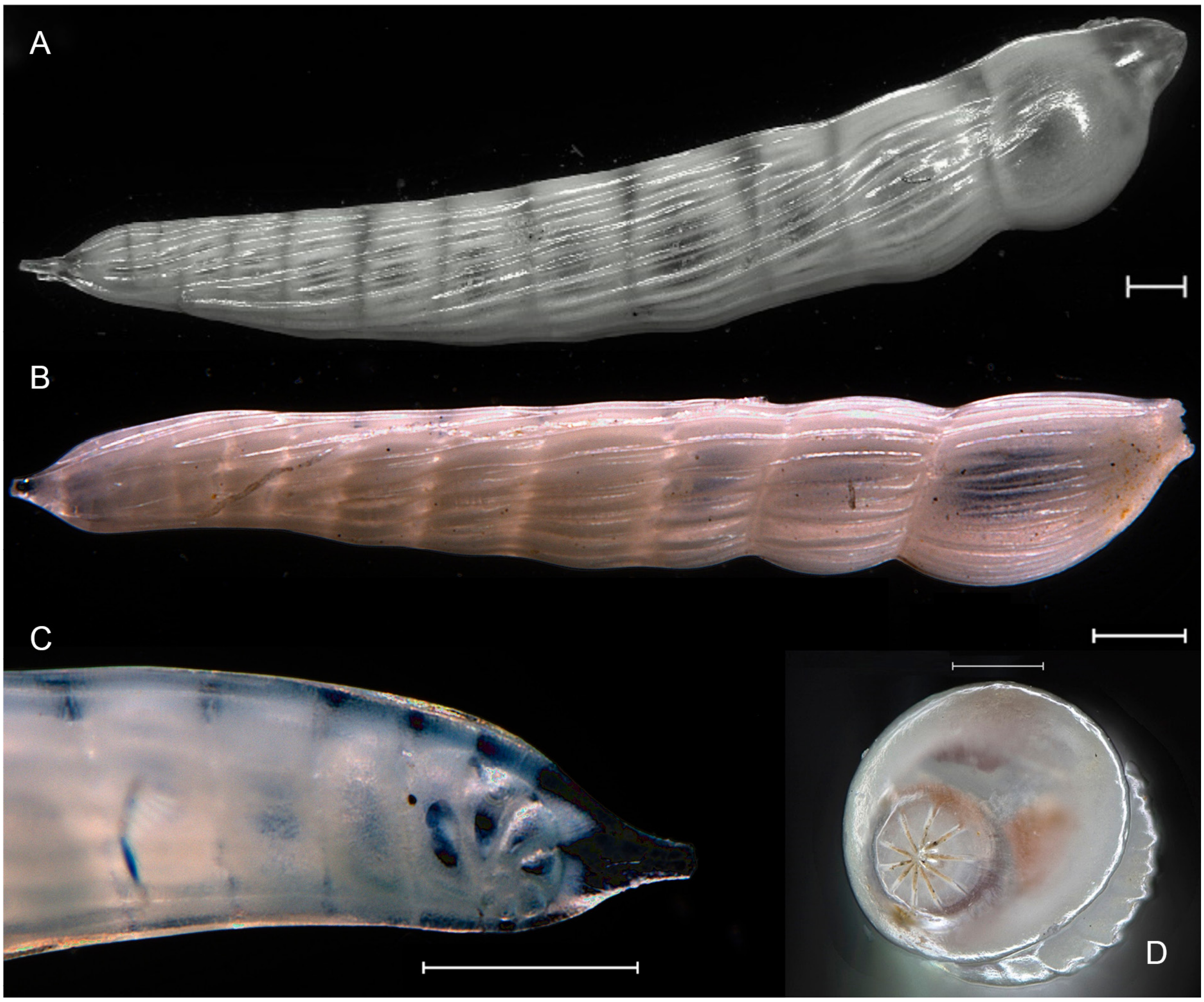

Fig. 6. *Dentalina obliqua* (Linnaeus, 1758). **A, D**. Megalosphere (BIOICE 3104, IINH 39227), side view (A) and aperture (D). **B–C**. Microsphere (BIOICE 2308, IINH 14759), side view (B) and details of the initial spire (C), where outer wall has been etched with acid and stained with indigo blue; diameter of proloculus <0.02 mm. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

depth 1146 m; unknown; unknown; 22 Aug. 2008; DREKINN B13-2008-462; IINH 14797 • 1; 68.3578° N, 9.8583° W; Agassiz troll / Agassiz trawl; depth 1077 m; unknown; unknown; 23 Aug. 2008; DREKINN B13-2008-473; IINH 14798 • 16; 68.3564° N, 9.8503° W; RP sleði / RP sledge; depth 1076 m; unknown; unknown; 23 Aug. 2008; DREKINN B13-2008-474; IINH 14799 • 10; 68.6667° N, 9.0667° W; RP sleði / RP sledge; depth 944 m; unknown; unknown; 24 Aug. 2008; DREKINN B13-2008-478; IINH 14800 • 15; 67.9503° N, 8.525° W; RP sleði / RP sledge; depth 1048 m; unknown; unknown; 24 Aug. 2008; DREKINN B13-2008-479; IINH 14801 • 1; 67.9211° N, 8.5639° W; Agassiz troll / Agassiz trawl; depth 1053 m; unknown; unknown; 24 Aug. 2008; DREKINN B13-2008-481; IINH 14802 • 21; 67.65° N, 19.0667° W; 0; depth 250 m; unknown; unknown; 22 Jun. 1979; HAFRO-JON BOGASON Dagný SI-70 St.5; IINH 37852.

Description

Test shape elongate, cylindrical, commonly distinctly curved, sometimes nearly straight, slightly nodular in latest chambers, somewhat tapering into a pointed end. Length of test 3–5 mm, the largest specimens nearly 7 mm; test width usually 0.6–0.8 mm. Chambers subglobular, rectilinearly arranged; number of chambers 8–11 or up to 13. Initial 6–9 chambers in microsphere are arranged in an evolute planispiral, nearly completing one whorl (Fig. 6C). Sutures horizontal, sometimes slightly oblique. Aperture radial, eccentric, protruding, made of up to 12 rather broad symmetrically arranged tines, that are fused in the center. Initial end with a short spine. Conspicuous longitudinal costae run the whole length of the test along slightly twisted lines; the costae divide or fuse as the diameter of the test changes; the apertural face is free of costae (Fig. 6A, D) and in occasional specimens the last one or two chambers are smooth. Secondary surface laminations seem to cover whole test (ortho-lamellar). Wall thick and finely perforated, except for nearly imperforate narrow segment close to the aperture.

Remarks

Seven microspheres were found among the 1082 examined specimens. Diameter of the proloculus in microspheres is about 0.02 mm, and > 0.2 mm in the megalospheres. Secondary laminations of successive chambers levels out the slightly nodular character of the earlier part of the test, resulting in an evenly tapering cylindrical shape.

Dentalina mutabilis (Costa, 1855)
Fig. 7

Nodosaria mutabilis Costa, 1855: 134, pl. 1 figs 1a, c, 2a, c.
Nodosaria flintii Cushman, 1923: 85, pl. 14 fig. 1.

Dentalina flintii – Jones 1994: 76, pl. 64 figs 20–22. — Eiland & Guðmundsson 2004: 198, pl. 1, fig. o, pl. 2 fig. a.
Dentalina mutabilis – Hayward *et al.* 2012: 237, pl. 39 figs 19–21.

non *Nodosaria obliqua* (Linnaeus, 1758) – Goës 1894 (part): 70, pl. 12 figs 691–692 (only). — Cushman 1913: 59, pl. 25 fig. 5.

Material examined

ICELANDIC WATERS • 1; 63.2544° N, 26.4925° W; detr. sledge (Sneli); depth 1200 m; 4.09°C; 34.94 ppt; 5 Sep. 1992; BIOICE 2256; IINH 14647 • 40; 63.2503° N, 26.4872° W; RP sledge; depth 1209 m; 4.09°C; 34.94 ppt; 5 Sep. 1992; BIOICE 2257; IINH 14648 • 1; 62.4739° N, 22.6733° W; RP sledge; depth 1203 m; 3.91°C; 34.95 ppt; 9 Sep. 1992; BIOICE 2293; IINH 14634 • 1; 63.0619° N, 22.6756° W; detr. sledge (Sneli); depth 601 m; 6.75°C; 35.1 ppt; 10 Sep. 1992; BIOICE 2302; IINH 14635 • 1; 63.0744° N, 22.6894° W; RP sledge; depth 600 m; 6.75°C; 35.1 ppt; 10 Sep. 1992; BIOICE

2303; IINH 14649 • 2; 63.0583° N, 21.8333° W; RP sledge; depth 838 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2403; IINH 39171 • 3; 63.0417° N, 21.8556° W; detr. sledge (Sneli); depth 802 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2404; IINH 39178 • 1; 62.8667° N, 21.7361° W; RP sledge; depth 1074 m; 4°C; 34.97 ppt; 2 Jul. 1993; BIOICE 2410; IINH 39177 • 1; 62.7572° N, 21.5547° W; detr. sledge (Sneli); depth 1170 m; 4.17°C; 34.98 ppt; 2 Jul. 1993; BIOICE 2412; IINH 14650 • 3; 62.7556° N, 21.5667° W; RP sledge; depth 1171 m; 4.17°C; 34.98 ppt; 2 Jul. 1993; BIOICE 2413; IINH 14651 • 1; 63.0083° N, 21.0211° W; detr. sledge (Sneli); depth 784 m; 5.36°C; 35.02 ppt; 2 Jul. 1993; BIOICE 2414; IINH 39176 • 1; 63.005° N, 21.015° W; RP sledge; depth 819 m; 5.36°C; 35.02 ppt; 2 Jul. 1993; BIOICE 2415; IINH 39175 • 3; 63.0689° N, 19.8592° W; detr. sledge (Sneli); depth 1207 m; 4.45°C; 34.99 ppt; 3 Jul. 1993; BIOICE 2431; IINH 39174 • 2; 63.1233° N, 21.6119° W; detr. sledge (Sneli); depth 647 m; 6.09°C; 35.06 ppt; 5 Jul. 1993; BIOICE 2471; IINH 39173 • 2; 63.0722° N, 21.5917° W; RP sledge; depth 842 m; 5.54°C; 35.03 ppt; 5 Jul. 1993; BIOICE 2475; IINH 39172 • 2; 64.4361° N, 28.2389° W; detr. sledge (Sneli); depth 1162 m; 3.72°C; 34.92 ppt; 31 Aug. 1994; BIOICE 2691; IINH 14652 • 4; 64.1722° N, 27.7194° W; RP sledge; depth 1042 m; 4.2°C; 34.93 ppt; 2 Sep. 1994; BIOICE 2697; IINH 14653 • 1; 64.0972° N, 27.8361° W; RP sledge; depth 1121 m; 3.84°C; 34.92 ppt; 2 Sep. 1994; BIOICE 2701; IINH 14637 • 4; 63.8472° N, 27.7222° W; RP sledge; depth 1295 m; 3.8°C; 34.92 ppt; 2 Sep. 1994; BIOICE 2704; IINH 14654 • 5; 63.9389° N, 28.275° W; detr. sledge (Sneli); depth 1406 m; 3.71°C; 34.91 ppt; 3 Sep. 1994; BIOICE 2706; IINH 14638 • 7; 63.925° N, 28.2889° W; RP sledge; depth 1407 m; 3.71°C; 34.91 ppt; 3 Sep. 1994; BIOICE 2707; IINH 14639 • 27; 64.7278° N, 30.125° W; detr. sledge (Sneli); depth 2170 m; 3.13°C; 34.9 ppt; 3 Sep. 1994; BIOICE 2708; IINH 14665 • 1; 64.3861° N, 27.3194° W; detr. sledge (Sneli); depth 711 m; 6°C; 35.05 ppt; 7 Sep. 1994; BIOICE 2726; IINH 14656 • 1; 63.0944° N, 17.3528° W; RP sledge; depth 1085 m; 4.48°C; 35.01 ppt; 27 Aug. 1995; BIOICE 2844; IINH 39220 • 3; 62.3472° N, 16.9917° W; RP sledge; depth 2074 m; 2.34°C; 34.96 ppt; 29 Aug. 1995; BIOICE 2856; IINH 14657 • 3; 61.8394° N, 16.8906° W; RP sledge; depth 2270 m; 2.37°C; 34.95 ppt; 29 Aug. 1995; BIOICE 2859; IINH 14658 • 6; 61.7286° N, 16.9633° W; RP sledge; depth 2295 m; 2.6°C; 34.96 ppt; 30 Aug. 1995; BIOICE 2860; IINH 14659 • 2; 61.1717° N, 18.0492° W; RP sledge; depth 2400 m; 2.07°C; 34.95 ppt; 30 Aug. 1995; BIOICE 2863; IINH 14660 • 1; 62.0725° N, 20.5986° W; RP sledge; depth 1681 m; 2.67°C; 34.96 ppt; 31 Aug. 1995; BIOICE 2864; IINH 39219 • 2; 64.5767° N, 27.6106° W; detr. sledge (Sneli); depth 775 m; 6.05°C; 35.03 ppt; 22 Aug. 1996; BIOICE 2876; IINH 14661 • 1; 64.5878° N, 27.6167° W; RP sledge; depth 776 m; 6.05°C; 35.03 ppt; 23 Aug. 1996; BIOICE 2877; IINH 14662 • 1; 64.5781° N, 27.6206° W; Agassiz trawl; depth 779 m; 6.05°C; 35.03 ppt; 23 Aug. 1996; BIOICE 2878; IINH 14663 • 2; 65.3908° N, 28.3575° W; RP sledge; depth 1057 m; 4.78°C; 34.98 ppt; 24 Aug. 1996; BIOICE 2904; IINH 14899 • 1; 65.2764° N, 28.8433° W; detr. sledge (Sneli); depth 1311 m; 3.96°C; 34.94 ppt; 25 Aug. 1996; BIOICE 2907; IINH 39876 • 9; 65.2669° N, 28.8375° W; RP sledge; depth 1300 m; 3.96°C; 34.94 ppt; 25 Aug. 1996; BIOICE 2909; IINH 39877 • 6; 65.1889° N, 29.0747° W; detr. sledge (Sneli); depth 1467 m; 3.9°C; 34.94 ppt; 25 Aug. 1996; BIOICE 2911; IINH 39878 • 8; 65.1836° N, 29.0717° W; RP sledge; depth 1456 m; 3.9°C; 34.94 ppt; 25 Aug. 1996; BIOICE 2912; IINH 39879 • 3; 64.91° N, 29.9869° W; detr. sledge (Sneli); depth 2005 m; 3.21°C; 34.88 ppt; 25 Aug. 1996; BIOICE 2914; IINH 14897 • 2; 65.2158° N, 29.2486° W; detr. sledge (Sneli); depth 1539 m; 3.22°C; 34.93 ppt; 26 Aug. 1996; BIOICE 2918; IINH 14893 • 1; 62.8708° N, 14.7006° W; RP sledge; depth 1729 m; 2.51°C; 34.96 ppt; 11 Jul. 1997; BIOICE 3067; IINH 14640 • 1; 62.3008° N, 15.3333° W; RP sledge; depth 2067 m; 3.19°C; 34.96 ppt; 12 Jul. 1997; BIOICE 3071; IINH 14641 • 3; 61.9014° N, 15.1375° W; RP sledge; depth 2082 m; 2.83°C; 34.97 ppt; 12 Jul. 1997; BIOICE 3072; IINH 39262 • 2; 61.9075° N, 15.1547° W; detr. sledge (Sneli); depth 2085 m; 2.83°C; 34.97 ppt; 12 Jul. 1997; BIOICE 3074; IINH 39260 • 4; 62.0075° N, 15.9836° W; detr. sledge (Sneli); depth 2191 m; 3.07°C; 34.97 ppt; 13 Jul. 1997; BIOICE 3076; IINH 39261 • 4; 62.6189° N, 23.3719° W; RP sledge; depth 1250 m; 3.61°C; 34.99 ppt; 25 Jul. 2000; BIOICE 3161; IINH 39271 • 2; 62.6197° N, 23.3669° W; detr. sledge (Sneli); depth 1250 m; 3.61°C; 34.99 ppt; 25 Jul. 2000; BIOICE 3162; IINH 39263 • 6; 61.7167° N, 22.9639° W; RP sledge; depth 1741 m; 2.79°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3164; IINH 14642 • 4; 60.9264° N, 22.7897° W; detr. sledge (Sneli);

depth 1898 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3166; IINH 39264 • 6; 60.9244° N, 22.7906° W; RP sledge; depth 1897 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3167; IINH 39265 • 1; 60.7586° N, 23.72° W; RP sledge; depth 1951 m; unknown; unknown; 29 Jul. 2000; BIOICE 3177; IINH 39266 • 3; 60.8906° N, 26.8033° W; RP sledge; depth 1543 m; 3.53°C; 34.98 ppt; 30 Jul. 2000; BIOICE 3181;

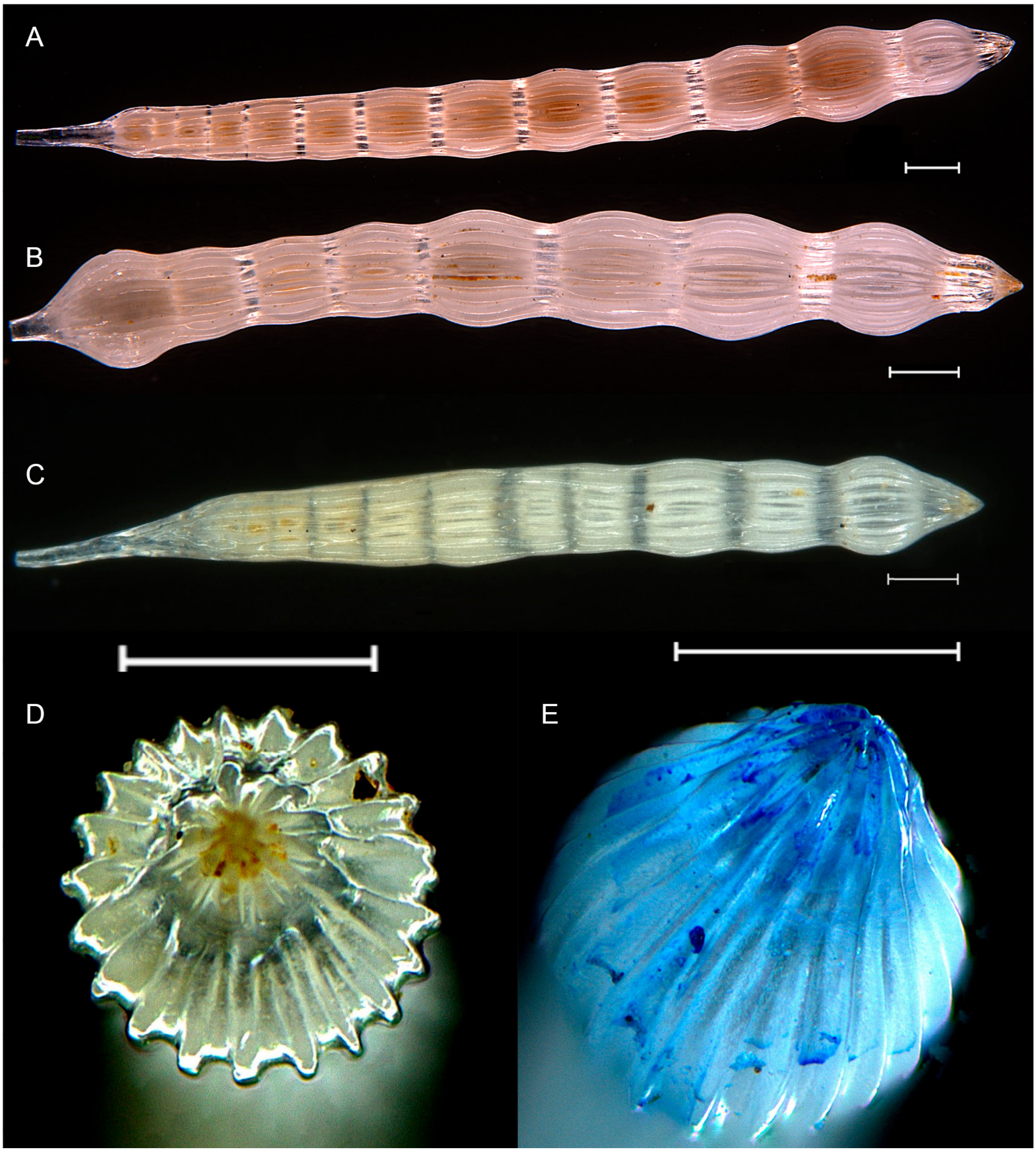

Fig. 7. *Dentalina mutabilis* (Costa, 1855). **A**. Megalosphere (BIOICE 3501, IINH 39299), side view. **B**. Megalosphere (BIOICE 3598, IINH 39281), variant with exceptionally large proloculus. **C–E**. Megalosphere (BIOICE 3280, IINH 39273), side view (C), aperture (D) and aperture (E) of the same specimen stained with indigo blue. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

IINH 14643 • 1; 61.2403° N, 27.9272° W; Triangle dredge; depth 1005 m; 4.6°C; 34.97 ppt; 31 Jul. 2000; BIOICE 3183; IINH 39267 • 4; 62.15° N, 27.0172° W; Triangle dredge; depth 1325 m; 3.99°C; 34.96 ppt; 1 Aug. 2000; BIOICE 3186; IINH 39268 • 14; 62.1511° N, 27.0206° W; RP sledge; depth 1327 m; 3.99°C; 34.96 ppt; 1 Aug. 2000; BIOICE 3187; IINH 14644 • 5; 62.1542° N, 27.0089° W; Agassiz trawl; depth 1339 m; 3.99°C; 34.96 ppt; 1 Aug. 2000; BIOICE 3188; IINH 39269 • 6; 62.1508° N, 26.6381° W; Agassiz trawl; depth 950 m; 5.21°C; 35.01 ppt; 1 Aug. 2000; BIOICE 3189; IINH 39270 • 2; 62.5306° N, 19.6639° W; RP sledge; depth 1682 m; 3.3°C; 34.99 ppt; 13 Sep. 2001; BIOICE 3263; IINH 39272 • 1; 62.4222° N, 19.8167° W; RP sledge; depth 1780 m; 2.95°C; 34.98 ppt; 13 Sep. 2001; BIOICE 3264; IINH 14645 • 4; 62.8972° N, 15.9333° W; RP sledge; depth 1692 m; 2.85°C; 35 ppt; 16 Sep. 2001; BIOICE 3280; IINH 39273 • 2; 62.8° N, 16.2556° W; RP sledge; depth 1813 m; 2.54°C; 34.99 ppt; 16 Sep. 2001; BIOICE 3282; IINH 14646 • 1; 63.0083° N, 20.5083° W; detr. sledge (Sneli); depth 814 m; 5.82°C; 35.1 ppt; 31 Aug. 2002; BIOICE 3500; IINH 39300 • 1; 63.0067° N, 20.5069° W; RP sledge; depth 829 m; 5.82°C; 35.1 ppt; 31 Aug. 2002; BIOICE 3501; IINH 39299 • 1; 62.0294° N, 19.8208° W; RP sledge; depth 1733 m; 3.09°C; 34.99 ppt; 2 Sep. 2002; BIOICE 3504; IINH 39298 • 14; 62.0444° N, 19.6531° W; RP sledge; depth 1678 m; 2.7°C; 34.99 ppt; 3 Sep. 2002; BIOICE 3509; IINH 39297 • 1; 62.2711° N, 17.5489° W; RP sledge; depth 1960 m; 2.7°C; 34.99 ppt; 5 Sep. 2002; BIOICE 3519; IINH 39296 • 1; 61.6642° N, 13.9181° W; RP sledge; depth 1640 m; 2.86°C; 34.95 ppt; 11 Sep. 2002; BIOICE 3543; IINH 39295 • 5; 62.9836° N, 18.1517° W; detr. sledge (Sneli); depth 1232 m; unknown; unknown; 12 Sep. 2002; BIOICE 3546; IINH 39294 • 1; 62.9844° N, 18.1564° W; RP sledge; depth 1233 m; unknown; unknown; 12 Sep. 2002; BIOICE 3547; IINH 39293 • 5; 63.7197° N, 29.1767° W; RP sledge; depth 1819 m; 3.24°C; 34.92 ppt; 4 Sep. 2003; BIOICE 3570; IINH 39291 • 6; 63.5061° N, 29.6444° W; RP sledge; depth 2233 m; 3.14°C; 34.92 ppt; 5 Sep. 2003; BIOICE 3571; IINH 39290 • 9; 63.3803° N, 29.9236° W; RP sledge; depth 2359 m; 3.06°C; 34.92 ppt; 5 Sep. 2003; BIOICE 3573; IINH 39301 • 2; 63.2947° N, 28.5669° W; detr. sledge (Sneli); depth 1744 m; 3.7°C; 34.95 ppt; 6 Sep. 2003; BIOICE 3575; IINH 39289 • 6; 63.0847° N, 28.4428° W; detr. sledge (Sneli); depth 1796 m; 3.42°C; 34.93 ppt; 6 Sep. 2003; BIOICE 3578; IINH 39288 • 3; 63.0783° N, 28.4442° W; RP sledge; depth 1796 m; 3.42°C; 34.93 ppt; 6 Sep. 2003; BIOICE 3579; IINH 39287 • 1; 62.385° N, 28.2881° W; detr. sledge (Sneli); depth 1548 m; 3.77°C; 34.95 ppt; 7 Sep. 2003; BIOICE 3585; IINH 39292 • 3; 62.3875° N, 28.2919° W; RP sledge; depth 1558 m; 3.77°C; 34.95 ppt; 7 Sep. 2003; BIOICE 3586; IINH 39286 • 5; 61.8019° N, 27.0386° W; detr. sledge (Sneli); depth 880 m; 6.09°C; 35.08 ppt; 9 Sep. 2003; BIOICE 3591; IINH 39285 • 2; 61.8044° N, 27.0328° W; RP sledge; depth 888 m; 6.09°C; 35.08 ppt; 9 Sep. 2003; BIOICE 3592; IINH 39284 • 3; 61.835° N, 26.1589° W; detr. sledge (Sneli); depth 906 m; 5.52°C; 35.07 ppt; 10 Sep. 2003; BIOICE 3594; IINH 39283 • 4; 61.8328° N, 26.1769° W; RP sledge; depth 916 m; 5.52°C; 35.07 ppt; 10 Sep. 2003; BIOICE 3595; IINH 39282 • 7; 62.2936° N, 25.6328° W; RP sledge; depth 769 m; 6.5°C; 35.12 ppt; 10 Sep. 2003; BIOICE 3598; IINH 39281

Description

Test shape elongate, cylindrical, usually straight, sometimes only slightly curved, somewhat nodular near the apertural end; tapering to a pointed initial end. Length of test commonly 4–5 mm, the largest 7 mm; test width 0.3–0.4 mm. Chambers sub-globular, rectilinearly arranged, number of chambers 8–14, or up to 16. Sutures horizontal. Aperture radial, central and protruding, with up to 14 tines that are symmetrically arranged and fused in the center. Initial end with relatively long spine; conspicuous longitudinal costae run in nearly straight lines along the whole length of the test and are fused with the base of the apertural tines (Fig. 7D–E); the costae divide or fuse as the diameter of the test changes. Secondary surface laminations cover the whole test (ortho-lamellar). Wall thick and finely perforated.

Remarks

All the 322 examined specimens of this species had a rectilinear chamber arrangement in the initial part. Diameter of proloculus falls usually within the range of 0.10–0.15 mm, but in few specimens

Fig. 8. *Grigelis pyrula* (d'Orbigny, 1826). **A–B**. Specimen with missing initial end (BIOICE 2424, IINH 40388), side view (A) and detail of aperture (B), stained with indigo blue. **C**. Megalospheres (BIOICE 2966, IINH 40390), initial ends of specimens with damaged apertures. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

the diameter reaches 0.40 mm. Robust specimens of *D. mutabilis* bear some superficial resemblance to exceptionally slender individuals of *D. obliqua*. Nevertheless, *D. mutabilis* differs from *D. obliqua* in having a central aperture and the surface costae run in direct continuation of the apertural tines (Fig. 7E), and nearly parallel to the axis of the test, whereas the costae are slightly twisted in *D. obliqua* (Fig. 6A–B).

Genus ***Grigelis*** Mikhalevich, 1981

Diagnosis

"Test elongate, uniserial; ovoid to fusiform proloculus may be up to twice the length of the first chamber; later chambers usually, but not always separated by long narrow necks; aperture terminal, at end of a long, narrow neck, radiate bars join at center giving petalloid effect." (Hayward *et al.* 2012: 139)

Grigelis pyrula (d'Orbigny, 1826)
Fig. 8

Nodosaria pyrula d'Orbigny, 1826: 253, nr. 13.
Nodosaria mariae d'Orbigny, 1846: 33, pl. 1 figs 15–16.

Grigelis pyrula – Mikhalevich 1981: 39, fig 3b (*Grigelis* gen. n. in figure text p. 25).
Nodosaria pyrula – Papp & Schmid 1985: 24 (nr. 8), pl. 4 figs 2–3.

Material examined

BARENTS SEA • 3; 68.5897° N, 13.7158° W; large Van Veen grab; depth 142 m; unknown; unknown; 18 Jun. 2008; MAREANO-2008104 R243-36A; IINH 40400 • 4; 68.5897° N, 13.7158° W; large Van Veen grab; depth 142 m; unknown; unknown; 18 Jun. 2008; MAREANO-2008104 R243-37B; IINH 40401.

ICELANDIC WATERS • 1; 63.72° N, 24.4217° W; RP sledge; depth 209 m; 6.98°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2233; IINH 40399 • 1; 63.0417° N, 21.8556° W; detr. sledge (Sneli); depth 802 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2404; IINH 40392 • 1; 63.1742° N, 20.165° W; RP sledge; depth 495 m; 6.46°C; 35.08 ppt; 3 Jul. 1993; BIOICE 2424; IINH 40388 • 1; 66.6094° N, 23.9836° W; detr. sledge (Sneli); depth 226 m; 5.61°C; 35.01 ppt; 13 Jul. 1993; BIOICE 2526; IINH 40397 • 1; 64.575° N, 24.5222° W; detr. sledge (Sneli); depth 250 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2712; IINH 40393 • 1; 63.2511° N, 17.8528° W; RP sledge; depth 206 m; 7.18°C; 35.14 ppt; 25 Aug. 1995; BIOICE 2818; IINH 40398 • 1; 63.4183° N, 16.8444° W; RP sledge; depth 272 m; 7.21°C; 35.15 ppt; 25 Aug. 1995; BIOICE 2830; IINH 40396• 1; 65.1333° N, 23.6° W; Triangle dredge; depth 121 m; 7.97°C; 34.93 ppt; 30 Aug. 1996; BIOICE 2965; IINH 40437 • 6; 65.1336° N, 23.6047° W; RP sledge; depth 120 m; 7.97°C; 34.93 ppt; 30 Aug. 1996; BIOICE 2966; IINH 40390 • 1; 65.0433° N, 25.8742° W; RP sledge; depth 163 m; 6.34°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2976; IINH 40394 • 1; 64.9225° N, 25.7775° W; Triangle dredge; depth 183 m; 6.22°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2978; IINH 40395 • 1; 64.92° N, 25.5167° W; RP sledge; depth 168 m; 6.42°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2981; IINH 40391 • 4; 63.9969° N, 14.1558° W; RP sledge; depth 221 m; 7.59°C; 35.16 ppt; 10 Jul. 1997; BIOICE 3061; IINH 40389 • 1; 63.7567° N, 25.7097° W; RP sledge; depth 366 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3608; IINH 40387.

Description

Test shape elongate, nearly straight to slightly curved, strongly nodular, barely tapering, or successive chambers are of equal diameter, except the proloculus which is often largest. Length of test fragments 2–4 mm, the largest 8 mm; test width 0.15–0.25 mm. Chambers pear-shaped, rectilinearly arranged, embracement minimal; chambers attached at the very end of a long apertural neck; number of chambers unknown, the largest fragment has 11 chambers. Proloculus often larger than later chambers. Sutures horizontal. Aperture radial, central and protruding, at the end of a long neck, with up to 12 symmetrical tines, that are fused in center. Surface smooth, except for short longitudinal costae extending for about one third to half of the upper part of the apertural neck; initial end pointed or with long spine. Secondary surface laminations absent. Wall transparent of medium thickness, finely perforated.

Remarks

The 29 examined specimens were all fragments, of which four had a proloculus. The top of the aperture is commonly damaged, exposing a circular, crenulated opening.

***Grigelis semirugosus*?** (d'Orbigny, 1846)
Fig. 9

Nodosaria semirugosa d'Orbigny, 1846: 34, pl. 1 figs 20–23 (*rugosa* in plate text).

Grigelis semirugosa – Jones 1994: 75, pl. 63 figs 23–27.

non *Nodosaria pyrula* (d'Orbigny, 1826) – Papp & Schmid 1985: 24 (nr. 10), pl. 4 figs 6–8.

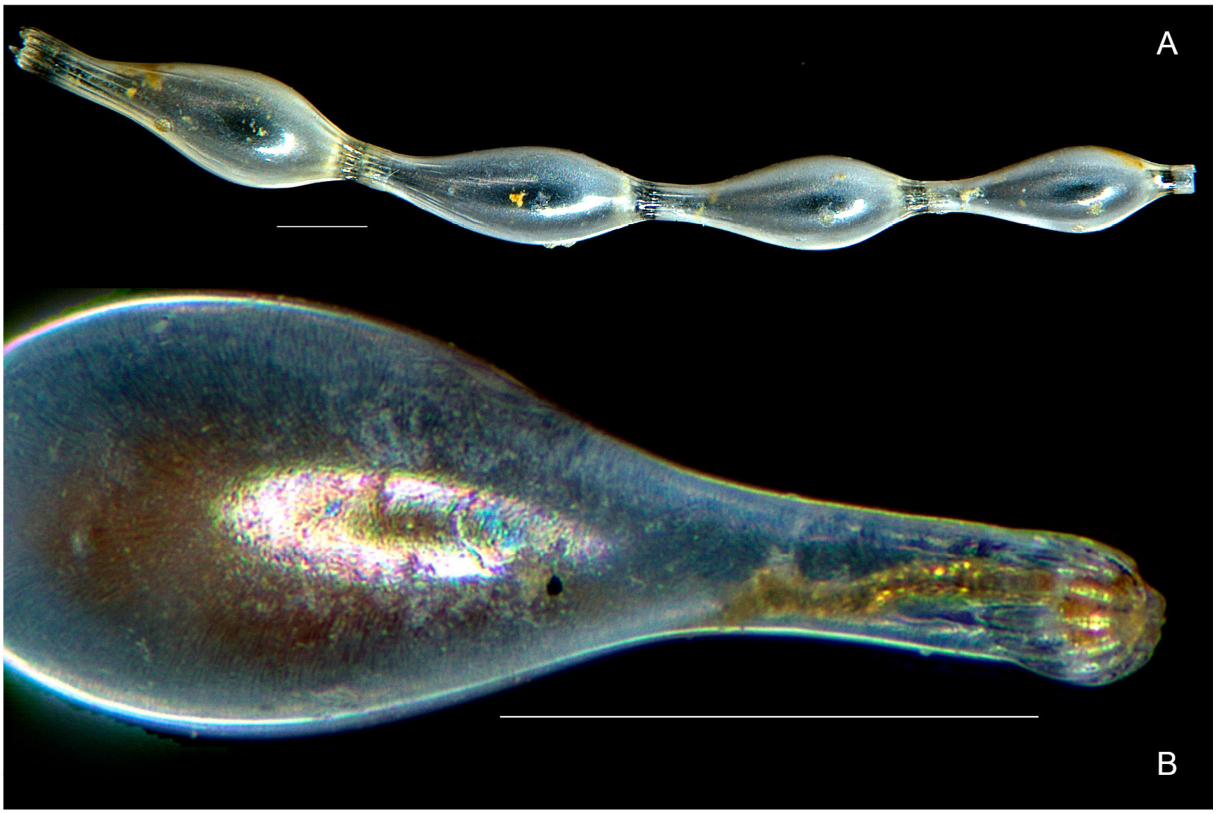

Fig. 9. *Grigelis semirugosus*? (d'Orbigny, 1846). **A**. Specimen with missing initial end (BIOICE 3669, IINH 40403). **B**. Detail of aperture (BIOICE 2465, IINH 40402). Light source combination of incident light and dark field. Scale bars = 0.25 mm.

Material examined

ICELANDIC WATERS • 5; 66.3425° N, 23.5217° W; RP sledge; depth 158 m; 6.66°C; 35.06 ppt; 25 Jul. 2004; BIOICE 3669; IINH 40403 • 1; 63.2556° N, 21.2389° W; detr. sledge (Sneli); depth 180 m; 7.24°C; 35.11 ppt; 5 Jul. 1993; BIOICE 2465; IINH 40402.

Description

Test shape elongate, nearly straight to slightly curved, strongly nodular, barely tapering, or successive chambers are of equal diameter. Length of test fragments 2–3 mm, comprising 3–7 chambers; test width 0.2–0.3 mm. Chambers pear-shaped with an elongated long neck, rectilinearly arranged, with minimal embracement; chambers attached at the very end of the apertural neck; number of chambers unknown, the largest fragment has 7 chambers. Sutures horizontal. Aperture radial, protruding and central, at the end of a long neck; radial tines up to 12, symmetrically arranged and fused in the center. Longitudinal striae cover the apertural neck and the upper and lower part of the chambers, leaving the central part smooth. Secondary surface laminations absent, wall finely perforated thin and transparent.

Remarks

Typical *G. semirugosus*? has distinct costae or furrows that are mostly confined to the base of the chambers. However, the six specimen fragments at hand differ in having rather faint striations or furrows, covering the upper half and the lower part of the chambers, leaving the central part smooth (Fig. 9A). In addition to being striated, the putative *P. semirugosus*? differs from *P. pyrula* in having a relatively shorter and more conical neck. The initial end in available material is missing.

Grigelis guttifera (d'Orbigny, 1846) comb. nov.
Figs 10–11

Dentalina guttifera d'Orbigny, 1846: 49, pl. 2 figs 11–13.

Nodosaria guttifera – Papp & Schmid 1985: 30. pl. 13 figs 1–6.

non *Nodosaria farcimen* (Soldani, 1791) – Flint 1899: 309, pl. 55 fig. 5. — Cushman 1923: 71–72, pl. 14 figs 8, 11. — Eiland & Guðmundsson 2004: 202, 204, pl. 1 fig. l; pl. 2 figs f–h.
non *Nodosaria simplex* Silvestri, 1872 – Flint 1899: 309, pl. 55 fig. 2. — Cushman 1923 (part): 68, pl. 14 fig. 10 (only).

Material examined

ICELANDIC WATERS • 3; 63.4528° N, 24.6875° W; RP sledge; depth 296 m; 6.92°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2237; IINH 40193 • 2; 63.1439° N, 24.9833° W; RP sledge; depth 313 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2273; IINH 40172 • 1; 63.0744° N, 22.6894° W; RP sledge; depth 600 m; 6.75°C; 35.1 ppt; 10 Sep. 1992; BIOICE 2303; IINH 39704 • 3; 63.2506° N, 22.7936° W; RP sledge; depth 263 m; 7.12°C; 35.13 ppt; 10 Sep. 1992; BIOICE 2308; IINH 40185 • 4; 62.7167° N, 12.8167° W; detr. sledge (Sneli); depth 800 m; unknown; unknown; 4 May 1993; BIOICE 2333; IINH 40203 • 5; 62.7167° N, 12.7167° W; RP sledge; depth 803 m; unknown; unknown; 4 May 1993; BIOICE 2334; IINH 40195 • 25; 62.45° N, 12.9167° W; RP sledge; depth 1099 m; unknown; unknown; 5 May 1993; BIOICE 2337; IINH 14883 • 2; 63.25° N, 22.2° W; detr. sledge (Sneli); depth 288 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2392; IINH 40196 • 2; 63.1667° N, 21.9056° W; detr. sledge (Sneli); depth 330 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2397; IINH 40197 • 3; 63.175° N, 21.8889° W; RP sledge; depth 346 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2398; IINH 40202 • 2; 62.8769° N, 21.7283° W; detr. sledge (Sneli); depth 1060 m; 4°C; 34.97 ppt; 2 Jul. 1993; BIOICE 2409; IINH 40204 • 2; 62.8667° N, 21.7361° W; RP sledge; depth 1074 m; 4°C; 34.97 ppt; 2 Jul. 1993; BIOICE 2410; IINH 40139 • 2;

62.7556° N, 21.5667° W; RP sledge; depth 1171 m; 4.17°C; 34.98 ppt; 2 Jul. 1993; BIOICE 2413; IINH 40239 • 2; 63.005° N, 21.015° W; RP sledge; depth 819 m; 5.36°C; 35.02 ppt; 2 Jul. 1993; BIOICE 2415; IINH 40299 • 1; 63.1333° N, 20.6667° W; detr. sledge (Sneli); depth 300 m; 7.02°C; 35.11 ppt; 2 Jul. 1993; BIOICE 2420; IINH 40206 • 1; 66.1717° N, 25.9386° W; detr. sledge (Sneli); depth 275 m; 5.7°C; 35.01 ppt; 11 Jul. 1993; BIOICE 2493; IINH 40303 • 5; 64.45° N, 28.2639° W; RP sledge; depth 1162 m; 3.72°C; 34.92 ppt; 31 Aug. 1994; BIOICE 2692; IINH 40209 • 6; 64.1722° N, 27.7194° W; RP sledge; depth 1042 m; 4.2°C; 34.93 ppt; 2 Sep. 1994; BIOICE 2697; IINH 40257 • 4; 64.0972° N, 27.8361° W; RP sledge; depth 1121 m; 3.84°C; 34.92 ppt; 2 Sep. 1994; BIOICE 2701; IINH 40249 • 15; 64.7278° N, 30.125° W; detr. sledge (Sneli); depth 2170 m; 3.13°C; 34.9 ppt; 3 Sep. 1994; BIOICE 2708; IINH 40107 • 8; 62.6667° N, 19.75° W; detr. sledge (Sneli); depth 1695 m; 3.31°C; 34.97 ppt; 23 Aug. 1995; BIOICE 2810; IINH 40108 • 1; 62.6733° N, 19.76° W; RP sledge; depth 1695 m; 3.31°C; 34.97 ppt; 23 Aug. 1995; BIOICE 2811; IINH 40109 • 3; 62.9833° N, 17.8361° W; RP sledge; depth 947 m; 3.48°C; 34.98 ppt; 27

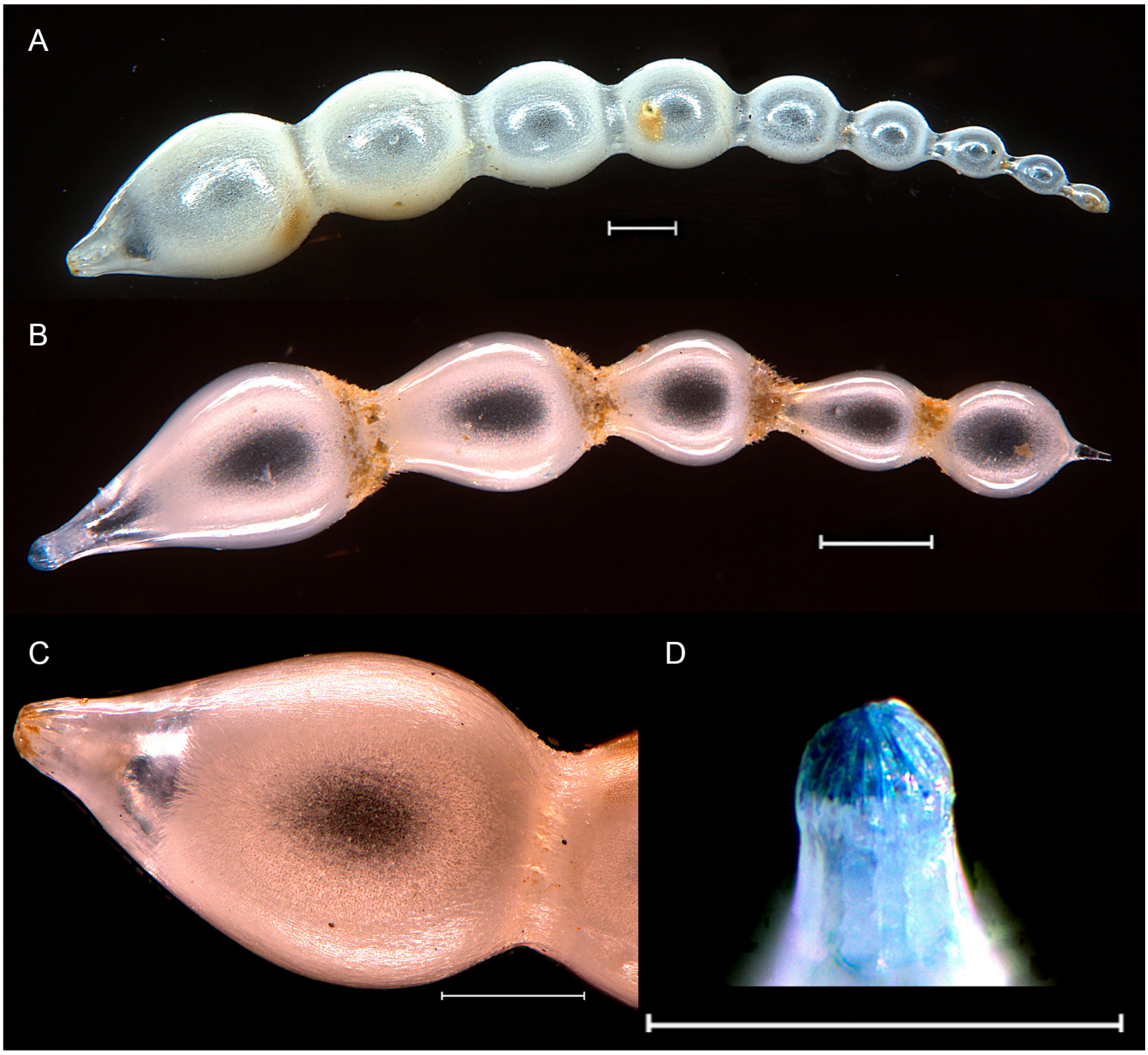

Fig. 10. *Grigelis guttifera* (d'Orbigny, 1846) comb. nov. **A, C**. Microsphere with missing initial chambers (BIOICE 2853, IINH 40236a), side view (A) and detail of last chamber (C). **B, D**. Megalosphere (BIOICE 3264, IINH 40118), side view (B) and aperture (D) stained with indigo blue. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

Aug. 1995; BIOICE 2846; IINH 40238 • 1; 62.8394° N, 18.0117° W; RP sledge; depth 976 m; 3.26°C; 34.98 ppt; 27 Aug. 1995; BIOICE 2849; IINH 40237 • 8; 62.675° N, 16.9722° W; RP sledge; depth 1833 m; 2.4°C; 34.96 ppt; 28 Aug. 1995; BIOICE 2853; IINH 40236 • 7; 62.3472° N, 16.9917° W; RP sledge; depth 2074 m; 2.34°C; 34.96 ppt; 29 Aug. 1995; BIOICE 2856; IINH 40101 • 2; 61.8394° N, 16.8906° W; RP sledge; depth 2270 m; 2.37°C; 34.95 ppt; 29 Aug. 1995; BIOICE 2859; IINH 42234 • 2; 61.7286° N, 16.9633° W; RP sledge; depth 2295 m; 2.6°C; 34.96 ppt; 30 Aug. 1995; BIOICE 2860; IINH 40103 • 2; 64.6281° N, 27.2411° W; RP sledge; depth 554 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2873; IINH 40104 • 1; 64.5878° N, 27.6167° W; RP sledge; depth 776 m; 6.05°C; 35.03 ppt; 23 Aug. 1996; BIOICE 2877; IINH 40106 • 1; 65.3889° N, 28.3508° W; detr. sledge (Sneli); depth 1066 m; 4.78°C; 34.98 ppt; 24 Aug. 1996; BIOICE 2903; IINH 40232 • 1; 65.3908° N, 28.3575° W; RP sledge; depth 1057 m; 4.78°C; 34.98 ppt; 24 Aug. 1996; BIOICE 2904; IINH 40228 • 1; 65.1836° N, 29.0717° W; RP sledge; depth 1456 m; 3.9°C; 34.94 ppt; 25 Aug. 1996; BIOICE 2912; IINH 40234 • 1; 64.91° N, 29.9869° W; detr. sledge (Sneli); depth 2005 m; 3.21°C; 34.88 ppt; 25 Aug. 1996; BIOICE 2914; IINH 40110 • 2; 63.3153° N, 14.3614° W; detr. sledge (Sneli); depth 1642 m; 2.78°C; 34.97 ppt; 6 Jul. 1997; BIOICE 3005; IINH 40231 • 1; 61.3722° N, 15.3272° W; RP sledge; depth 2133 m; 3.29°C; 34.95 ppt; 7 Jul. 1997; BIOICE 3012; IINH 40111 • 12; 62.8708° N, 14.7006° W; RP sledge; depth 1729 m; 2.51°C; 34.96 ppt; 11 Jul. 1997; BIOICE 3067; IINH 40235 • 13; 62.4889° N, 14.5094° W; RP sledge; depth 1602 m; 3.24°C; 34.94 ppt; 11 Jul. 1997; BIOICE 3069; IINH 40123 • 2; 61.9014° N, 15.1375° W; RP sledge; depth 2082 m; 2.83°C; 34.97 ppt; 12 Jul. 1997; BIOICE 3072; IINH 40112 • 1; 62.6189° N, 23.3719° W; RP sledge; depth 1250 m; 3.61°C; 34.99 ppt; 25 Jul. 2000; BIOICE 3161; IINH 40242 • 3; 60.9264° N, 22.7897° W; detr. sledge (Sneli); depth 1898 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3166; IINH 40116 • 5; 60.9244° N, 22.7906° W; RP sledge; depth 1897 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3167; IINH 40114 • 3; 61.2403° N, 27.9272° W; Triangle dredge; depth 1005 m; 4.6°C; 34.97 ppt; 31 Jul. 2000; BIOICE 3183; IINH 40229 • 3; 62.9972° N, 19.1861° W; detr. sledge (Sneli); depth 1311 m; 3.72°C; 34.99 ppt; 11 Sep. 2001; BIOICE 3259; IINH 40122 • 2; 62.9944° N, 19.1917° W; RP sledge; depth 1308 m; 3.72°C; 34.99 ppt; 12 Sep. 2001; BIOICE 3260; IINH 40121 • 80; 62.5306° N, 19.6639° W; RP sledge; depth 1682 m; 3.3°C; 34.99 ppt; 13 Sep. 2001; BIOICE 3263; IINH 40120 • 1; 62.4222° N, 19.8167° W; RP sledge; depth 1780 m; 2.95°C; 34.98 ppt; 13 Sep. 2001; BIOICE 3264; IINH 40118 • 5; 62.8972° N, 15.9333° W; RP sledge; depth 1692 m; 2.85°C; 35 ppt; 16 Sep. 2001; BIOICE 3280; IINH 40245 • 4; 62.8028° N, 16.225° W; detr. sledge (Sneli); depth 1810 m; 2.54°C; 34.99 ppt; 16 Sep. 2001; BIOICE 3281; IINH 40244 • 14; 62.8° N, 16.2556° W; RP sledge; depth 1813 m; 2.54°C; 34.99 ppt; 16 Sep. 2001; BIOICE 3282; IINH 40256 • 9; 62.0294° N, 19.8208° W; RP sledge; depth 1733 m; 3.09°C; 34.99 ppt; 2 Sep. 2002; BIOICE 3504; IINH 40168 • 1; 61.7814° N, 19.7458° W; RP sledge; depth 1809 m; 2.55°C; 34.99 ppt; 2 Sep. 2002; BIOICE 3505; IINH 40251 • 1; 61.9264° N, 19.2839° W; RP sledge; depth 1595 m; 3.12°C; 35.01 ppt; 3 Sep. 2002; BIOICE 3507; IINH 40252 • 120; 62.0444° N, 19.6531° W; RP sledge; depth 1678 m; 2.7°C; 34.99 ppt; 3 Sep. 2002; BIOICE 3509; IINH 40125 • 3; 62.2447° N, 19.4839° W; RP sledge; depth 1605 m; 2.67°C; 34.99 ppt; 3 Sep. 2002; BIOICE 3510; IINH 40248 • 1; 62.4331° N, 19.7708° W; RP sledge; depth 1780 m; 2.93°C; 35 ppt; 4 Sep. 2002; BIOICE 3514; IINH 40167 • 2; 62.5203° N, 17.9464° W; RP sledge; depth 1521 m; 3.57°C; 35.02 ppt; 5 Sep. 2002; BIOICE 3518; IINH 40254 • 2; 62.2711° N, 17.5489° W; RP sledge; depth 1960 m; 2.7°C; 34.99 ppt; 5 Sep. 2002; BIOICE 3519; IINH 40243 • 50; 62.5206° N, 17.1742° W; RP sledge; depth 1940 m; 2.34°C; 34.99 ppt; 7 Sep. 2002; BIOICE 3522; IINH 40126 • 3; 62.6467° N, 17.0625° W; RP sledge; depth 1921 m; 2.37°C; 34.99 ppt; 7 Sep. 2002; BIOICE 3524; IINH 40169 • 8; 62.7886° N, 17.3436° W; RP sledge; depth 1662 m; 3.36°C; 35.02 ppt; 8 Sep. 2002; BIOICE 3527; IINH 40241 • 2; 62.7914° N, 17.1214° W; Agassiz trawl; depth 1757 m; 2.95°C; 35.01 ppt; 8 Sep. 2002; BIOICE 3529; IINH 40240 • 10; 62.7239° N, 14.5861° W; detr. sledge (Sneli); depth 1708 m; 2.51°C; 34.98 ppt; 9 Sep. 2002; BIOICE 3531; IINH 40247 • 1; 62.4139° N, 14.2319° W; RP sledge; depth 1516 m; 2.57°C; 35 ppt; 10 Sep. 2002; BIOICE 3538; IINH 40255 • 1; 63.7628° N, 26.3861° W; RP sledge; depth 496 m; 7.48°C; 35.18 ppt; 3 Sep. 2003; BIOICE 3563; IINH 40160 • 1; 63.7769° N, 26.6589° W; detr. sledge (Sneli); depth 788 m; 6.07°C; 35.06 ppt; 3 Sep. 2003; BIOICE 3564; IINH 40156 • 1; 63.7742° N, 26.6525° W;

RP sledge; depth 791 m; 6.07°C; 35.06 ppt; 3 Sep. 2003; BIOICE 3565; IINH 40158 • 2; 63.9908° N, 26.8294° W; detr. sledge (Sneli); depth 677 m; 6.62°C; 35.09 ppt; 3 Sep. 2003; BIOICE 3568; IINH 40157 • 1; 63.2961° N, 28.5775° W; RP sledge; depth 1744 m; 3.7°C; 34.95 ppt; 6 Sep. 2003; BIOICE 3576; IINH 40144 • 6; 62.8347° N, 29.3883° W; RP sledge; depth 1995 m; 3.13°C; 34.92 ppt; 7 Sep.

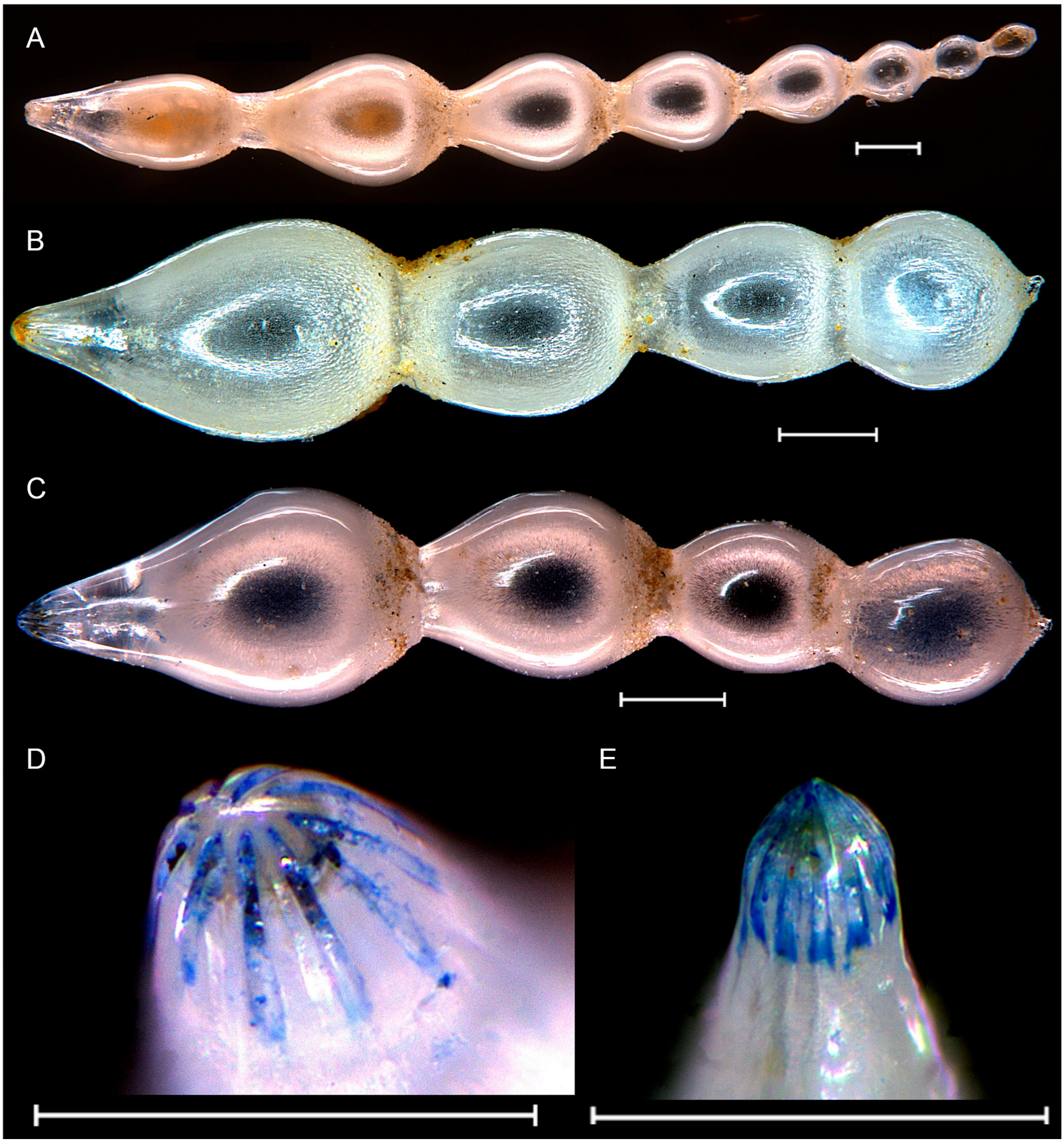

Fig. 11. *Grigelis guttifera* (d'Orbigny, 1846) comb. nov. **A**. Microsphere (BIOICE 3522, IINH 40126), base of chambers hispid; initial end missing. **B, D**. Megalosphere (BIOICE 2708, IINH 40107), side view, base of chambers mostly with knobs and faint striations (A) and aperture (D) stained with indigo blue. **C**. Megalosphere (BIOICE 2853, IINH 40236b), base of chambers hispid and with knobs. **E**. Megalosphere (BIOICE 3166, IINH 40116), aperture stained with indigo blue. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

2003; BIOICE 3582; IINH 40253 • 1; 61.835° N, 26.1589° W; detr. sledge (Sneli); depth 906 m; 5.52°C; 35.07 ppt; 10 Sep. 2003; BIOICE 3594; IINH 40153 • 1; 61.8328° N, 26.1769° W; RP sledge; depth 916 m; 5.52°C; 35.07 ppt; 10 Sep. 2003; BIOICE 3595; IINH 40141 • 2; 62.2953° N, 25.6311° W; detr. sledge (Sneli); depth 774 m; 6.5°C; 35.12 ppt; 10 Sep. 2003; BIOICE 3597; IINH 40102 • 6; 62.2936° N, 25.6328° W; RP sledge; depth 769 m; 6.5°C; 35.12 ppt; 10 Sep. 2003; BIOICE 3598; IINH 40250 • 2; 63.3289° N, 25.265° W; RP sledge; depth 306 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3605; IINH 39170 • 4; 64.6761° N, 26.4503° W; detr. sledge (Sneli); depth 269 m; 6.99°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3616; IINH 14755

Description

Test shape elongate, slightly curved, sometimes straight, usually strongly nodular, megalospheres barely or slightly tapering with a rounded end; microspheres distinctly tapering to a pointed end. Length of test often 2–4 mm, the largest is over 8 mm; test width 0.3–0.7 mm. Chambers usually pear-shaped with a conical neck, rectilinearly arranged in both generations, chamber embracement minimal; number of chambers in megalospheres 4 to 6; up to 12 in microspheres. Sutures horizontal. Aperture radial and central, at the end of an elongated conical neck; up to 15 radial tines, symmetrically arranged and fused in the center. Basal knob or short spine at initial end; base of chambers commonly hispid, sometimes granular or with faint striations (Fig. 11B), rarely smooth. Secondary surface laminations absent. Wall thick and relatively coarsely perforated, except for an imperforate segment next to the aperture.

Remarks

Of the 521 examined specimens, 17 were microspheres. Diameter of proloculus is < 0.04 mm in microspheres and 0.24–0.46 mm in the megalospheres. Some of the larger specimens of *G. guttifera* resemble *N. subsoluta*, but the former differs in being distinctively much more coarsely perforated (Fig. 10A, C) with less embracing chambers and a longer neck. This species is placed in *Grigelis* since the top of the fused apertural tines is distinctively more protruding than in *Nodosaria* and the chambers are less embracing. It seems likely that the rare reports of *Nodosaria simplex* Silvestri, 1872 in the North Atlantic (Flint 1899; Cushman 1923) are of megalospheric juveniles of *G. guttifera*; illustrated specimens have two chambers, with an elongated neck and radiate aperture. However, the types of *N. simplex* from Pliocene, Sicily, have only two chambers but are described to have a rounded aperture (Silvestri 1872). Flint (1899) and Cushman (1923) reported *G. guttifera* as rare off Ireland and perhaps also in the Faroe Channel, but most reports are from deep waters in the Gulf of Mexico, Caribbean, and off Carolina. Revision of the BIOICE material, previously identified as *N. subsoluta* (Eiland & Guðmundsson 2004), was found to include several specimens of *G. guttifera*.

Genus ***Nodosaria*** Lamarck, 1816

Diagnosis

Test uniserial, sutures horizontal, perpendicular to test axis. Surface smooth or with vertical costae; aperture radiate, or circular, bordered with radial grooves (Hayward *et al.* 2012). Species of this genus in Icelandic waters have sub-globular to pyriform and slightly embracing chambers, resulting in a moderately nodular shape.

Nodosaria subsoluta Cushman, 1923
Fig. 12

Nodosaria subsoluta Cushman, 1923: 74–75, pl. 13 fig. 1.

Nodosaria subsoluta – Eiland & Guðmundsson 2004: 202, pl. 1 figs f, m; pl. 2 fig. d.
Dentalina subsoluta – Jones 1994: 73, pl. 62 figs 13–16.

non *Nodosaria (D.) soluta* (Reuss, 1851) – Goës 1894: 70, pl. 12 fig. 690. — Flint 1899: 310, pl. 56 fig. 3.

Material examined

ICELANDIC WATERS • 1; 64.1583° N, 23.9744° W; RP sledge; depth 260 m; 7.04°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2213; IINH 40184 • 7; 64.2686° N, 24.4386° W; detr. sledge (Sneli); depth 214 m; 6.85°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2216; IINH 40188 • 3; 64.2128° N, 25.2931° W; detr. sledge (Sneli); depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2218; IINH 40171 • 8; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 40182 • 9; 63.9169° N, 25.2775° W; RP sledge; depth 240 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2221; IINH 40192 • 13; 63.9269° N, 25.2733° W; detr. sledge (Sneli); depth 242 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2222; IINH 40190 • 2; 63.7578° N, 24.9397° W; RP sledge; depth 426 m; 5.88°C; 35.06 ppt; 3 Sep. 1992; BIOICE 2226; IINH 40164 • 1; 63.8167° N, 24.3736° W; RP sledge; depth 296 m; 6.96°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2229; IINH 40186 • 8; 63.8283° N, 24.3547° W; detr. sledge (Sneli); depth 296 m; 6.96°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2230; IINH 40183 • 5; 63.7231° N, 24.4164° W; detr. sledge (Sneli); depth 208 m; 6.98°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2232; IINH 40189 • 2; 63.6517° N, 24.4328° W; Triangle dredge; depth 189 m; unknown; unknown; 4 Sep. 1992; BIOICE 2234; IINH 40191 • 7; 63.4528° N, 24.6875° W; RP sledge; depth 296 m; 6.92°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2237; IINH 40448 • 4; 63.3608° N, 25.3669° W; Triangle dredge; depth 307 m; 6.65°C; 35.1 ppt; 4 Sep. 1992; BIOICE 2239; IINH 40180 • 1; 63.3517° N, 25.3628° W; detr. sledge (Sneli); depth 307 m; 6.65°C; 35.1 ppt; 4 Sep. 1992; BIOICE 2240; IINH 40176 • 2; 63.3519° N, 25.3717° W; RP sledge; depth 305 m; 6.65°C; 35.1 ppt; 4 Sep. 1992; BIOICE 2241; IINH 40175 • 7; 63.2503° N, 26.4872° W; RP sledge; depth 1209 m; 4.09°C; 34.94 ppt; 5 Sep. 1992; BIOICE 2257; IINH 40187 • 4; 63.1444° N, 24.9881° W; Triangle dredge; depth 312 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2271; IINH 40174 • 4; 63.1406° N, 24.9908° W; detr. sledge (Sneli); depth 316 m; 6.97°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2272; IINH 40178 • 2; 63.1856° N, 24.3083° W; Triangle dredge; depth 114 m; 7.34°C; 35.11 ppt; 8 Sep. 1992; BIOICE 2275; IINH 40177 • 1; 63.1447° N, 23.9331° W; detr. sledge (Sneli); depth 390 m; 7.09°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2281; IINH 40179 • 1; 63.1406° N, 23.9336° W; RP sledge; depth 390 m; 7.09°C; 35.12 ppt; 8 Sep. 1992; BIOICE 2282; IINH 40173 • 2; 63.0744° N, 22.6894° W; RP sledge; depth 600 m; 6.75°C; 35.1 ppt; 10 Sep. 1992; BIOICE 2303; IINH 40199 • 3; 63.2506° N, 22.7936° W; RP sledge; depth 263 m; 7.12°C; 35.13 ppt; 10 Sep. 1992; BIOICE 2308; IINH 40194 • 3; 63.25° N, 22.2° W; detr. sledge (Sneli); depth 288 m; 6.92°C; 35.1 ppt; 30 Jun. 1993; BIOICE 2392; IINH 40198 • 1; 63.1667° N, 21.9056° W; detr. sledge (Sneli); depth 330 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2397; IINH 40200 • 17; 63.175° N, 21.8889° W; RP sledge; depth 346 m; 7.06°C; 35.11 ppt; 30 Jun. 1993; BIOICE 2398; IINH 40201 • 11; 63.1306° N, 21.9422° W; detr. sledge (Sneli); depth 511 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2400; IINH 40207 • 9; 63.1278° N, 22.9083° W; RP sledge; depth 520 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2401; IINH 40208 • 6; 63.0583° N, 21.8333° W; RP sledge; depth 838 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2403; IINH 40298 • 2; 63.0417° N, 21.8556° W; detr. sledge (Sneli); depth 802 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2404; IINH 40304 • 7; 63.0083° N, 21.0211° W; detr. sledge (Sneli); depth 784 m; 5.36°C; 35.02 ppt; 2 Jul. 1993; BIOICE 2414; IINH 40308 • 1; 63.175° N, 21.2056° W; detr. sledge (Sneli); depth 259 m; 7.08°C; 35.11 ppt; 2 Jul. 1993; BIOICE 2417; IINH 40099 • 1; 63.1333° N, 20.6722° W; RP sledge; depth 312 m; 7.02°C; 35.11 ppt; 2 Jul. 1993; BIOICE 2421; IINH 40302 • 5; 63.1778° N, 20.15° W; detr. sledge (Sneli); depth 600 m; 6.46°C; 35.08 ppt; 3 Jul. 1993; BIOICE 2423; IINH 40300 • 8; 63.175° N, 20.0692° W; RP sledge; depth 778 m; 5.5°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2427; IINH 40306 • 2; 63.1167° N, 19.95° W; detr. sledge (Sneli); depth 1072 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2429; IINH 40309 • 3; 63.0689° N, 19.8592° W; detr. sledge (Sneli); depth 1207 m; 4.45°C; 34.99 ppt; 3 Jul. 1993; BIOICE 2431; IINH 40100 • 4; 63.2389° N, 19.5361° W; RP sledge; depth 965 m; 5.48°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2435; IINH 40205 • 7; 63.1233° N, 21.6119° W; detr. sledge (Sneli); depth 647 m; 6.09°C; 35.06 ppt; 5 Jul. 1993; BIOICE 2471; IINH 40301 • 4; 63.1194° N, 21.6333° W;

RP sledge; depth 666 m; 6.09°C; 35.06 ppt; 5 Jul. 1993; BIOICE 2472; IINH 40307 • 2; 63.0686° N, 21.5911° W; detr. sledge (Sneli); depth 791 m; 5.54°C; 35.03 ppt; 5 Jul. 1993; BIOICE 2474; IINH 40305 • 20; 63.0722° N, 21.5917° W; RP sledge; depth 842 m; 5.54°C; 35.03 ppt; 5 Jul. 1993; BIOICE 2475; IINH 40292 • 1; 63.925° N, 28.2889° W; RP sledge; depth 1407 m; 3.71°C; 34.91 ppt; 3 Sep. 1994; BIOICE 2707; IINH 40212 • 15; 64.575° N, 24.5222° W; detr. sledge (Sneli); depth 250 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2712; IINH 40210 • 4; 64.575° N, 24.5472° W; RP sledge; depth 273 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2713; IINH 40216 • 2; 64.4361° N, 26.4056° W; detr. sledge (Sneli); depth 300 m; 5.56°C; 35.04 ppt; 7 Sep. 1994; BIOICE 2719; IINH 40215 • 5; 64.4389° N, 26.4056° W; RP sledge; depth 304 m; 5.56°C; 35.04 ppt; 7 Sep. 1994; BIOICE 2720; IINH 40214 • 2; 62.8394° N, 18.0117° W; RP sledge; depth 976 m; 3.26°C; 34.98 ppt; 27 Aug. 1995; BIOICE 2849; IINH 40221 • 6; 62.0725° N, 20.5986° W; RP sledge; depth 1681 m; 2.67°C; 34.96 ppt; 31 Aug. 1995; BIOICE 2864; IINH 40223 • 2; 64.6936° N, 25.6056° W; RP sledge; depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2867; IINH 40226 • 8; 64.6928° N, 25.6061° W; RP sledge; depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2868; IINH 40218 • 7; 64.6833° N, 25.6072° W; detr. sledge (Sneli); depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2869; IINH 40217 • 4; 64.6311° N, 27.2417° W; detr. sledge (Sneli); depth 549 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2872; IINH 40220 • 3; 64.6281° N, 27.2411° W; RP sledge; depth 554 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2873; IINH 39425 • 2; 64.5767° N, 27.6106° W; detr. sledge (Sneli); depth 775 m; 6.05°C; 35.03 ppt; 22 Aug. 1996; BIOICE 2876; IINH 40105 • 11; 64.9278° N, 27.2494° W; detr. sledge (Sneli); depth 367 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2880; IINH 40137 • 1; 65.0417° N, 27.0694° W; Triangle dredge; depth 219 m; 6.29°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2881; IINH 40227 • 4; 65.1764° N, 27.0556° W; detr. sledge (Sneli); depth 242 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2883; IINH 40225 • 15; 65.1722° N, 27.0694° W; RP sledge; depth 229 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2884; IINH 40222 • 1; 65.1225° N, 27.525° W; detr. sledge (Sneli); depth 464 m; 6.24°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2886; IINH 40138 • 1; 65.1222° N, 27.5278° W; RP sledge; depth 464 m; 6.24°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2887; IINH 40219 • 2; 65.3561° N, 27.4286° W; RP sledge; depth 513 m; 6.24°C; 35.05 ppt; 24 Aug. 1996; BIOICE 2893; IINH 40224 • 1; 65.0433° N, 25.8742° W; RP sledge; depth 163 m; 6.34°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2976; IINH 40346 • 4; 64.9225° N, 25.7775° W; Triangle dredge; depth 183 m; 6.22°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2978; IINH 40347 • 2; 63.3167° N, 14.35° W; RP sledge; depth 1634 m; 2.78°C; 34.97 ppt; 6 Jul. 1997; BIOICE 3006; IINH 40115 • 11; 62.5306° N, 19.6639° W; RP sledge; depth 1682 m; 3.3°C; 34.99 ppt; 13 Sep. 2001; BIOICE 3263; IINH 40230 • 2; 63.0083° N, 20.5083° W; detr. sledge (Sneli); depth 814 m; 5.82°C; 35.1 ppt; 31 Aug. 2002; BIOICE 3500; IINH 40143 • 3; 63.0067° N, 20.5069° W; RP sledge; depth 829 m; 5.82°C; 35.1 ppt; 31 Aug. 2002; BIOICE 3501; IINH 40161 • 13; 62.0444° N, 19.6531° W; RP sledge; depth 1678 m; 2.7°C; 34.99 ppt; 3 Sep. 2002; BIOICE 3509; IINH 40145 • 10; 62.2447° N, 19.4839° W; RP sledge; depth 1605 m; 2.67°C; 34.99 ppt; 3 Sep. 2002; BIOICE 3510; IINH 40163 • 15; 62.5206° N, 17.9381° W; Agassiz trawl; depth 1528 m; 3.57°C; 35.02 ppt; 5 Sep. 2002; BIOICE 3517; IINH 40147 • 4; 64.1292° N, 24.1047° W; detr. sledge (Sneli); depth 291 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3549; IINH 40154 • 20; 64.1297° N, 24.1044° W; RP sledge; depth 290 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3550; IINH 40151 • 6; 64.2911° N, 25.6833° W; detr. sledge (Sneli); depth 300 m; 7.19°C; 35.16 ppt; 2 Sep. 2003; BIOICE 3552; IINH 40162 • 30; 64.2872° N, 25.6994° W; RP sledge; depth 304 m; 7.19°C; 35.16 ppt; 2 Sep. 2003; BIOICE 3554; IINH 40152 • 8; 64.2092° N, 26.2181° W; RP sledge; depth 336 m; 6.95°C; 35.14 ppt; 2 Sep. 2003; BIOICE 3558; IINH 40146 • 1; 64.2106° N, 26.2117° W; Agassiz trawl; depth 337 m; 6.95°C; 35.14 ppt; 2 Sep. 2003; BIOICE 3559; IINH 40149 • 2; 63.8675° N, 26.1964° W; detr. sledge (Sneli); depth 230 m; 7.55°C; 35.18 ppt; 3 Sep. 2003; BIOICE 3561; IINH 40142 • 2; 61.8019° N, 27.0386° W; detr. sledge (Sneli); depth 880 m; 6.09°C; 35.08 ppt; 9 Sep. 2003; BIOICE 3591; IINH 40140 • 3; 61.8044° N, 27.0328° W; RP sledge; depth 888 m; 6.09°C; 35.08 ppt; 9 Sep. 2003; BIOICE 3592; IINH 40148 • 3; 62.2953° N, 25.6311° W; detr. sledge (Sneli); depth 774 m; 6.5°C; 35.12 ppt; 10 Sep. 2003; BIOICE 3597; IINH 40150 • 12; 62.2936° N, 25.6328° W; RP sledge; depth 769 m; 6.5°C; 35.12 ppt; 10 Sep. 2003; BIOICE

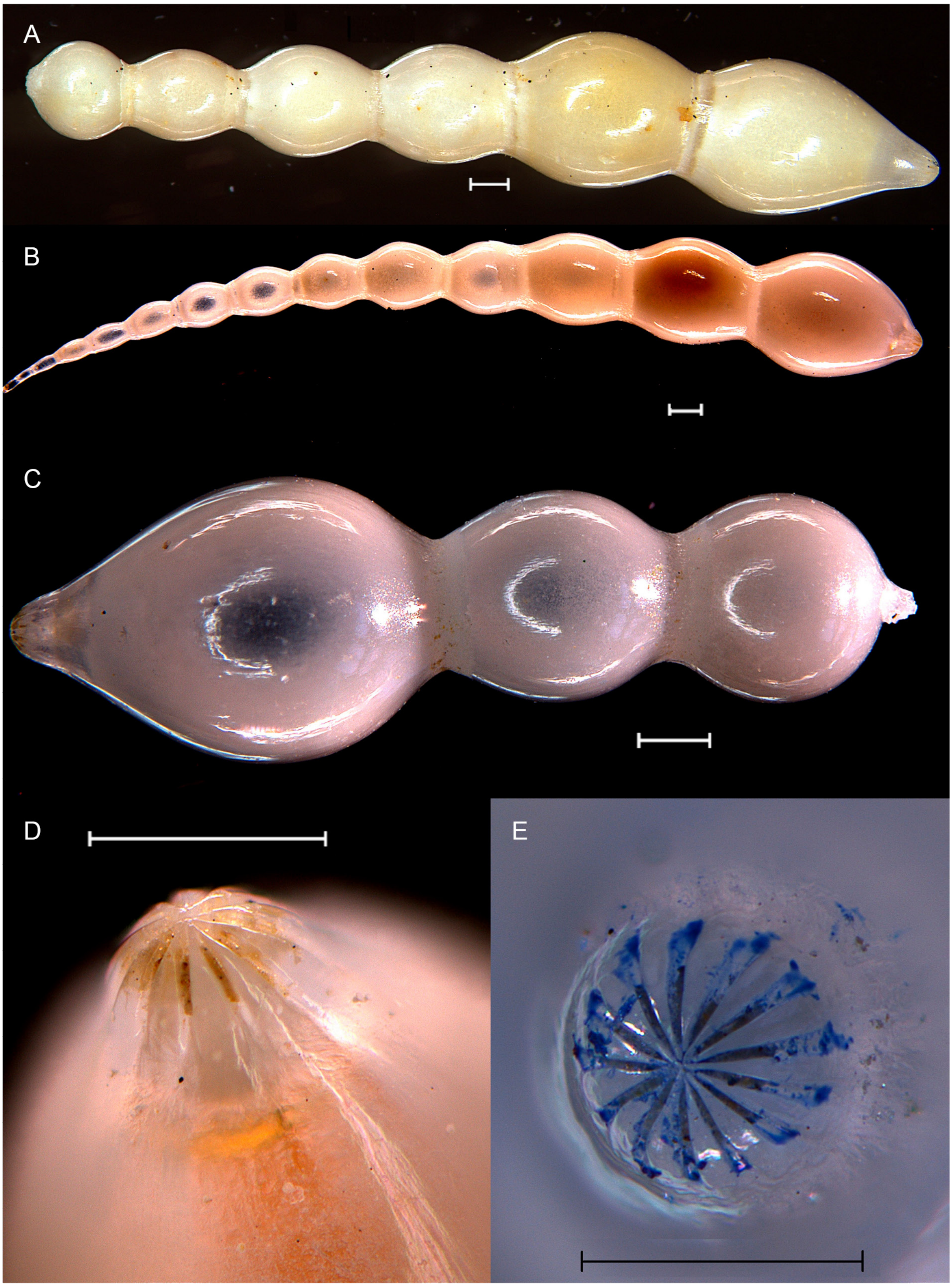

Fig. 12. *Nodosaria subsoluta* Cushman, 1923. **A**. Megalosphere side view (BIOICE 2868, IINH 40218). **B, D**. Microsphere (BIOICE 2219, IINH 40182), side view of specimen containing cytoplasm (B) and aperture (D). **C, E**. Megalosphere (BIOICE 2978, IINH 40347), side view (C) and aperture (E) stained with indigo blue. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

3598; IINH 40159 • 2; 62.8328° N, 25.2522° W; detr. sledge (Sneli); depth 424 m; 7.61°C; 35.18 ppt; 11 Sep. 2003; BIOICE 3603; IINH 40135 • 2; 63.32° N, 25.2569° W; detr. sledge (Sneli); depth 296 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3604; IINH 40136 • 6; 63.3289° N, 25.265° W; RP sledge; depth 306 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3605; IINH 40133 • 3; 63.7533° N, 25.7064° W; detr. sledge (Sneli); depth 365 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3607; IINH 40134 • 4; 63.7567° N, 25.7097° W; RP sledge; depth 366 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3608; IINH 40132 • 3; 63.9842° N, 25.5192° W; RP sledge; depth 188 m; 7.43°C; 35.17 ppt; 12 Sep. 2003; BIOICE 3611; IINH 40131 • 8; 64.2564° N, 26.0536° W; detr. sledge (Sneli); depth 345 m; 6.95°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3613; IINH 40130 • 3; 64.2569° N, 26.0578° W; RP sledge; depth 342 m; 6.95°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3615; IINH 40129 • 9; 64.6761° N, 26.4503° W; detr. sledge (Sneli); depth 269 m; 6.99°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3616; IINH 40128 • 1; 64.6689° N, 26.4647° W; Agassiz trawl; depth 274 m; 6.99°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3618; IINH 39873.

Description

Test shape elongate, slightly curved, sometimes straight, usually moderately nodular, rarely strongly nodular, megalospheres slightly tapering, with round initial end; evenly tapering to a pointed end in microspheres. Length of test usually 3–6 mm, the largest nearly 10 mm; test width 0.6–1 mm. Chambers subglobular, rarely pear-shaped. Chamber arrangement rectilinear, chamber embracement usually moderate; number of chambers 4–8 in megalospheres, up to 16 in microspheres. Sutures horizontal. Aperture radial, central, slightly raised or protruding; radial tines up to 15, symmetrically arranged, usually fused in center (Fig. 12D), sometimes partly fused (Fig. 12E). Initial end with a short spine or thick knob. Secondary surface laminations absent, wall finely perforated and thick.

Remarks

Twelve microspheres were found among the 499 examined specimens. Diameter of proloculus in megalospheres is 0.6–1.0 mm, and < 0.03 mm in the microsphere.

Nodosaria haliensis Eiland & Guðmundsson, 2004
Fig. 13

Nododaria haliensis Eiland & Guðmundsson, 2004: 204, pl. 1 figs q–v, pl. 2 fig. e, pl. 5 fig. a.

Material examined

ICELANDIC WATERS • 1; 65.3606° N, 13.6158° W; RP sledge; depth 64 m; 5.17°C; unknown; 19 Jul. 1991; BIOICE 2003; IINH 40264 • 2; 65.3558° N, 13.3342° W; RP sledge; depth 177 m; 2.8°C; unknown; 19 Jul. 1991; BIOICE 2004; IINH 40269 • 6; 67.0581° N, 13.4239° W; RP sledge; depth 931 m; -0.56°C; unknown; 23 Jul. 1991; BIOICE 2029; IINH 40268 • 19; 66.3647° N, 13.4856° W; RP sledge; depth 310 m; 1.3°C; unknown; 24 Jul. 1991; BIOICE 2040; IINH 40266 • 6; 65.7792° N, 13.9722° W; detr. sledge (Sneli); depth 229 m; 2.6°C; unknown; 24 Jul. 1991; BIOICE 2045; IINH 40260 • 15; 65.7025° N, 12.8833° W; RP sledge; depth 272 m; 1.96°C; unknown; 25 Jul. 1991; BIOICE 2047; IINH 40267 • 1; 65.3003° N, 13.7408° W; RP sledge; depth 82 m; 4.1°C; unknown; 25 Jul. 1991; BIOICE 2053; IINH 40124 • 2; 65.3086° N, 13.7533° W; detr. sledge (Sneli); depth 83 m; 4.1°C; unknown; 25 Jul. 1991; BIOICE 2054; IINH 40265 • 2; 66.4583° N, 16.8906° W; detr. sledge (Sneli); depth 243 m; unknown; unknown; 2 Jul. 1992; BIOICE 2057; IINH 40263 • 1; 66.0425° N, 17.5392° W; RP sledge; depth 104 m; 5.4°C; 34.69 ppt; 2 Jul. 1992; BIOICE 2062; IINH 40261 • 6; 66.1586° N, 17.6069° W; detr. sledge (Sneli); depth 198 m; 3.8°C; 34.85 ppt; 2 Jul. 1992; BIOICE 2065; IINH 40259 • 1; 66.5708° N, 17.73° W; detr. sledge (Sneli); depth 485 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2069; IINH 40258 • 80; 66.5711° N, 17.7425° W; RP sledge; depth 489 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2070; IINH 40246 • 11; 67.0342° N, 17.5717° W; detr.

sledge (Sneli); depth 303 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2094; IINH 40262 • 1; 67.7° N, 19.4397° W; detr. sledge (Sneli); depth 495 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2116; IINH 40274 • 13; 67.4756° N, 19.5386° W; detr. sledge (Sneli); depth 405 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2117; IINH 40275 • 9; 67.4897° N, 19.5528° W; RP sledge; depth 393 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2118; IINH 40276 • 21; 67.1189° N, 19.8775° W; RP sledge; depth 284 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2119; IINH 40280 • 50; 67.1275° N, 19.9042° W; detr. sledge (Sneli); depth 280 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2121; IINH 40279 • 45; 67.1858° N, 19.5672° W; detr. sledge (Sneli); depth 346 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2122; IINH 40272 • 24; 67.1839° N, 19.5736° W; RP sledge; depth 347 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2124; IINH 40277 • 16; 66.7744° N, 18.7042° W; detr. sledge (Sneli); depth 678 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2129; IINH 40278 • 8; 66.7661° N, 18.7081° W; RP sledge; depth 660 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2131; IINH 40281 • 6; 66.7514° N, 18.925° W; RP sledge; depth 492 m; 0.12°C; 34.85 ppt; 8 Jul. 1992; BIOICE 2132; IINH 40282 • 2; 66.7322° N, 18.9556° W; RP sledge; depth 417 m; 0.58°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2136; IINH 40283 • 20; 66.7197° N, 19.3303° W; RP sledge; depth 297 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2137; IINH 40284 • 6; 66.7128° N, 19.3186° W; detr. sledge (Sneli); depth 300 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2139; IINH 40285 • 2; 66.7228° N, 19.5883° W; RP sledge; depth 207 m; 4.71°C; 34.95 ppt; 8 Jul. 1992; BIOICE 2142; IINH 40286 • 30; 66.8586° N, 20.1614° W; RP sledge; depth 399 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2143; IINH 40287 • 15; 66.8581° N, 20.1603° W; detr. sledge (Sneli); depth 398 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2145; IINH 40288 • 6; 66.8531° N, 20.1731° W; RP sledge; depth 398 m; 0.12°C; 34.84 ppt; 9 Jul. 1992; BIOICE 2146; IINH 40289 • 8; 66.7592° N, 20.0878° W; RP sledge; depth 293 m; 3°C; 34.86 ppt; 9 Jul. 1992; BIOICE 2149; IINH 40273 • 16; 66.4369° N, 18.8214° W; RP sledge; depth 437 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2172; IINH 40290 • 30; 66.4436° N, 18.8192° W; detr. sledge (Sneli); depth 425 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2174; IINH 40291 • 30; 64.2833° N, 10.8167° W; RP sledge; depth 391 m; unknown; unknown; 7 May 1993; BIOICE 2360; IINH 40294 • 2; 64.4833° N, 10.4333° W; RP sledge; depth 495 m; unknown; unknown; 7 May 1993; BIOICE 2362; IINH 40297 • 1; 64.9167° N, 11.6333° W; Triangle dredge; depth 305 m; unknown; unknown; 10 May1993; BIOICE 2375; IINH 40295 • 3; 64.3167° N, 12.4833° W; Triangle dredge; depth 310 m; unknown; unknown; 10 May1993; BIOICE 2379; IINH 40296 • 1; 66.9131° N, 24.2° W; detr. sledge (Sneli); depth 252 m; 5.68°C; 34.98 ppt; 13 Jul. 1993; BIOICE 2522; IINH 40310 • 5; 66.6094° N, 23.9836° W; detr. sledge (Sneli); depth 226 m; 5.61°C; 35.01 ppt; 13 Jul. 1993; BIOICE 2526; IINH 40311 • 6; 66.2506° N, 23.2947° W; RP sledge; depth 115 m; 5.52°C; 34.88 ppt; 14 Jul. 1993; BIOICE 2540; IINH 40313 • 2; 66.1344° N, 23.02° W; detr. sledge (Sneli); depth 103 m; 5.7°C; 34.78 ppt; 14 Jul. 1993; BIOICE 2542; IINH 40312 • 3; 66.0803° N, 22.9503° W; RP sledge; depth 67 m; 6.25°C; 34.62 ppt; 14 Jul. 1993; BIOICE 2545; IINH 40320 • 2; 66.0853° N, 22.9567° W; detr. sledge (Sneli); depth 71 m; 6.25°C; 34.62 ppt; 14 Jul. 1993; BIOICE 2546; IINH 40314 • 16; 66.2728° N, 22.9525° W; Triangle dredge; depth 77 m; 4.83°C; 34.6 ppt; 14 Jul. 1993; BIOICE 2551; IINH 40315 • 1; 66.2694° N, 22.6778° W; detr. sledge (Sneli); depth 84 m; 4.65°C; 34.61 ppt; 14 Jul. 1993; BIOICE 2553; IINH 40316 • 1; 66.3814° N, 23.1353° W; detr. sledge (Sneli); depth 30 m; 7.23°C; 34.34 ppt; 14 Jul. 1993; BIOICE 2558; IINH 40317 • 18; 67.4214° N, 22.4072° W; RP sledge; depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2585; IINH 40318 • 22; 67.3406° N, 22.5425° W; detr. sledge (Sneli); depth 356 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2588; IINH 40319 • 8; 67.3381° N, 22.5525° W; RP sledge; depth 355 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2589; IINH 40322 • 13; 67.2147° N, 22.4294° W; RP sledge; depth 333 m; 0.12°C; 34.84 ppt; 16 Jul. 1993; BIOICE 2591; IINH 40323 • 7; 67.0028° N, 22.5714° W; RP sledge; depth 203 m; 5.41°C; 34.99 ppt; 16 Jul. 1993; BIOICE 2595; IINH 40324 • 1; 66.6539° N, 20.9364° W; Agassiz trawl; depth 335 m; 1.49°C; 34.76 ppt; 17 Jul. 1993; BIOICE 2601; IINH 40325 • 24; 66.9417° N, 17.9389° W; detr. sledge (Sneli); depth 433 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2603; IINH 40326 • 8; 66.9344° N, 17.9397° W; RP sledge; depth 435 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2606; IINH 42235 • 40; 67.4286° N, 16.1703° W; RP sledge;

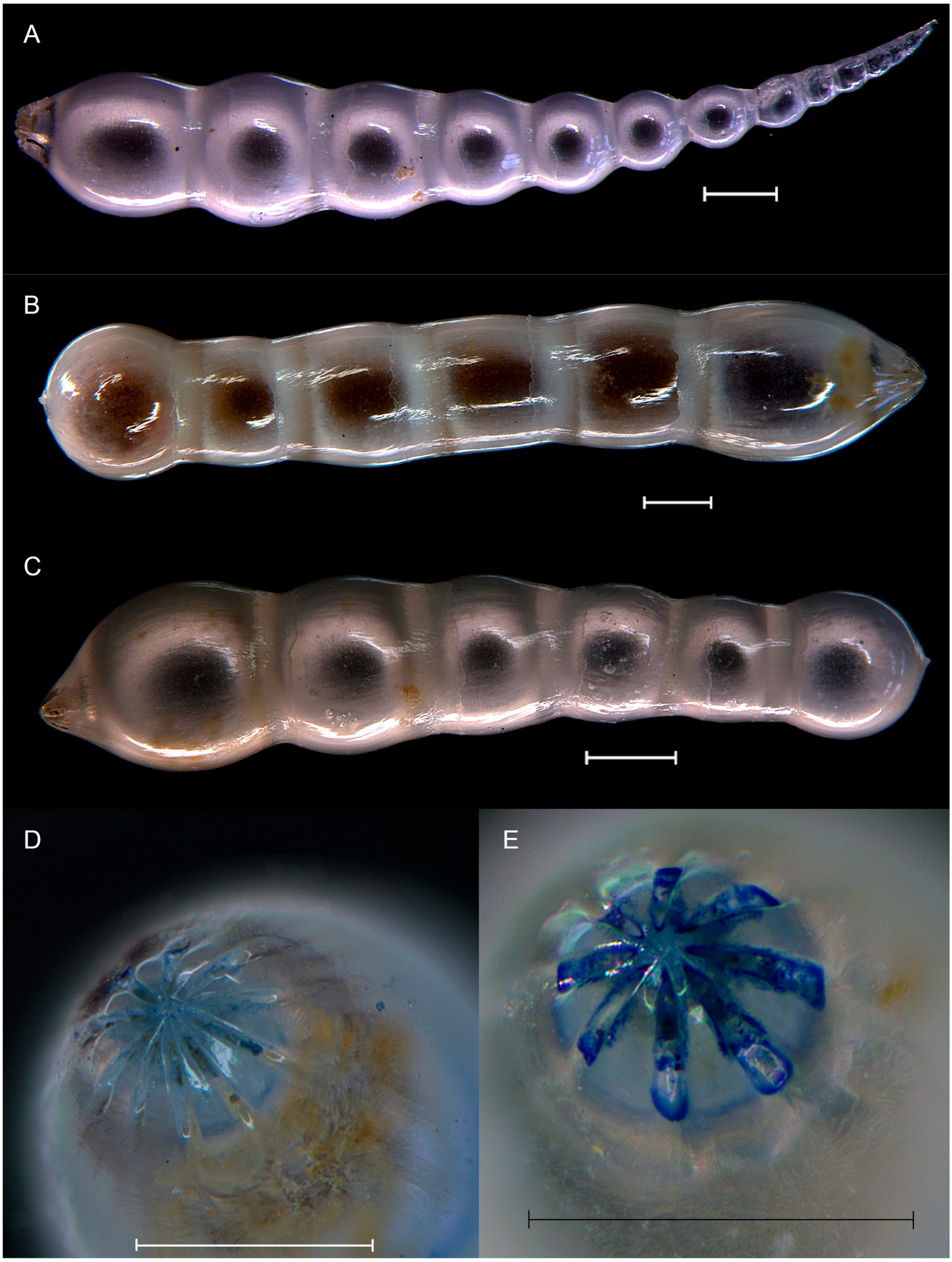

Fig. 13. *Nodosaria haliensis* Eiland & Gudmundsson, 2004. **A**. Microsphere side view (BIOICE 2526, IINH 40311). **B, E**. Megalosphere (BIOICE 2118, IINH 40276), side view (B) and aperture (E) stained with indigo blue. **C, D**. Megalosphere (holotype, BIOICE 2588, IINH 40319), side view (C) and aperture (D) stained with indigo blue. Light source combination of incident light and dark field. Scale bars = 0.25 mm.

depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2627; IINH 40332 • 1; 67.3364° N, 16.1194° W; detr. sledge (Sneli); depth 602 m; -0.55°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2629; IINH 40333 • 3; 68.0858° N, 15.3181° W; RP sledge; depth 1306 m; -0.72°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2648; IINH 40327 • 1; 67.6103° N, 15.1283° W; RP sledge; depth 910 m; -0.57°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2652; IINH 40334 • 2; 67.2447° N, 15.4783° W; RP sledge; depth 277 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2660; IINH 40328 • 5; 67.2258° N, 16.1578° W; detr. sledge (Sneli); depth 350 m; -0.03°C; 34.87 ppt; 15 Jul. 1994; BIOICE 2662; IINH 40335 • 7; 67.0561° N, 16.2747° W; detr. sledge (Sneli); depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2664; IINH 40329 • 18; 67.0575° N, 16.2675° W; RP sledge; depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2666; IINH 40336 • 1; 66.2558° N, 17.3339° W; detr. sledge (Sneli); depth 178 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2681; IINH 40330 • 1; 66.2594° N, 17.3356° W; RP sledge; depth 181 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2682; IINH 40331 • 9; 67.0908° N, 20.1411° W; RP sledge; depth 284 m; -0.01°C; 34.86 ppt; 30 Jul. 1995; BIOICE 2736; IINH 40339 • 7; 67.3208° N, 19.7114° W; detr. sledge (Sneli); depth 352 m; -0.38°C; 34.88 ppt; 30 Jul. 1995; BIOICE 2737; IINH 40337 • 5; 67.6439° N, 20.2722° W; detr. sledge (Sneli); depth 503 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2740; IINH 40340 • 8; 67.6583° N, 20.2411° W; RP sledge; depth 514 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2741; IINH 40341 • 3; 68.345° N, 15.7858° W; RP sledge; depth 1413 m; -0.74°C; 34.89 ppt; 4 Aug. 1995; BIOICE 2779; IINH 40338 • 3; 67.2547° N, 18.8669° W; Agassiz trawl; depth 480 m; 0.01°C; 34.85 ppt; 5 Aug. 1995; BIOICE 2792; IINH 40342 • 30; 65.1333° N, 23.6° W; Triangle dredge; depth 121 m; 7.97°C; 34.93 ppt; 30 Aug. 1996; BIOICE 2965; IINH 40345 • 50; 65.1336° N, 23.6047° W; RP sledge; depth 120 m; 7.97°C; 34.93 ppt; 30 Aug. 1996; BIOICE 2966; IINH 40343 • 6; 65.1219° N, 23.4872° W; RP sledge; depth 143 m; 8.04°C; 34.91 ppt; 30 Aug. 1996; BIOICE 2969; IINH 40344 • 4; 64.4225° N, 13.3558° W; RP sledge; depth 139 m; 7.22°C; 35.09 ppt; 9 Jul. 1997; BIOICE 3033; IINH 40350 • 1; 64.3531° N, 14.705° W; RP sledge; depth 18 m; 4.74°C; 33.98 ppt; 10 Jul. 1997; BIOICE 3058; IINH 40352 • 1; 67.1442° N, 22.7658° W; detr. sledge (Sneli); depth 290 m; 0.5°C; 34.87 ppt; 20 Aug. 1999; BIOICE 3094; IINH 40349 • 1; 67.1839° N, 21.7689° W; RP sledge; depth 230 m; 1.3°C; 34.87 ppt; 21 Aug. 1999; BIOICE 3099; IINH 40351 • 25; 67.3264° N, 21.1819° W; RP sledge; depth 314 m; 0.23°C; 34.86 ppt; 21 Aug. 1999; BIOICE 3104; IINH 40355 • 2; 67.3186° N, 20.7789° W; detr. sledge (Sneli); depth 330 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3107; IINH 40353 • 12; 67.3219° N, 20.7528° W; RP sledge; depth 328 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3108; IINH 40354 • 3; 67.5253° N, 20.1039° W; RP sledge; depth 439 m; -0.51°C; 34.89 ppt; 21 Aug. 1999; BIOICE 3110; IINH 40356 • 15; 65.7436° N, 12.2692° W; RP sledge; depth 232 m; 1.48°C; 34.86 ppt; 14 Jul. 2001; BIOICE 3253; IINH 40357 • 2; 67.6561° N, 20.0778° W; RP sledge; depth 493 m; -0.5°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3663; IINH 40359 • 2; 66.3425° N, 23.5217° W; RP sledge; depth 158 m; 6.66°C; 35.06 ppt; 25 Jul. 2004; BIOICE 3669; IINH 40358.

Description

Test shape elongate, cylindrical, nearly straight to slightly curved, slightly nodular; barely tapering in megalospheres and initial end rounded; microspheres distinctly curved, sometimes moderately nodular, and tapering to a pointed end. Length of test 2–3 mm, the largest is 4.2 mm; test width 0.4–0.6 mm. Chambers subglobular, rectilinearly arranged, moderately embracing. Number of chambers 5–8 in megalospheres; up to 17 in microspheres. Sutures horizontal. Aperture radial, central; up to 11 radial tines, symmetrically arranged, fused in center. Initial chamber with a basal knob or short spine. Secondary surface laminations limited to the upper half of preceding chamber. Wall finely perforated and thick.

Remarks

Resembles *N. subsoluta* but differs in being less nodular and in having short secondary surface laminations that cover only the upper most parts of preceding chambers. The edges of the laminations are clearly visible in stereo microscope as faint irregular lines. Available material comprised 923 specimens, of which 21 were microspheres. Diameter of proloculus in megalospheres is 0.3–0.6 mm, and < 0.02 mm in microspheres.

Nodosaria incerta Neugeboren, 1856
Fig. 14

Nodosaria incerta Neugeboren, 1856: 72, pl. 1 figs 10–11.

Pseudonodosaria incerta – Eiland & Guðmundsson 2004: 204–206, pl. 1 fig. g, pl. 3 fig. d.

Material examined

ICELANDIC WATERS • 1; 65.3558° N, 13.3342° W; RP sledge; depth 177 m; 2.8°C; unknown; 19 Jul. 1991; BIOICE 2004; IINH 40404 • 1; 65.5836° N, 11.2881° W; RP sledge; depth 768 m; -0.42°C; unknown; 20 Jul. 1991; BIOICE 2011; IINH 39920 • 1; 66.5394° N, 13.2833° W; RP sledge; depth 317 m; 1.41°C; unknown; 22 Jul. 1991; BIOICE 2024; IINH 39924 • 1; 67.0214° N, 13.5356° W; RP sledge; depth 781 m; -0.54°C; unknown; 22 Jul. 1991; BIOICE 2025; IINH 39923 • 5; 67.0581° N, 13.4239° W; RP sledge; depth 931 m; -0.56°C; unknown; 23 Jul. 1991; BIOICE 2029; IINH 39922 • 1; 67.0081° N, 13.4403° W; RP sledge; depth 831 m; -0.55°C; unknown; 23 Jul. 1991; BIOICE 2030; IINH 39925 • 1; 66.9225° N, 13.5181° W; RP sledge; depth 552 m; -0.54°C; unknown; 23 Jul. 1991; BIOICE 2033; IINH 39926 • 6; 66.3647° N, 13.4856° W; RP sledge; depth 310 m; 1.3°C; unknown; 24 Jul. 1991; BIOICE 2040; IINH 39927 • 5; 65.7792° N, 13.9722° W; detr. sledge (Sneli); depth 229 m; 2.6°C; unknown; 24 Jul. 1991; BIOICE 2045; IINH 39928 • 5; 65.7025° N, 12.8833° W; RP sledge; depth 272 m; 1.96°C; unknown; 25 Jul. 1991; BIOICE 2047; IINH 39929 • 2; 65.6531° N, 12.3583° W; RP sledge; depth 247 m; 1.2°C; unknown; 25 Jul. 1991; BIOICE 2049; IINH 39701 • 1; 66.5711° N, 17.7425° W; RP sledge; depth 489 m; 0.52°C; 34.8 ppt; 3 Jul. 1992; BIOICE 2070; IINH 39921 • 1; 67.6808° N, 17.1772° W; RP sledge; depth 1048 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2077; IINH 39931 • 1; 67.0194° N, 17.585° W; RP sledge; depth 300 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2096; IINH 39932 • 120; 67.7292° N, 19.4722° W; RP sledge; depth 603 m; -0.54°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2113; IINH 39964 • 2; 67.7047° N, 19.4669° W; RP sledge; depth 489 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2114; IINH 39963 • 1; 67.7° N, 19.4397° W; detr. sledge (Sneli); depth 495 m; -0.52°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2116; IINH 39967 • 2; 67.4756° N, 19.5386° W; detr. sledge (Sneli); depth 405 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2117; IINH 39971 • 1; 67.4897° N, 19.5528° W; RP sledge; depth 393 m; -0.25°C; 34.86 ppt; 7 Jul. 1992; BIOICE 2118; IINH 39970 • 4; 67.1189° N, 19.8775° W; RP sledge; depth 284 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2119; IINH 39972 • 4; 67.1275° N, 19.9042° W; detr. sledge (Sneli); depth 280 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2121; IINH 39966 • 4; 67.1858° N, 19.5672° W; detr. sledge (Sneli); depth 346 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2122; IINH 39975 • 1; 67.1839° N, 19.5736° W; RP sledge; depth 347 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2124; IINH 39976 • 22; 66.7744° N, 18.7042° W; detr. sledge (Sneli); depth 678 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2129; IINH 39965 • 2; 66.7661° N, 18.7081° W; RP sledge; depth 660 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2131; IINH 39978 • 1; 66.7514° N, 18.925° W; RP sledge; depth 492 m; 0.12°C; 34.85 ppt; 8 Jul. 1992; BIOICE 2132; IINH 39980 • 2; 66.7322° N, 18.9556° W; RP sledge; depth 417 m; 0.58°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2136; IINH 39968 • 4; 66.7197° N, 19.3303° W; RP sledge; depth 297 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2137; IINH 39973 • 6; 66.7228° N, 19.5883° W; RP sledge; depth 207 m; 4.71°C; 34.95 ppt; 8 Jul. 1992; BIOICE 2142; IINH 39969 • 5; 66.8586° N, 20.1614° W; RP sledge; depth 399 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2143; IINH 39979 • 1; 66.8581° N, 20.1603° W; detr. sledge (Sneli);

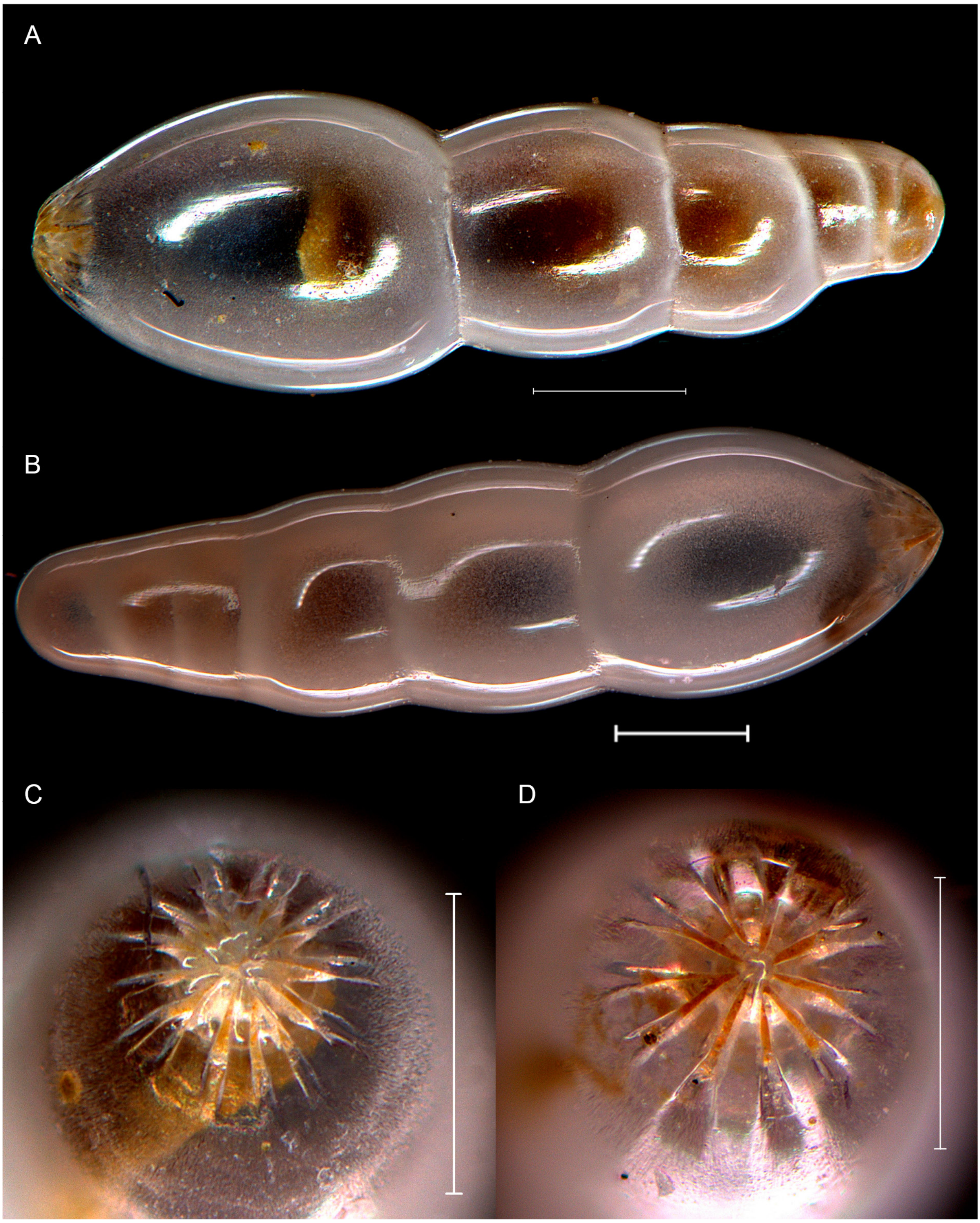

Fig. 14. *Nodosaria incerta* Neugeboren, 1856. **A, C**. Microsphere (BIOICE 2664, IINH 40071), side view (A), showing initial spiral end, and aperture (C). **B, D**. Megalosphere (BIOICE 3108, IINH 40085), side view (B) and aperture (D). Light source combination of incident light and dark field. Scale bars = 0.25 mm.

depth 398 m; 0.12°C; 34.84 ppt; 8 Jul. 1992; BIOICE 2145; IINH 39981 • 3; 66.7592° N, 20.0878° W; RP sledge; depth 293 m; 3°C; 34.86 ppt; 9 Jul. 1992; BIOICE 2149; IINH 39982 • 26; 66.4369° N, 18.8214° W; RP sledge; depth 437 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2172; IINH 39983 • 2; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 40044 • 1; 63.2503° N, 26.4872° W; RP sledge; depth 1209 m; 4.09°C; 34.94 ppt; 5 Sep. 1992; BIOICE 2257; IINH 40043 • 11; 64.1° N, 9.05° W; detr. sledge (Sneli); depth 991 m; unknown; unknown; 2 May1993; BIOICE 2315; IINH 40045 • 5; 64.0333° N, 9.6167° W; detr. sledge (Sneli); depth 772 m; unknown; unknown; 2 May1993; BIOICE 2318; IINH 40049 • 1; 64.0167° N, 9.6167° W; RP sledge; depth 776 m; unknown; unknown; 2 May1993; BIOICE 2319; IINH 40046 • 2; 64.5833° N, 10.05° W; RP sledge; depth 605 m; unknown; unknown; 8 May 1993; BIOICE 2364; IINH 40048 • 2; 64.75° N, 10.5167° W; detr. sledge (Sneli); depth 449 m; unknown; unknown; 8 May 1993; BIOICE 2371; IINH 40050 • 1; 64.3333° N, 12.45° W; Triangle dredge; depth 403 m; unknown; unknown; 10 May1993; BIOICE 2380; IINH 40051 • 6; 66.0803° N, 22.9503° W; RP sledge; depth 67 m; 6.25°C; 34.62 ppt; 14 Jul. 1993; BIOICE 2545; IINH 40052 • 1; 66.2728° N, 22.9525° W; Triangle dredge; depth 77 m; 4.83°C; 34.6 ppt; 14 Jul. 1993; BIOICE 2551; IINH 40053 • 8; 67.1014° N, 24.0992° W; detr. sledge (Sneli); depth 495 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2572; IINH 39974 • 1; 67.1097° N, 24.085° W; RP sledge; depth 489 m; -0.47°C; 34.86 ppt; 15 Jul. 1993; BIOICE 2573; IINH 40054 • 3; 67.4214° N, 22.4072° W; RP sledge; depth 450 m; -0.46°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2585; IINH 40055 • 1; 67.3406° N, 22.5425° W; detr. sledge (Sneli); depth 356 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2588; IINH 40056 • 1; 67.3381° N, 22.5525° W; RP sledge; depth 355 m; -0.47°C; 34.87 ppt; 16 Jul. 1993; BIOICE 2589; IINH 40057 • 1; 66.9417° N, 17.9389° W; detr. sledge (Sneli); depth 433 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2603; IINH 40058 • 3; 66.9344° N, 17.9397° W; RP sledge; depth 435 m; -0.31°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2606; IINH 40064 • 1; 67.1894° N, 16.8589° W; detr. sledge (Sneli); depth 528 m; -0.52°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2615; IINH 40065 • 1; 67.1939° N, 16.8444° W; RP sledge; depth 535 m; -0.52°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2616; IINH 40060 • 6; 67.2761° N, 16.6592° W; detr. sledge (Sneli); depth 597 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2618; IINH 40059 • 1; 67.2906° N, 16.6381° W; RP sledge; depth 600 m; -0.55°C; 34.9 ppt; 11 Jul. 1994; BIOICE 2619; IINH 40061 • 1; 67.4331° N, 16.1753° W; detr. sledge (Sneli); depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2626; IINH 40066 • 1; 67.3364° N, 16.1194° W; detr. sledge (Sneli); depth 602 m; -0.55°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2629; IINH 40067 • 1; 67.3894° N, 15.9775° W; detr. sledge (Sneli); depth 699 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2631; IINH 40068 • 1; 67.5044° N, 15.8069° W; detr. sledge (Sneli); depth 795 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2634; IINH 40062 • 1; 68.0922° N, 15.3258° W; detr. sledge (Sneli); depth 1304 m; -0.72°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2647; IINH 40069 • 1; 68.0858° N, 15.3181° W; RP sledge; depth 1306 m; -0.72°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2648; IINH 40063 • 9; 67.3° N, 14.9581° W; RP sledge; depth 549 m; -0.55°C; 34.9 ppt; 14 Jul. 1994; BIOICE 2655; IINH 40070 • 1; 67.0561° N, 16.2747° W; detr. sledge (Sneli); depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2664; IINH 40071 • 2; 67.0528° N, 16.2847° W; Agassiz trawl; depth 384 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2665; IINH 40072 • 2; 67.0575° N, 16.2675° W; RP sledge; depth 382 m; 0.07°C; 34.88 ppt; 15 Jul. 1994; BIOICE 2666; IINH 40073 • 1; 66.2558° N, 17.3339° W; detr. sledge (Sneli); depth 178 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2681; IINH 40074 • 1; 66.2594° N, 17.3356° W; RP sledge; depth 181 m; 3.82°C; 34.88 ppt; 16 Jul. 1994; BIOICE 2682; IINH 40075 • 6; 67.0908° N, 20.1411° W; RP sledge; depth 284 m; -0.01°C; 34.86 ppt; 30 Jul. 1995; BIOICE 2736; IINH 40080 • 4; 67.6439° N, 20.2722° W; detr. sledge (Sneli); depth 503 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2740; IINH 40081 • 3; 67.6583° N, 20.2411° W; RP sledge; depth 514 m; -0.6°C; 34.89 ppt; 30 Jul. 1995; BIOICE 2741; IINH 40078 • 1; 68.5883° N, 16.9397° W; Triangle dredge; depth 519 m; -0.37°C; 34.86 ppt; 2 Aug. 1995; BIOICE 2769; IINH 40076 • 6; 67.4156° N, 18.2417° W; RP sledge; depth 693 m; -0.41°C; 34.88 ppt; 5 Aug. 1995; BIOICE 2786; IINH 40077 • 1; 67.36° N, 18.3344° W; RP sledge; depth 561 m; -0.29°C; 34.87 ppt; 5 Aug. 1995; BIOICE 2787; IINH 40079 • 1; 62.4889° N, 14.5094° W; RP sledge; depth 1602 m; 3.24°C; 34.94 ppt; 11 Jul. 1997; BIOICE 3069; IINH 40090 • 5;

67.3264° N, 21.1819° W; RP sledge; depth 314 m; 0.23°C; 34.86 ppt; 21 Aug. 1999; BIOICE 3104; IINH 40084 • 1; 67.3186° N, 20.7789° W; detr. sledge (Sneli); depth 330 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3107; IINH 40086 • 1; 67.3219° N, 20.7528° W; RP sledge; depth 328 m; -0.21°C; 34.88 ppt; 21 Aug. 1999; BIOICE 3108; IINH 40085 • 4; 67.875° N, 22.2581° W; RP sledge; depth 768 m; -0.46°C; 34.89 ppt; 25 Aug. 1999; BIOICE 3140; IINH 40082 • 3; 62.1511° N, 27.0206° W; RP sledge; depth 1327 m; 3.99°C; 34.96 ppt; 1 Aug. 2000; BIOICE 3187; IINH 40083 • 4; 65.5139° N, 8.525° W; RP sledge; depth 935 m; -0.63°C; 34.9 ppt; 8 Jul. 2001; BIOICE 3198; IINH 40087 • 1; 68.59° N, 8.2514° W; Agassiz trawl; depth 1997 m; -0.86°C; 34.91 ppt; 12 Jul. 2001; BIOICE 3226; IINH 40092 • 1; 65.8428° N, 12.0242° W; RP sledge; depth 192 m; 1.92°C; 34.87 ppt; 14 Jul. 2001; BIOICE 3249; IINH 40091 • 3; 66.5283° N, 20.9525° W; RP sledge; depth 200 m; 1.98°C; 34.89 ppt; 25 Jul. 2004; BIOICE 3668; IINH 40089.

Description

Test shape elongate, cylindrical, straight, barely to moderately nodular and slightly tapering; initial end rounded. Length of test 0.7–1.5 mm, the largest 2.2 mm; test width 0.4–0.5 mm. Chambers subglobular to cylindrical. Chamber arrangement rectilinear, embracement moderate to minimal; number of chambers 4–6 in microsphere, up to 12 in microsphere. Initial 3–5 chambers in microsphere are wound in about half of an evolutive planispiral (Fig. 14A). Sutures horizontal. Aperture radial, central and slightly raised; radial tines up to 12, symmetrically arranged and fused in the center. Wall smooth, finely perforated of medium thickness.

Remarks

Available material of this species comprised 371 specimens, of which 9 were microspheres. Diameter of proloculus in megalospheres is 0.15–0.30 mm, and < 0.05 mm in microspheres.

Genus ***Pseudonodosaria*** Boomgaart, 1949

Diagnosis

Test ovoid, uniserial, early chambers strongly embracing and increasing rapidly in diameter; sutures horizontal and flush; aperture terminal with radiate slits (Hayward *et al*. 2012).

Pseudonodosaria subannulata (Cushman, 1923)

Fig. 15

Nodosaria subannulata Cushman, 1923: 66, pl. 12 fig. 9.

Pseudonodosaria subannulata – Eiland & Guðmundsson 2004: 206, pl. 1 figs h–k, pl. 3 figs e–f.

non Nodosaria aequalis (Reuss, 1863) – Goës 1894: 72, pl. 13 figs 704–705, 708, 710–711.

Material examined

ICELANDIC WATERS • 2; 65.6953° N, 11.0106° W; RP sledge; depth 978 m; -0.41°C; unknown; 20 Jul. 1991; BIOICE 2014; IINH 39912 • 7; 65.9853° N, 10.7419° W; RP sledge; depth 1195 m; -0.79°C; unknown; 21 Jul. 1991; BIOICE 2015; IINH 39911 • 1; 66.0186° N, 10.725° W; detr. sledge (Sneli); depth 1211 m; -0.79°C; unknown; 21 Jul. 1991; BIOICE 2016; IINH 39913 • 60; 66.5769° N, 11.2303° W; RP sledge; depth 1390 m; -0.82°C; unknown; 21 Jul. 1991; BIOICE 2018; IINH 39901 • 2; 66.5547° N, 12.1989° W; RP sledge; depth 1253 m; -0.86°C; unknown; 21 Jul. 1991; BIOICE 2019; IINH 39902 • 6; 66.6278° N, 12.1542° W; detr. sledge (Sneli); depth 1314 m; -0.86°C; unknown; 22 Jul. 1991; BIOICE 2020; IINH 39903 • 2; 66.5394° N, 13.2833° W; RP sledge; depth 317 m; 1.41°C; unknown; 22 Jul. 1991; BIOICE 2024; IINH 39904 • 15; 67.2061° N, 13.3494° W; RP sledge; depth

1648 m; -0.76°C; unknown; 23 Jul. 1991; BIOICE 2027; IINH 39905 • 6; 67.0581° N, 13.4239° W; RP sledge; depth 931 m; -0.56°C; unknown; 23 Jul. 1991; BIOICE 2029; IINH 39906 • 1; 67.0081° N, 13.4403° W; RP sledge; depth 831 m; -0.55°C; unknown; 23 Jul. 1991; BIOICE 2030; IINH 39907 • 5; 66.3647° N, 13.4856° W; RP sledge; depth 310 m; 1.3°C; unknown; 24 Jul. 1991; BIOICE 2040; IINH 39908 • 1; 65.7025° N, 12.8833° W; RP sledge; depth 272 m; 1.96°C; unknown; 25 Jul. 1991; BIOICE 2047; IINH 39909 • 2; 65.6531° N, 12.3583° W; RP sledge; depth 247 m; 1.2°C; unknown; 25 Jul. 1991; BIOICE 2049; IINH 39910 • 7; 66.6778° N, 17.92° W; detr. sledge (Sneli); depth 201 m; 2.73°C; 34.86 ppt; 3 Jul. 1992; BIOICE 2074; IINH 39914 • 12; 67.6808° N, 17.1772° W; RP sledge; depth 1048 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2077; IINH 39917 • 5; 67.6719° N, 17.2008° W; detr. sledge (Sneli); depth 1046 m; -0.52°C; 34.85 ppt; 3 Jul. 1992; BIOICE 2079; IINH 39915 • 5; 67.0194° N, 17.585° W; RP sledge; depth 300 m; 1.67°C; 34.85 ppt; 5 Jul. 1992; BIOICE 2096; IINH 39916 • 48; 68.0017° N, 19.4239° W; RP sledge; depth 1141 m; -0.58°C; 34.88 ppt; 6 Jul. 1992; BIOICE 2100; IINH 39918 • 1; 68.0072° N, 19.4414° W; detr. sledge (Sneli); depth 1146 m; -0.58°C; 34.88 ppt; 6 Jul. 1992; BIOICE 2102; IINH 39919 • 2; 67.8372° N, 19.5581° W; RP sledge; depth 905 m; -0.55°C; 34.87 ppt; 6 Jul. 1992; BIOICE 2107; IINH 39934 • 1; 67.1189° N, 19.8775° W; RP sledge; depth 284 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2119; IINH 39959 • 7; 67.1275° N, 19.9042° W; detr. sledge (Sneli); depth 280 m; 0.5°C; 34.82 ppt; 7 Jul. 1992; BIOICE 2121; IINH 39935 • 4; 67.1858° N, 19.5672° W; detr. sledge (Sneli); depth 346 m; 0.15°C; 34.84 ppt; 7 Jul. 1992; BIOICE 2122; IINH 42233 • 6; 66.9975° N, 18.8394° W; detr. sledge (Sneli); depth 208 m; 2.7°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2126; IINH 39936 • 8; 66.9839° N, 18.8436° W; RP sledge; depth 203 m; 2.7°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2128; IINH 39937 • 1; 66.7744° N, 18.7042° W; detr. sledge (Sneli); depth 678 m; -0.08°C; 34.86 ppt; 8 Jul. 1992; BIOICE 2129; IINH 39933 • 6; 66.7197° N, 19.3303° W; RP sledge; depth 297 m; 2.11°C; 34.83 ppt; 8 Jul. 1992; BIOICE 2137; IINH 39938 • 2; 66.72° N, 19.5861° W; detr. sledge (Sneli); depth 204 m; 4.71°C; 34.95 ppt; 8 Jul. 1992; BIOICE 2140; IINH 39939 • 4; 66.7228° N, 19.5883° W; RP sledge; depth 207 m; 4.71°C; 34.95 ppt; 8 Jul. 1992; BIOICE 2142; IINH 39940 • 11; 66.7592° N, 20.0878° W; RP sledge; depth 293 m; 3°C; 34.86 ppt; 9 Jul. 1992; BIOICE 2149; IINH 39958 • 6; 66.7097° N, 20.0469° W; RP sledge; depth 149 m; 5.06°C; 34.95 ppt; 9 Jul. 1992; BIOICE 2150; IINH 39941 • 14; 66.45° N, 19.5969° W; detr. sledge (Sneli); depth 294 m; 4.51°C; 34.93 ppt; 9 Jul. 1992; BIOICE 2162; IINH 39957 • 2; 66.4542° N, 19.6078° W; RP sledge; depth 294 m; 4.51°C; 34.93 ppt; 9 Jul. 1992; BIOICE 2164; IINH 39956 • 3; 66.3308° N, 19.6042° W; detr. sledge (Sneli); depth 169 m; 5.07°C; 34.93 ppt; 9 Jul. 1992; BIOICE 2166; IINH 39955 • 2; 66.3367° N, 19.5953° W; RP sledge; depth 183 m; 5.07°C; 34.93 ppt; 9 Jul. 1992; BIOICE 2167; IINH 39960 • 4; 66.4369° N, 18.8214° W; RP sledge; depth 437 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2172; IINH 39961 • 2; 66.4436° N, 18.8192° W; detr. sledge (Sneli); depth 425 m; 0.55°C; 34.83 ppt; 9 Jul. 1992; BIOICE 2174; IINH 39954 • 2; 66.5139° N, 18.5422° W; RP sledge; depth 201 m; 4.63°C; 34.94 ppt; 10 Jul. 1992; BIOICE 2177; IINH 39962 • 30; 64.2689° N, 24.4347° W; RP sledge; depth 213 m; 6.85°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2215; IINH 39984 • 4; 64.2686° N, 24.4386° W; detr. sledge (Sneli); depth 214 m; 6.85°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2216; IINH 39985 • 2; 64.2128° N, 25.2931° W; detr. sledge (Sneli); depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2218; IINH 39986 • 10; 64.2158° N, 25.2883° W; RP sledge; depth 265 m; 6.36°C; 35.09 ppt; 3 Sep. 1992; BIOICE 2219; IINH 39953 • 16; 63.9169° N, 25.2775° W; RP sledge; depth 240 m; 6.5°C; 35.1 ppt; 3 Sep. 1992; BIOICE 2221; IINH 39987 • 1; 63.7564° N, 24.9353° W; detr. sledge (Sneli); depth 425 m; 5.88°C; 35.06 ppt; 3 Sep. 1992; BIOICE 2224; IINH 39988 • 2; 63.7578° N, 24.9397° W; RP sledge; depth 426 m; 5.88°C; 35.06 ppt; 3 Sep. 1992; BIOICE 2226; IINH 39989 • 2; 63.8167° N, 24.3736° W; RP sledge; depth 296 m; 6.96°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2229; IINH 39952 • 1; 63.8283° N, 24.3547° W; detr. sledge (Sneli); depth 296 m; 6.96°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2230; IINH 39951 • 2; 63.4528° N, 24.6875° W; RP sledge; depth 296 m; 6.92°C; 35.11 ppt; 4 Sep. 1992; BIOICE 2237; IINH 39992 • 1; 63.3519° N, 25.3717° W; RP sledge; depth 305 m; 6.65°C; 35.1 ppt; 4 Sep. 1992; BIOICE 2241; IINH 39990 • 1; 63.2528° N, 25.8286° W; Triangle dredge; depth 852 m; 5.41°C; 34.99 ppt; 5 Sep. 1992; BIOICE 2251; IINH 39991 • 2; 63.3464° N, 23.4236° W; detr. sledge (Sneli); depth 347 m; 6.87°C;

35.12 ppt; 9 Sep. 1992; BIOICE 2284; IINH 39993 • 1; 62.9039° N, 22.6592° W; RP sledge; depth 981 m; 4.54°C; 34.98 ppt; 10 Sep. 1992; BIOICE 2297; IINH 39994 • 2; 63.0028° N, 22.6669° W; RP sledge; depth 775 m; 5.53°C; 35.03 ppt; 10 Sep. 1992; BIOICE 2299; IINH 39950 • 3; 63.2506° N, 22.7936° W; RP sledge; depth 263 m; 7.12°C; 35.13 ppt; 10 Sep. 1992; BIOICE 2308; IINH 39949 • 13; 62.7167° N, 12.7167° W; RP sledge; depth 803 m; unknown; unknown; 4 May 1993; BIOICE 2334; IINH 39996 • 1; 62.45° N, 12.9167° W; RP sledge; depth 1099 m; unknown; unknown; 5 May 1993; BIOICE 2337; IINH 39995 • 1; 62.1333° N, 13.3333° W; RP sledge; depth 1302 m; unknown; unknown; 5 May 1993; BIOICE 2340; IINH 40001 • 1; 62.8667° N, 21.7361° W; RP sledge; depth 1074 m; 4°C; 34.97 ppt; 2 Jul. 1993; BIOICE 2410; IINH 39948 • 3; 63.1167° N, 19.95° W; detr. sledge (Sneli); depth 1072 m; 4.8°C; 35 ppt; 3 Jul. 1993; BIOICE 2429; IINH 40000 • 5; 63.0689° N, 19.8592° W; detr. sledge (Sneli); depth 1207 m; 4.45°C; 34.99 ppt; 3 Jul. 1993; BIOICE 2431; IINH 39998 • 2; 63.2389° N, 19.5361° W; RP sledge; depth 965 m; 5.48°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2435; IINH 39999 • 2; 65.8094° N, 23.9242° W; RP sledge; depth 62 m; 3.56°C; 34.3 ppt; 11 Jul. 1993; BIOICE 2480; IINH 39997 • 2; 66.8425° N, 23.1786° W; detr. sledge (Sneli); depth 196 m; 5.52°C; 35.01 ppt; 15 Jul. 1993; BIOICE 2566; IINH 40012 • 3; 67.2147° N, 22.4294° W; RP sledge; depth 333 m; 0.12°C; 34.84 ppt; 16 Jul. 1993; BIOICE 2591; IINH 40002 • 25; 67.0028° N, 22.5714° W; RP sledge; depth 203 m; 5.41°C; 34.99 ppt; 16 Jul. 1993; BIOICE 2595; IINH 40003 • 2; 67.0092° N, 17.4175° W; detr. sledge (Sneli); depth 246 m; 2.95°C; 34.89 ppt; 10 Jul. 1994; BIOICE 2608; IINH 40004 • 1; 67.4286° N, 16.1703° W; RP sledge; depth 748 m; -0.56°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2627; IINH 40005 • 1; 67.3894° N, 15.9775° W; detr. sledge (Sneli); depth 699 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2631; IINH 40006 • 1; 67.5044° N, 15.8069° W; detr. sledge (Sneli); depth 795 m; -0.57°C; 34.9 ppt; 12 Jul. 1994; BIOICE 2634; IINH 40015 • 30; 67.8189° N, 15.505° W; RP sledge; depth 1009 m; -0.59°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2638; IINH 40008 • 6; 67.9364° N, 15.3725° W; detr. sledge (Sneli); depth 1097 m; -0.61°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2640; IINH 40009 • 9; 68.0208° N, 15.2519° W; RP sledge; depth 1202 m; -0.64°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2644; IINH 39947 • 16; 68.0922° N, 15.3258° W; detr. sledge (Sneli); depth 1304 m; -0.72°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2647; IINH 39946 • 6; 68.0858° N, 15.3181° W; RP sledge; depth 1306 m; -0.72°C; 34.91 ppt; 14 Jul. 1994; BIOICE 2648; IINH 40010 • 5; 67.2447° N, 15.4783° W; RP sledge; depth 277 m; 2.69°C; 34.9 ppt; 15 Jul. 1994; BIOICE 2660; IINH 40011 • 1; 66.9989° N, 15.7606° W; detr. sledge (Sneli); depth 187 m; 2.55°C; 34.87 ppt; 15 Jul. 1994; BIOICE 2668; IINH 40013 • 2; 66.6331° N, 16.7017° W; Triangle dredge; depth 77 m; 4.1°C; 34.9 ppt; 16 Jul. 1994; BIOICE 2678; IINH 40014 • 10; 64.1722° N, 27.7194° W; RP sledge; depth 1042 m; 4.2°C; 34.93 ppt; 2 Sep. 1994; BIOICE 2697; IINH 40016 • 1; 63.925° N, 28.2889° W; RP sledge; depth 1407 m; 3.71°C; 34.91 ppt; 3 Sep. 1994; BIOICE 2707; IINH 40018 • 1; 64.7278° N, 30.125° W; detr. sledge (Sneli); depth 2170 m; 3.13°C; 34.9 ppt; 3 Sep. 1994; BIOICE 2708; IINH 40021 • 9; 64.575° N, 24.5222° W; detr. sledge (Sneli); depth 250 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2712; IINH 40020 • 10; 64.575° N, 24.5472° W; RP sledge; depth 273 m; 6.15°C; 35.06 ppt; 6 Sep. 1994; BIOICE 2713; IINH 39945 • 7; 64.5167° N, 25.725° W; detr. sledge (Sneli); depth 358 m; 5.59°C; 35.04 ppt; 6 Sep. 1994; BIOICE 2716; IINH 40022 • 45; 64.5083° N, 25.7333° W; RP sledge; depth 256 m; 5.59°C; 35.04 ppt; 7 Sep. 1994; BIOICE 2717; IINH 39944 • 3; 64.4389° N, 26.4056° W; RP sledge; depth 304 m; 5.56°C; 35.04 ppt; 7 Sep. 1994; BIOICE 2720; IINH 39943 • 1; 62.3472° N, 16.9917° W; RP sledge; depth 2074 m; 2.34°C; 34.96 ppt; 29 Aug. 1995; BIOICE 2856; IINH 40017 • 2; 61.7286° N, 16.9633° W; RP sledge; depth 2295 m; 2.6°C; 34.96 ppt; 30 Aug. 1995; BIOICE 2860; IINH 40025 • 50; 64.6833° N, 25.6072° W; detr. sledge (Sneli); depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2869; IINH 40024 • 1; 64.9278° N, 27.2494° W; detr. sledge (Sneli); depth 367 m; 6.14°C; 35.06 ppt; 23 Aug. 1996; BIOICE 2880; IINH 40023 • 15; 62.8708° N, 14.7006° W; RP sledge; depth 1729 m; 2.51°C; 34.96 ppt; 11 Jul. 1997; BIOICE 3067; IINH 40038 • 5; 67.3264° N, 21.1819° W; RP sledge; depth 314 m; 0.23°C; 34.86 ppt; 21 Aug. 1999; BIOICE 3104; IINH 40037 • 1; 68.1561° N, 17.9856° W; RP sledge; depth 875 m; -0.48°C; 34.89 ppt; 22 Aug. 1999; BIOICE 3124; IINH 40030 • 9; 61.7167° N, 22.9639° W; RP sledge; depth 1741 m; 2.79°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3164; IINH 40032 • 10; 60.9244° N, 22.7906° W; RP sledge; depth 1897 m; 2.98°C; 34.99 ppt;

26 Jul. 2000; BIOICE 3167; IINH 40035 • 1; 65.7425° N, 7.0264° W; RP sledge; depth 2002 m; -0.87°C; 34.91 ppt; 9 Jul. 2001; BIOICE 3208; IINH 40028 • 1; 66.235° N, 6.8714° W; RP sledge; depth 2544 m; -0.87°C; 34.91 ppt; 9 Jul. 2001; BIOICE 3210; IINH 40036 • 1; 67.0383° N, 6.2064° W; RP sledge; depth 3003 m; -0.9°C; 34.91 ppt; 10 Jul. 2001; BIOICE 3214; IINH 40039 • 8; 67.1072° N, 7.4533° W; RP sledge; depth 2014 m; -0.86°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3216; IINH 40033 • 4; 67.2553° N, 8.4683° W; RP sledge; depth 1642 m; -0.82°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3219; IINH 40042 • 5; 68.59° N, 8.2514° W; Agassiz trawl; depth 1997 m; -0.86°C; 34.91 ppt; 12 Jul. 2001; BIOICE 3226; IINH 40029 • 2; 62.4222° N, 19.8167° W; RP sledge; depth 1780 m; 2.95°C; 34.98 ppt; 13 Sep. 2001; BIOICE 3264; IINH 40031 • 1; 62.9836° N, 18.1517° W; detr. sledge (Sneli); depth 1232 m; unknown; unknown; 12 Sep. 2002; BIOICE 3546; IINH 40040 • 1; 63.32° N, 25.2569° W; detr. sledge (Sneli); depth 296 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3604; IINH 40027 • 1; 68.8364° N, 9.245° W; RP sledge; depth 1844 m; -0.81°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3636; IINH 40041 • 1; 68.7864° N, 15.3186° W; RP sledge; depth 1492 m; -0.72°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3656; IINH 40026 • 2; 66.5283° N, 20.9525° W; RP sledge; depth 200 m; 1.98°C; 34.89 ppt; 25 Jul. 2004; BIOICE 3668; IINH 40034 • 16; 74.9756° N, 13.0942°E; 0; depth 317 m; unknown; unknown; 19 Jun. 1994; NI-SAFN 31-14; IINH 40095 • 1; 65.3606° N, 13.6158° W; RP sledge; depth 64 m; 5.17°C; unknown; 19 Jul. 1991; BIOICE 2003; IINH 42143 • 1; 63.1278° N, 22.9083° W; RP sledge; depth 520 m; 6.74°C; 35.09 ppt; 1 Jul. 1993; BIOICE 2401; IINH 42144 • 18; 63.0583° N, 21.8333° W; RP sledge; depth 838 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2403; IINH 42145 • 4; 63.0417° N, 21.8556° W; detr. sledge (Sneli); depth 802 m; 5.49°C; 35.03 ppt; 1 Jul. 1993; BIOICE 2404; IINH 42146 • 1; 63.0083° N, 21.0211° W; detr. sledge (Sneli); depth 784 m; 5.36°C; 35.02 ppt; 2 Jul. 1993; BIOICE 2414; IINH 42147 • 4; 63.005° N, 21.015° W; RP sledge; depth 819 m; 5.36°C; 35.02 ppt; 2 Jul. 1993; BIOICE 2415; IINH 42148 • 3; 63.175° N, 20.0692° W; RP sledge; depth 778 m; 5.5°C; 35.03 ppt; 3 Jul. 1993; BIOICE 2427; IINH 42149 • 2; 63.175° N, 21.5333° W; RP sledge; depth 450 m; 6.74°C; 35.09 ppt; 5 Jul. 1993; BIOICE 2469; IINH 42150 • 3; 63.1233° N, 21.6119° W; detr. sledge (Sneli); depth 647 m; 6.09°C; 35.06 ppt; 5 Jul. 1993; BIOICE 2471; IINH 42151 • 2; 63.0722° N, 21.5917° W; RP sledge; depth 842 m; 5.54°C; 35.03 ppt; 5 Jul. 1993; BIOICE 2475; IINH 42152 • 31; 67.9419° N, 15.3581° W; RP sledge; depth 1098 m; -0.61°C; 34.91 ppt; 13 Jul. 1994; BIOICE 2642; IINH 42153 • 17; 66.8389° N, 16.2706° W; RP sledge; depth 227 m; 2.78°C; 34.89 ppt; 15 Jul. 1994; BIOICE 2673; IINH 42154 • 7; 67.0908° N, 20.1411° W; RP sledge; depth 284 m; -0.01°C; 34.86 ppt; 30 Jul. 1995; BIOICE 2736; IINH 42155 • 10; 68.0203° N, 20.6578° W; detr. sledge (Sneli); depth 970 m; -0.57°C; 34.89 ppt; 31 Jul. 1995; BIOICE 2749; IINH 42156 • 6; 67.9178° N, 19.3269° W; RP sledge; depth 1023 m; -0.61°C; 34.89 ppt; 31 Jul. 1995; BIOICE 2754; IINH 42157 • 11; 67.93° N, 17.7072° W; RP sledge; depth 1130 m; -0.53°C; 34.89 ppt; 1 Aug. 1995; BIOICE 2762; IINH 42158 • 6; 68.1083° N, 17.5347° W; RP sledge; depth 1220 m; -0.52°C; 34.89 ppt; 1 Aug. 1995; BIOICE 2765; IINH 42159 • 17; 69.2614° N, 14.2172° W; detr. sledge (Sneli); depth 1633 m; -0.86°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2772; IINH 42160 • 16; 68.6028° N, 14.6756° W; detr. sledge (Sneli); depth 1553 m; -0.78°C; 34.9 ppt; 3 Aug. 1995; BIOICE 2776; IINH 42161 • 42; 68.345° N, 15.7858° W; RP sledge; depth 1413 m; -0.74°C; 34.89 ppt; 4 Aug. 1995; BIOICE 2779; IINH 42162 • 5; 63.0681° N, 17.1217° W; Triangle dredge; depth 1318 m; 3.94°C; 34.95 ppt; 26 Aug. 1995; BIOICE 2841; IINH 42164 • 21; 63.0944° N, 17.3528° W; RP sledge; depth 1085 m; 4.48°C; 35.01 ppt; 27 Aug. 1995; BIOICE 2844; IINH 42163 • 12; 62.0725° N, 20.5986° W; RP sledge; depth 1681 m; 2.67°C; 34.96 ppt; 31 Aug. 1995; BIOICE 2864; IINH 42165 • 11; 64.6936° N, 25.6056° W; RP sledge; depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2867; IINH 42166 • 78; 64.6928° N, 25.6061° W; RP sledge; depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2868; IINH 42167 • 75; 64.6833° N, 25.6072° W; detr. sledge (Sneli); depth 212 m; 6.35°C; 35.06 ppt; 22 Aug. 1996; BIOICE 2869; IINH 40024 • 1; 65.8086° N, 25.6522° W; RP sledge; depth 227 m; 6.2°C; 35.05 ppt; 29 Aug. 1996; BIOICE 2947; IINH 42169 • 52; 65.0433° N, 25.8742° W; RP sledge; depth 163 m; 6.34°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2976; IINH 42171 • 79; 64.9225° N, 25.7775° W; Triangle dredge; depth 183 m; 6.22°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2978; IINH 42170 • 5; 64.92° N, 25.5167° W; RP sledge; depth 168 m; 6.42°C; 35.06 ppt; 30 Aug. 1996; BIOICE

2981; IINH 42173 • 18; 64.775° N, 25.5583° W; RP sledge; depth 175 m; 6.45°C; 35.06 ppt; 30 Aug. 1996; BIOICE 2983; IINH 42174 • 2; 63.3153° N, 14.3614° W; detr. sledge (Sneli); depth 1642 m; 2.78°C; 34.97 ppt; 6 Jul. 1997; BIOICE 3005; IINH 42175 • 4; 63.3167° N, 14.35° W; RP sledge; depth 1634 m; 2.78°C; 34.97 ppt; 6 Jul. 1997; BIOICE 3006; IINH 42176 • 2; 61.9014° N, 15.1375° W; RP sledge; depth 2082 m; 2.83°C; 34.97 ppt; 12 Jul. 1997; BIOICE 3072; IINH 42177 • 14; 67.1442° N, 22.7658° W; detr. sledge (Sneli); depth 290 m; 0.5°C; 34.87 ppt; 20 Aug. 1999; BIOICE 3094; IINH 42178 • 43; 67.1839° N, 21.7689° W; RP sledge; depth 230 m; 1.3°C; 34.87 ppt; 21 Aug. 1999; BIOICE 3099; IINH 42179 • 2; 68.7325° N, 16.5853° W; RP sledge; depth 1715 m; unknown; unknown; 23 Aug. 1999; BIOICE 3127; IINH 42183 • 23; 68.2575° N, 20.0189° W; RP sledge; depth 1112 m; unknown; unknown; 24 Aug. 1999; BIOICE 3136; IINH 42180 • 1; 67.2194° N, 24.9389° W; detr. sledge (Sneli); depth 1223 m; unknown; unknown; 25 Aug. 1999; BIOICE 3146; IINH 42184 • 1; 62.6197° N, 23.3669° W; detr. sledge (Sneli); depth 1250 m; 3.61°C; 34.99 ppt; 25 Jul. 2000; BIOICE 3162; IINH 42185 • 3; 60.9264° N, 22.7897° W; detr. sledge (Sneli); depth 1898 m; 2.98°C; 34.99 ppt; 26 Jul. 2000; BIOICE 3166; IINH 42186 • 43; 65.6508° N, 9.1203° W; detr. sledge (Sneli); depth 818 m; -0.58°C; 34.9 ppt; 7 Jul. 2001; BIOICE 3194; IINH 42182 • 38; 65.5139° N, 8.525° W; RP sledge; depth 935 m; -0.63°C; 34.9 ppt; 8 Jul. 2001; BIOICE 3198; IINH 42181 • 43; 67.9047° N, 8.1094° W; RP sledge; depth 1525 m; -0.83°C; 34.91 ppt; 11 Jul. 2001; BIOICE 3222; IINH 42187 • 4; 68.5794° N, 8.2653° W; RP sledge; depth 1993 m; -0.86°C; 34.91 ppt; 12 Jul. 2001; BIOICE 3225; IINH 42188 • 3; 62.9972° N, 19.1861° W; detr. sledge (Sneli); depth 1311 m; 3.72°C; 34.99 ppt; 11 Sep. 2001; BIOICE 3259; IINH 42189 • 3; 62.9944° N, 19.1917° W; RP sledge; depth 1308 m; 3.72°C; 34.99 ppt; 12 Sep. 2001; BIOICE 3260; IINH 42191 • 6; 62.5306° N, 19.6639° W; RP sledge; depth 1682 m; 3.3°C; 34.99 ppt; 13 Sep. 2001; BIOICE 3263; IINH 42190 • 16; 62.0294° N, 19.8208° W; RP sledge; depth 1733 m; 3.09°C; 34.99 ppt; 2 Sep. 2002; BIOICE 3504; IINH 42192 • 1; 61.9264° N, 19.2839° W; RP sledge; depth 1595 m; 3.12°C; 35.01 ppt; 3 Sep. 2002; BIOICE 3507; IINH 42193 • 16; 62.0444° N, 19.6531° W; RP sledge; depth 1678 m; 2.7°C; 34.99 ppt; 3 Sep. 2002; BIOICE 3509; IINH 42194 • 2; 62.5206° N, 17.1742° W; RP sledge; depth 1940 m; 2.34°C; 34.99 ppt; 7 Sep. 2002; BIOICE 3522; IINH 42195 • 1; 62.6467° N, 17.0625° W; RP sledge; depth 1921 m; 2.37°C; 34.99 ppt; 7 Sep. 2002; BIOICE 3524; IINH 42196 • 1; 62.7239° N, 14.5861° W; detr. sledge (Sneli); depth 1708 m; 2.51°C; 34.98 ppt; 9 Sep. 2002; BIOICE 3531; IINH 42197 • 15; 64.1292° N, 24.1047° W; detr. sledge (Sneli); depth 291 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3549; IINH 42198 • 16; 64.1297° N, 24.1044° W; RP sledge; depth 290 m; 7.6°C; 35.18 ppt; 2 Sep. 2003; BIOICE 3550; IINH 42199 • 3; 64.2911° N, 25.6833° W; detr. sledge (Sneli); depth 300 m; 7.19°C; 35.16 ppt; 2 Sep. 2003; BIOICE 3552; IINH 42200 • 3; 64.2872° N, 25.6994° W; RP sledge; depth 304 m; 7.19°C; 35.16 ppt; 2 Sep. 2003; BIOICE 3554; IINH 42201 • 5; 64.2086° N, 26.2211° W; detr. sledge (Sneli); depth 334 m; 6.95°C; 35.14 ppt; 2 Sep. 2003; BIOICE 3557; IINH 42202 • 2; 64.2106° N, 26.2117° W; Agassiz trawl; depth 337 m; 6.95°C; 35.14 ppt; 2 Sep. 2003; BIOICE 3559; IINH 42203 • 8; 62.3875° N, 28.2919° W; RP sledge; depth 1558 m; 3.77°C; 34.95 ppt; 7 Sep. 2003; BIOICE 3586; IINH 42204 • 1; 62.8328° N, 25.2522° W; detr. sledge (Sneli); depth 424 m; 7.61°C; 35.18 ppt; 11 Sep. 2003; BIOICE 3603; IINH 42205 • 4; 63.3289° N, 25.265° W; RP sledge; depth 306 m; 7.49°C; 35.17 ppt; 11 Sep. 2003; BIOICE 3605; IINH 42206 • 8; 63.7533° N, 25.7064° W; detr. sledge (Sneli); depth 365 m; 7.1°C; 35.15 ppt; 11 Sep. 2003; BIOICE 3607; IINH 42207 • 8; 64.2564° N, 26.0536° W; detr. sledge (Sneli); depth 345 m; 6.95°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3613; IINH 42208 • 3; 64.2569° N, 26.0578° W; RP sledge; depth 342 m; 6.95°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3615; IINH 42209 • 4; 64.6761° N, 26.4503° W; detr. sledge (Sneli); depth 269 m; 6.99°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3616; IINH 42210 • 13; 64.67° N, 26.4761° W; RP sledge; depth 270 m; 6.99°C; 35.14 ppt; 12 Sep. 2003; BIOICE 3617; IINH 42211 • 8; 66.4942° N, 9.7556° W; RP sledge; depth 1475 m; -0.78°C; 34.9 ppt; 14 Jul. 2004; BIOICE 3621; IINH 42212 • 6; 66.9967° N, 8.8203° W; RP sledge; depth 1628 m; -0.82°C; 34.9 ppt; 14 Jul. 2004; BIOICE 3624; IINH 42213 • 9; 67.3369° N, 9.5583° W; Agassiz trawl; depth 1616 m; -0.81°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3627; IINH 42214 • 16; 67.3314° N, 9.5544° W; RP sledge; depth 1609 m; -0.81°C; 34.9 ppt; 15 Jul. 2004; BIOICE 3628; IINH 42215 • 13; 67.9378° N, 8.2747° W; RP sledge; depth 1481 m;

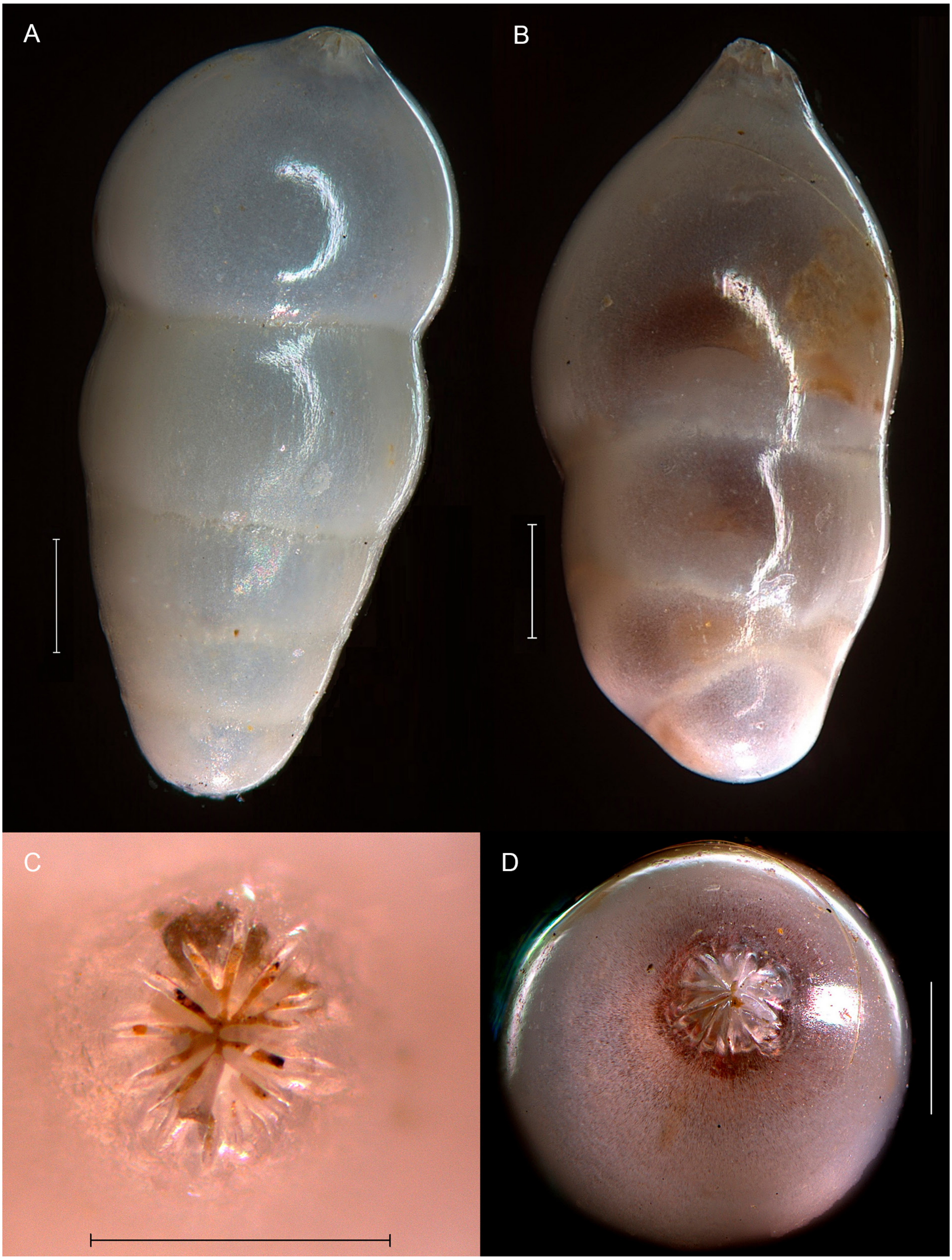

Fig. 15. *Pseudonodosaria subannulata* (Cushman, 1923). **A, C**. Megalosphere (BIOICE 2869, IIHN40054), specimen with nearly horizontal sutures (A) and aperture (C). **B, D**. Megalosphere (BIOICE 2856, IIHN40017), specimen with irregularly slanted sutures (B) and aperture (D). Light source combination of incident light and dark field. Scale bars = 0.25 mm.

-0.84°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3629; IINH 42216 • 6; 68.0256° N, 9.255° W; RP sledge; depth 1727 m; -0.82°C; 34.9 ppt; 16 Jul. 2004; BIOICE 3632; IINH 42217 • 18; 68.42° N, 8.97° W; RP sledge; depth 1952 m; -0.84°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3633; IINH 42218 • 2; 68.8303° N, 9.2436° W; Agassiz trawl; depth 1853 m; -0.81°C; 34.9 ppt; 17 Jul. 2004; BIOICE 3635; IINH 42219 • 20; 66.9856° N, 10.7206° W; RP sledge; depth 1450 m; -0.77°C; 34.92 ppt; 19 Jul. 2004; BIOICE 3641; IINH 42220 • 6; 67.4061° N, 10.6831° W; RP sledge; depth 1703 m; -0.81°C; 34.91 ppt; 21 Jul. 2004; BIOICE 3645; IINH 42221 • 4; 68.9231° N, 12.6275° W; detr. sledge (Sneli); depth 1900 m; -0.81°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3650; IINH 42222 • 11; 69.0667° N, 13.5736° W; RP sledge; depth 1678 m; -0.81°C; 34.9 ppt; 22 Jul. 2004; BIOICE 3652; IINH 42223 • 13; 68.6933° N, 14.3206° W; RP sledge; depth 1489 m; -0.8°C; 34.9 ppt; 23 Jul. 2004; BIOICE 3655; IINH 42224 • 1; 68.005° N, 18.8106° W; RP sledge; depth 1018 m; -0.6°C; 34.9 ppt; 24 Jul. 2004; BIOICE 3658; IINH 42225 • 5; 66.5325° N, 20.9519° W; detr. sledge (Sneli); depth 196 m; 1.98°C; 34.89 ppt; 25 Jul. 2004; BIOICE 3667; IINH 42226.

Description

Test shape elongate to pyriform, nearly straight, short, and somewhat nodular; slightly tapering; initial end rounded. Length of test 0.5–1.5 mm, largest specimen 2.4 mm; test width 0.3–0.8 mm. Chambers sub-globular, diameter increasing rapidly as added, rectilinearly arranged, sometimes in an irregular line; chambers usually strongly embracing; number of chambers 4–6. Sutures horizontal to somewhat irregularly slanted. Aperture radial, central, and slightly raised; radial tines up to 15 of different length, not fused; symmetrically arranged around a central opening. Surface smooth and secondary surface laminations absent. Wall finely perforated and thick.

Remarks

Variation within this species has been noted as varieties A and B (Eiland & Guðmundsson 2004): variety A has embracing rectilinear chambers, where the height of the last chamber may constitute more than half of the test length; whereas the B variety has less embracing chambers, with irregularly slanted sutures. Frequent intermediate forms render distinction between these varieties rather arbitrary. Available material of this species comprised 717 specimens. Diameter of proloculus varies between 0.25–0.40 mm.

Species distributions and environmental parameters

Foraminifera occurred in 879 of the of the 1031 BIOICE zoological samples; consistently in the RP- and detritus sledges (362 and 335 samples, respectively), but only sporadically in the Agassiz trawl and the triangle dredge (95 and 87 samples, respectively), because of the large mesh size of the tail bags. Over 415 000 foraminifera specimens were picked from all samples, with an average of about 470 specimens per sample. The larger species of Nodosariinae were present in 56% (492) of the samples that contained foraminifera, comprising 7598 Nodosariinae specimens, about 1.5% of all picked foraminifera of the BIOICE samples. Most specimens of Nodosariinae were collected with RP- and detritus sledges (271 and 176 samples, respectively), but intermittently in the triangle dredge and the Agassiz trawl (25 and 20 samples, respectively).

The Nodosariinae occur ubiquitously within the sampling area, albeit appearing rather sparsely in the strait between Iceland and Greenland (the Denmark Strait) and along the shallow shelf (< 400 m) between Iceland and the Faroe Islands (Fig. 16A). Most samples of Nodosariinae are from shallow waters (< 500 m) where sampling intensity is highest and have relatively higher occupancy in samples below 1200 m depth (Fig. 16B).

Species richness of Nodosariinae in samples from the RP- and detritus sledges varies from 1–7 species per sample (Fig. 17A) and increased sample occupancy of a species (Fig. 17B) tends to result in higher number of picked specimens for that species (Fig. 17C). All the 14 species occur in more than one sample (no singletons), and only one species (*G. semirugosus*?) is present in two samples (one doubleton). That satisfies the condition of a heuristic stopping rule, i.e., a satisfactory biodiversity sampling is achieved when every species is represented by at least two individuals, or occurs in two samples (no singletons), after which further sampling is superfluous, as estimated species number equals observed species number (Chao *et al.* 2009). Nonparametric estimation of species richness for incidence data (Chao2) indicates negligible probability that further sampling with present methods will reveal more undetected species.

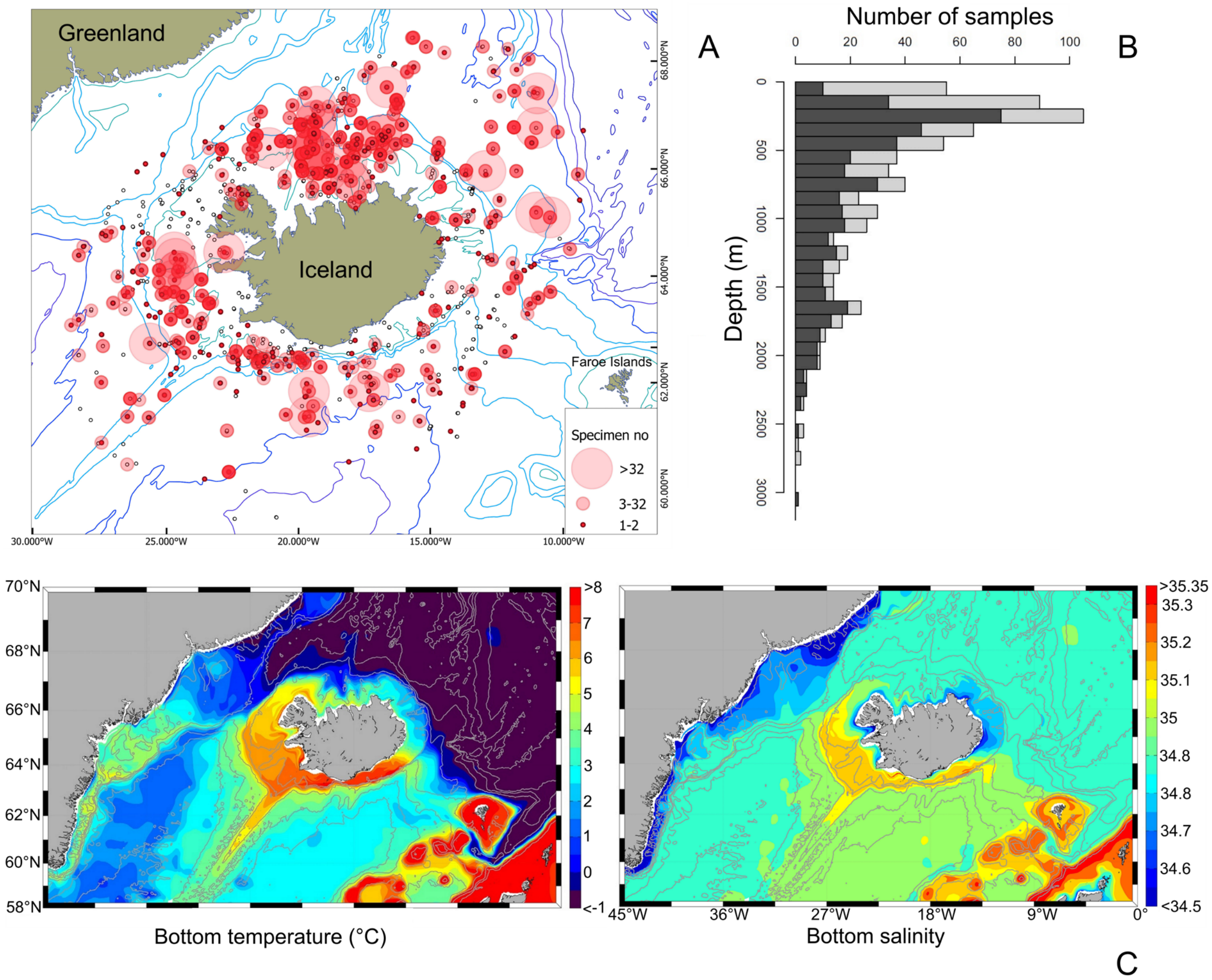

Fig. 16. A. Combined distribution of the 14 species of Nodosariinae Ehrenberg, 1838. Open black circles are locations of BIOICE samples examined for Foraminifera. Red filled circles show occurrence of Nodosariinae as rare (1–2 specimens), frequent (3–32 specimens), and common (>32 specimens); circle area increases proportional to average size of the first two bins i.e., rare (1.5), frequent (15), and common (150). **B**. Depth distribution of BIOICE samples per 100 m depth intervals overlaid with samples containing Nodosariinae in darker grey. **C**. Interpolated gridded mean bottom water properties for the period 1900–2008: temperature (left) and salinity (right). Depth contours are isobaths at 250 m, 500 m, 1000 m, 1500 m, 2000 m, and 3000 m (Jochumsen *et al.* 2016: 81, fig. 2; reproduced with permission from ©Elsevier).

Each of the species occurs within different and overlapping ranges of water depth, temperature, and salinity (Fig. 18). Distributions of the species are variously restricted to only a part of the sampling area (Figs 19–21), which seems to coincide with dispersion of near bottom water temperature and salinity (Fig. 16C). The 2-dimensional NMDS ordination converged with acceptable stress (0.094). The gradient axes were well correlated (Kendall's t = 0.92 and 0.32 for first and second axes, respectively) with an independent analysis by detrended correspondence analysis (DCA; vegan function decorana). Gradient fits between NMDS scores and latitude, longitude, and depth were highly significant (Fig. 22); we could not include temperature and salinity in this analysis due to missing values. The close alignment between latitude and longitude vectors reflect that the main geographical gradient was running diagonally from SE to NW, probably reflecting the distinct water masses on opposite sides of the Greenland-Scotland Ridge (Fig. 16C).

The species of Nodosariine show different distribution patterns. Two species, *G. guttifera* and *D. mutabilis*, are mostly confined to the medium salinity and cooler deep waters south off Iceland, albeit the former occurs also in shallower waters (Figs 18, 19A–B). Two species, *N. haliensis* and *N. incerta* occur mainly in shallow and temperate to cool waters northeast and east of Iceland, the latter with some scattered occurrences south and west off Iceland (Figs 18, 19C–D). The species *D. frobisherensis* and *D. elegans* occur mainly in the deep and shallow waters north and east of Iceland, with scattered occurrences in the more temperate and shallower to deep waters south of Iceland (Figs 18, 19E–F). Three species, *N. subsoluta*, *D. antennula* and *D. antarctica* occur mainly in shallow waters south and west off Iceland (Fig. 20A–C), each occurring within somewhat different ranges of physical variables (Fig. 18). The species *Dentalina obliqua* and *Pseudonodosaria subannulata* are widely dispersed in Icelandic waters (Fig. 20E–F), albeit *P. subannulata* seems more ubiquitous and spans a wider range of physical variables (Fig. 18). The main distribution of *Dentalina filiformis* and *Grigelis pyrula* occur in temperate and shallow waters south and west of Iceland (Figs 18, 21A–B). The distribution of *Grigelis semirugosus*? is known from two locations only (Fig. 20D), leaving little room for further inferences on wider distribution.

Discussion

Aspects of sampling

Taxonomic knowledge of Recent Nodosariinae in the North Atlantic and the Greenland-Iceland-Norwegian seas (GIN) is mainly based on classical publications in the late 19th and the early 20th centuries (Brady 1884; Goës 1894; Cushman 1923; Loeblich & Tappan 1953). These early studies relied mostly on dredging gears that cover wide areas of the sea floor as well as other large-volume samplers, which yielded rich material of Nodosariinae and other large foraminifera. Later and more recent studies on foraminifera in Icelandic waters and nearby seas have focused on quantitative core samplers or smaller grabs (< 0.05 m^2), often processing less than a few hundred cm^3 of sediment through finely gridded (> 63 µm) sieve series (Adams & Frampton 1962; Belanger & Streeter 1980; Sejrup *et al.* 1981; Mackensen *et al.* 1985; Mackensen 1987; Wagener 1988; Rytter *et al.* 2002; Murray 2003; Jennings *et al.* 2004; Bouchet *et al.* 2012). Some of these studies used a standard Shipek grab (Flannagan 1970) with a sampling surface of 0.04 m^2, or smaller subsamples of 0.004 m^2 from large box corers, and indicated that the larger species of Nodosariinae are either absent or very rare (Mackensen 1985, 1987; Rytter *et al.* 2002; Jennings *et al.* 2004). This is expected as the larger foraminifera (> 0.5 mm) rarely appear in a small sample volume of a few cm^3 (Bouchet *et al.* 2012). In addition, studies of macrofauna (> 0.125–0.5 mm) in the North Atlantic and the GIN seas, have often omitted larger foraminifera as a part of the studies, since these are not metazoans (Nørrevang *et al.* 1994; Bluhm *et al.* 2011; Buhl-Mortensen *et al.* 2015).

The rich material of Nodosariinae in the present study was obtained after processing large sample volumes, sometimes several liters. That a large sample volume is needed to detect Nodosariinae may perhaps stem from different dispersion patterns compared to smaller foraminifera. These relatively large foraminifera might be more widely dispersed, possibly occurring in denser aggregation, which in turn may have patchy distribution. Species with such heterogenous dispersion patterns are more effectively collected with samplers that cover large surface areas. During the MAREANO project in Norwegian waters, larger infaunal species (> 0.5 mm) were collected with a large Van Veen grab, that

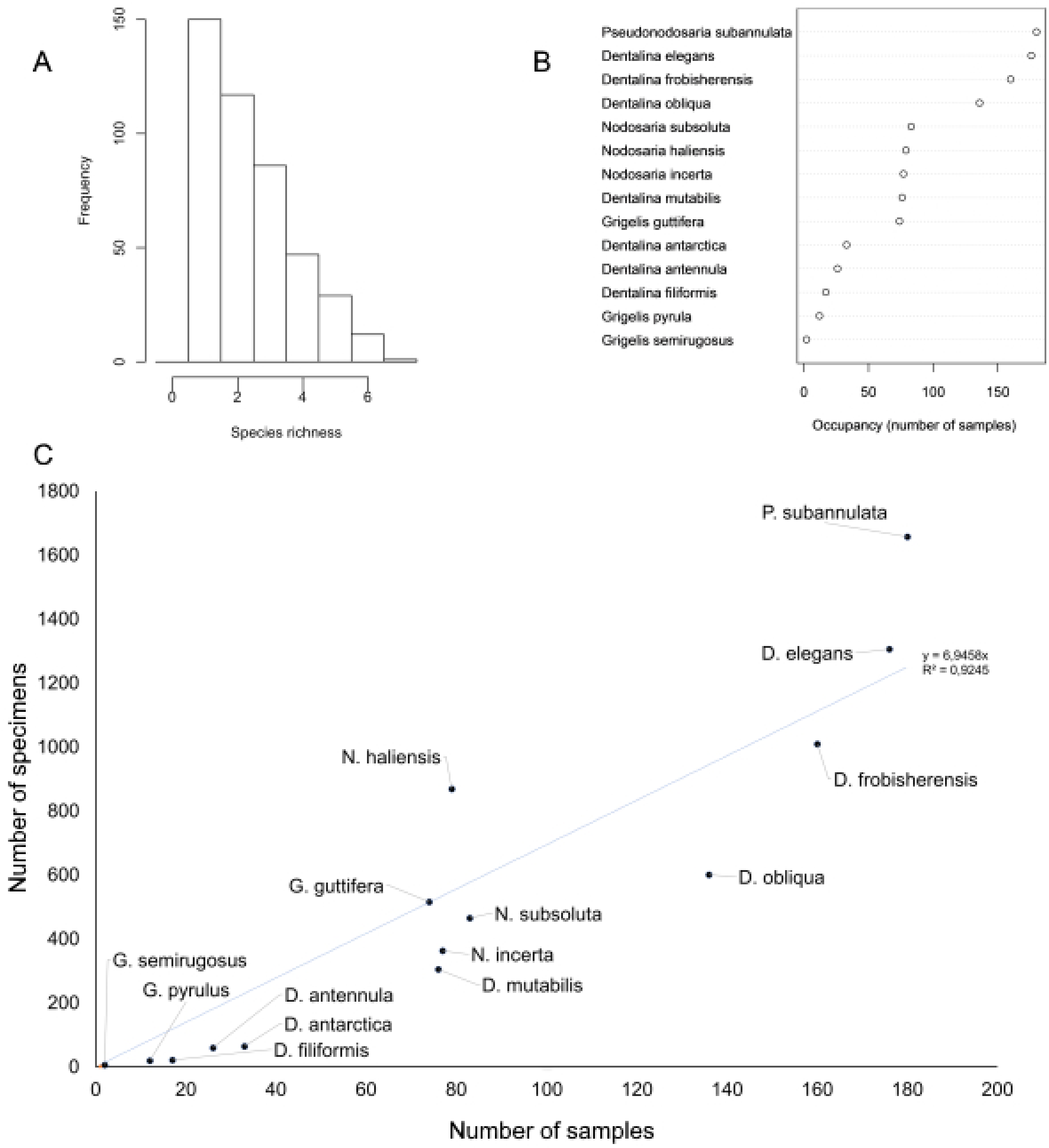

Fig. 17. Division of 7598 specimens among 14 species of Nodosariinae Ehrenberg, 1838, occurring in 447 BIOICE samples collected with RP- and detritus sledges. **A**. Number of samples ranked by number of species present. **B**. Number of samples occupied by each species. **C**. Relation between number of picked specimens of a species (y axis) and the number of samples it occupies (x axis).

cover a sampling area of 0.25 m^2 (Buhl-Mortensen *et al.* 2015) and with a volume capacity of 80 liters. Foraminifera were picked from a few of these samples, along with other macrofaunal taxa which resulted in rich material of Nodosariinae, using the same sorting procedure as for the BIOICE samples. The RP-sledge is designed to sample waters that lie slightly above the bottom (26–59 cm). Nevertheless it also samples the bottom dwelling organisms, as surface sediments are stirred up because a turbulence wave is

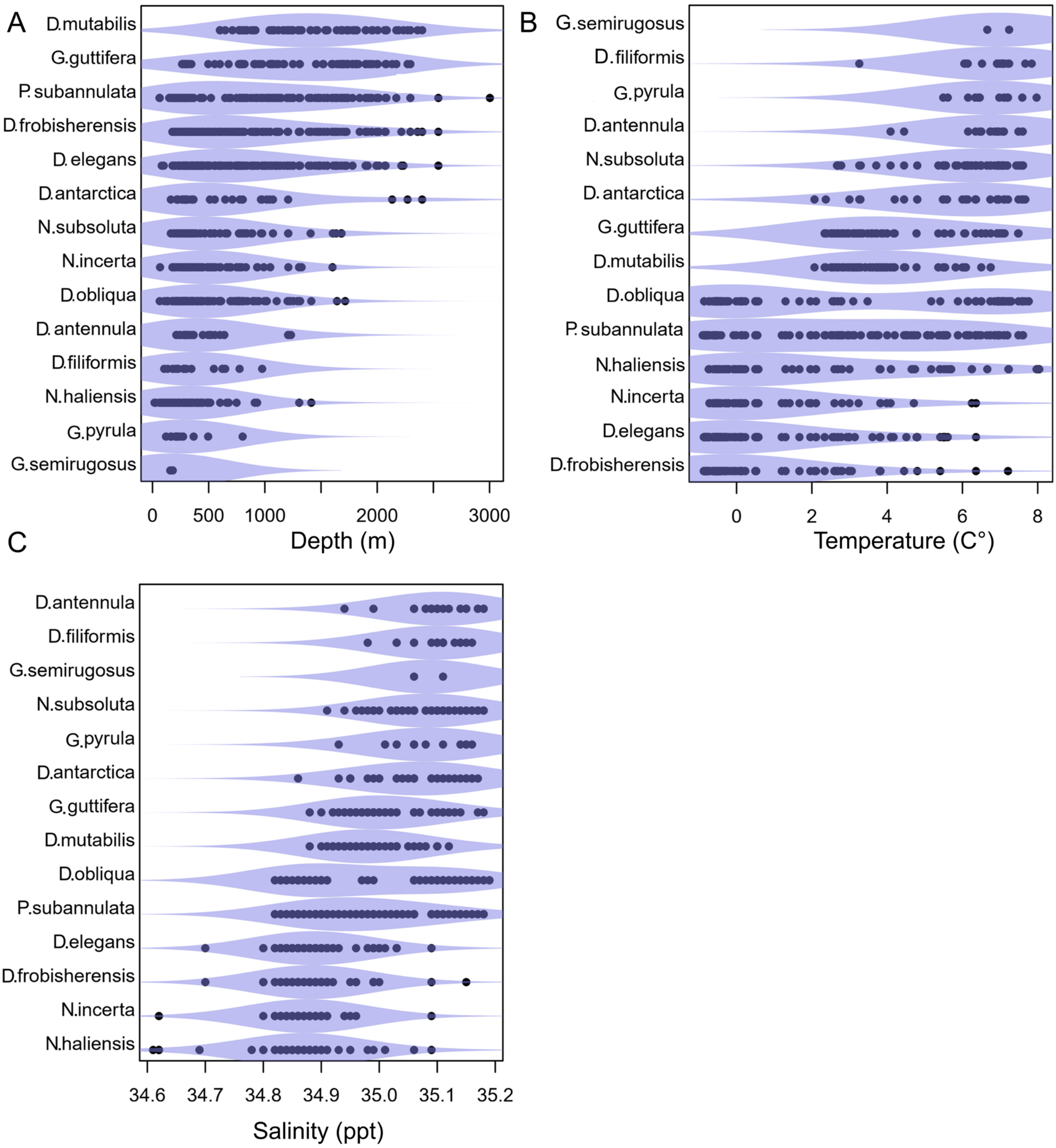

Fig. 18. Kernel density smoothed distribution (violin plots) of species along physical gradients. **A**. Depth (m). **B**. Temperature (°C). **C**. Salinity (ppt); omitted are two outlier salinity records for *N. haliensis* Eiland & Guðmundsson, 2004 (33.98 and 34.34 ppt) and one for *P. subannulata* (Cushman, 1923) (34.3 ppt). Based on BIOICE samples of the RP-epibenthic and detritus sledges.

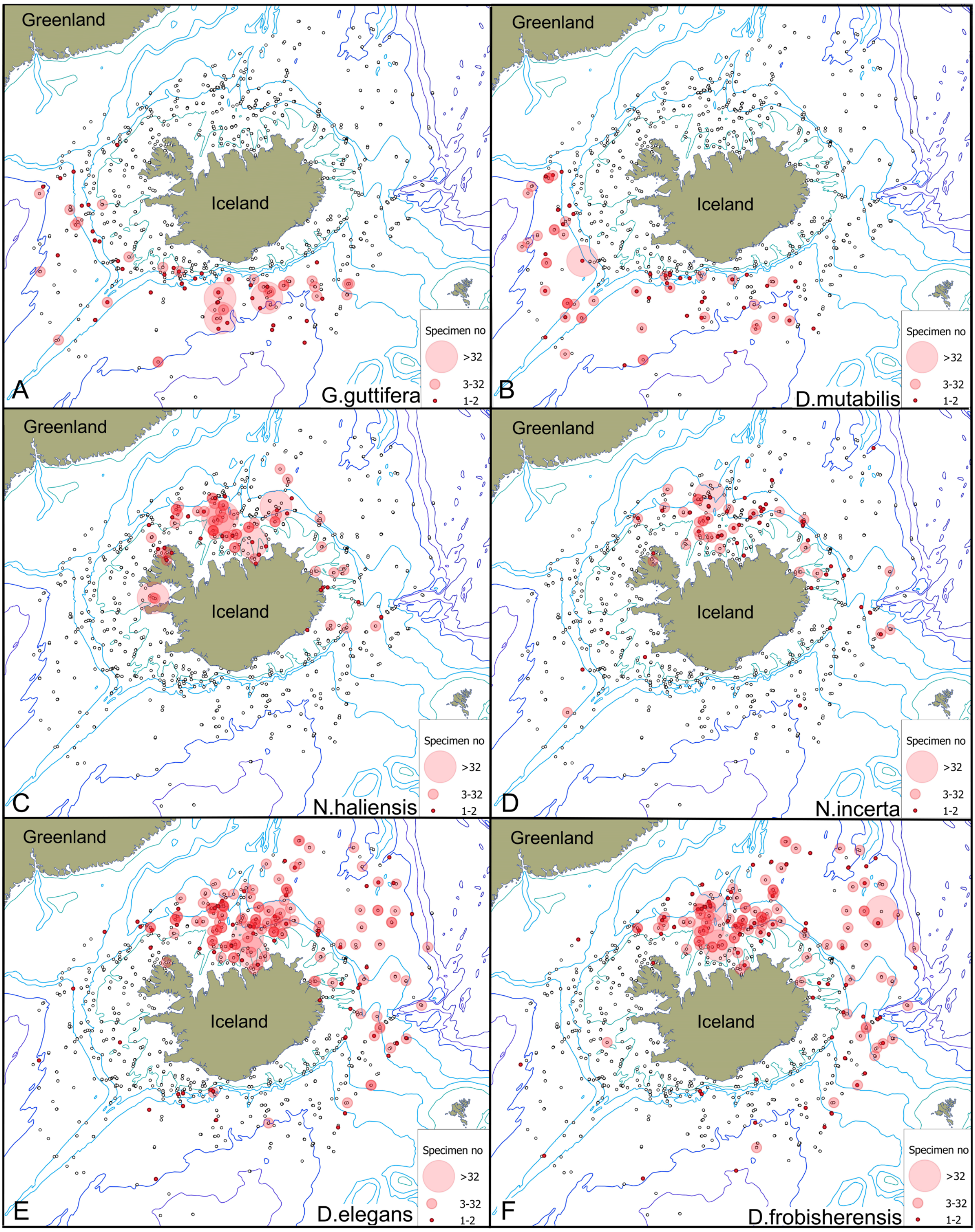

Fig. 19. Species distributions based on BIOICE samples (Icelandic waters). **A**. *Grigelis guttifera* (d'Orbigny, 1846) comb. nov. **B**. *Dentalina mutabilis* (Costa, 1855). **C**. *Nodosaria haliensis* Eiland & Gudmunðsson, 2004. **D**. *Nodosaria incerta* Neugeboren, 1856. **E**. *Dentalina elegans* d'Orbigny, 1846. **F**. *Dentalina frobisherensis* Loeblich & Tappan, 1953.

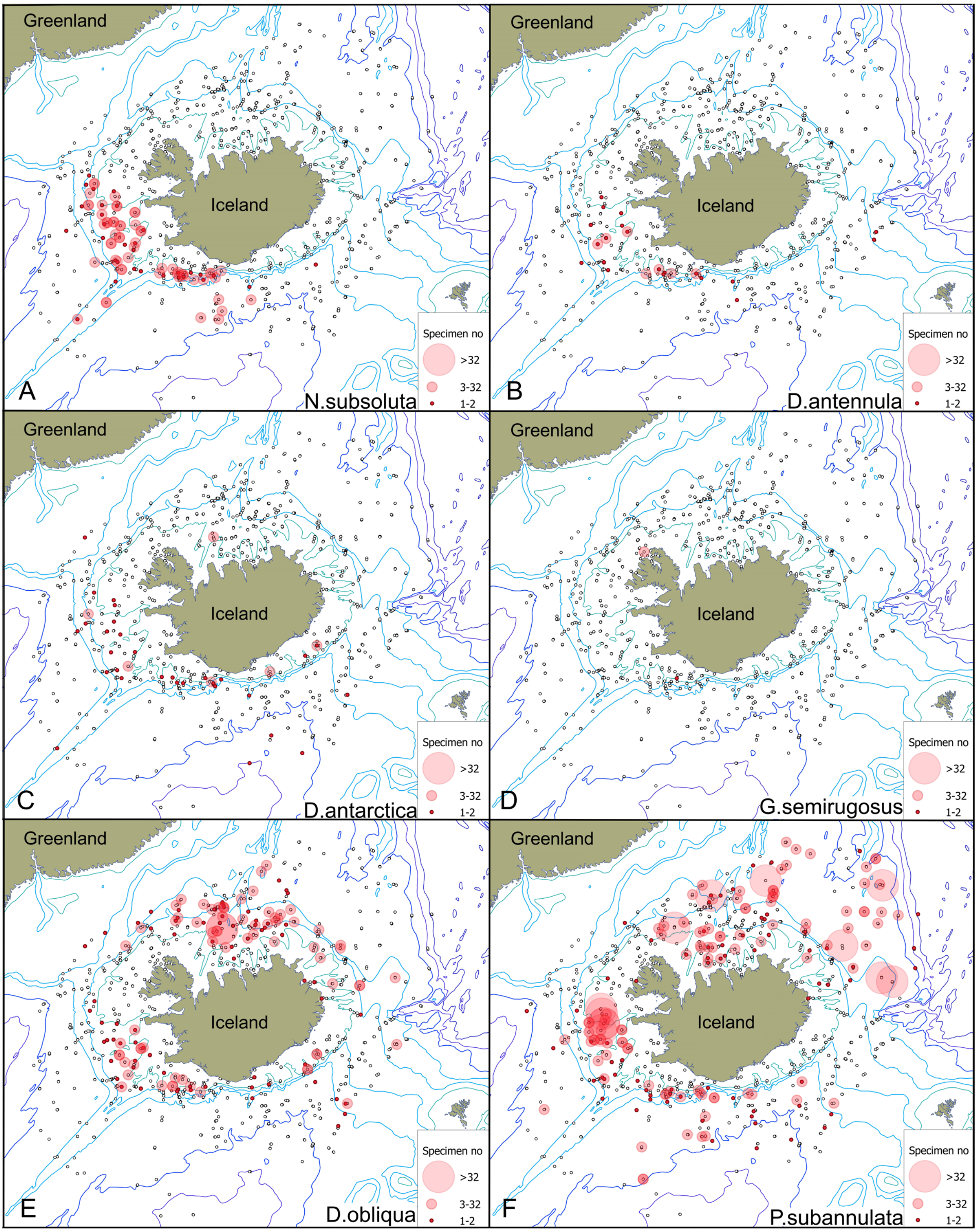

Fig. 20. Species distributions based on BIOICE samples (Icelandic waters). **A**. *Nodosaria subsoluta* Cushman, 1923. **B**. *Dentalina antennula* d'Orbigny, 1846. **C**. *Dentalina antarctica* Parr, 1950. **D**. *Grigelis semirugosus*? (d'Orbigny, 1846). **E**. *Dentalina obliqua* (Linnaeus, 1758). **F**. *Pseudonodosaria subannulata* (Cushman, 1923).

created in front of the sledge, as it is towed along the sea floor (Rothlisberg & Pearcy 1976; Buhl-Jensen 1986; Brattegard & Fosså 1991). In the BIOICE program the RP- and the detritus sledges were routinely towed for about 20 minutes (bottom time) at a speed of one knot (0.5144 m/s), resulting in a potential sampling surface of about 600 m^2 of the sea floor. A closing mechanism of the RP-sledge ensures that it is only open while in contact with the sea floor, with a potential filtering capacity of about 250 m^3 of water, after 20 min towing at 1 knot (Rothlisberg & Pearcy 1976).

Bottom waters and ocean currents off Iceland

The study area encompasses a large part of the GSR which forms a barrier that affects major ocean currents and shapes the physical conditions of the near bottom waters of the North Atlantic. The deep basins north of the GSR in the Nordic Seas, at water depths greater than 600–1200 m, the near bottom water temperature ranges from -0.5°C to -1.5°C with a of low salinity of < 35 ppt. In contrast, the deep-sea basins south of the GSR, near bottom water is more saline (> 35 ppt) with an average temperature around 1°C in the Irminger Basin, and about 2°C in the Iceland Basin (Fig. 16C). As a result, the near-bottom water masses in the deep basins north and south of GSR hold major temperature differences (Hansen & Østerhus 2000; Jochumsen *et al.* 2016).

The cold and dense deep waters north of the GSR flow southward along the sea floor through the deepest sills of the GSR, i.e., in the Faroe-Shetland Trough, the strait between Iceland and the Faroe Islands, and in the Denmark Strait (Fig. 23). These different overflows jointly form a cold overflow bottom water current system, that is directed westward along the southern slopes of the GSR, at about the 1000 m depth contour, and then turn southward as the current reaches the continental slopes east off Greenland and join the overflow branch that falls through the Denmark Strait (Dickson *et al.* 1990; Hansen & Østerhus 2000; Hansen *et al.* 2001). The recently discovered North Icelandic Jet bottom water current (NIJ), centered at the 650 m isobath at the continental slope north off Iceland, is a significant source of dense water to the overflow plume passing through Denmark Strait, and similarly the Iceland-Faroe Slope Jet (IFSJ) adds to the overflow between Iceland and Faroe Islands and to the overflow in the Faroe-Shetland Trough (Jochumsen *et al.* 2017; Semper *et al.* 2019).

The near bottom water temperature and salinity on the Icelandic shelf (< 500 m), and to some extent on the upper parts of the GSR slopes, is largely controlled by near surface currents, i.e., the temperate

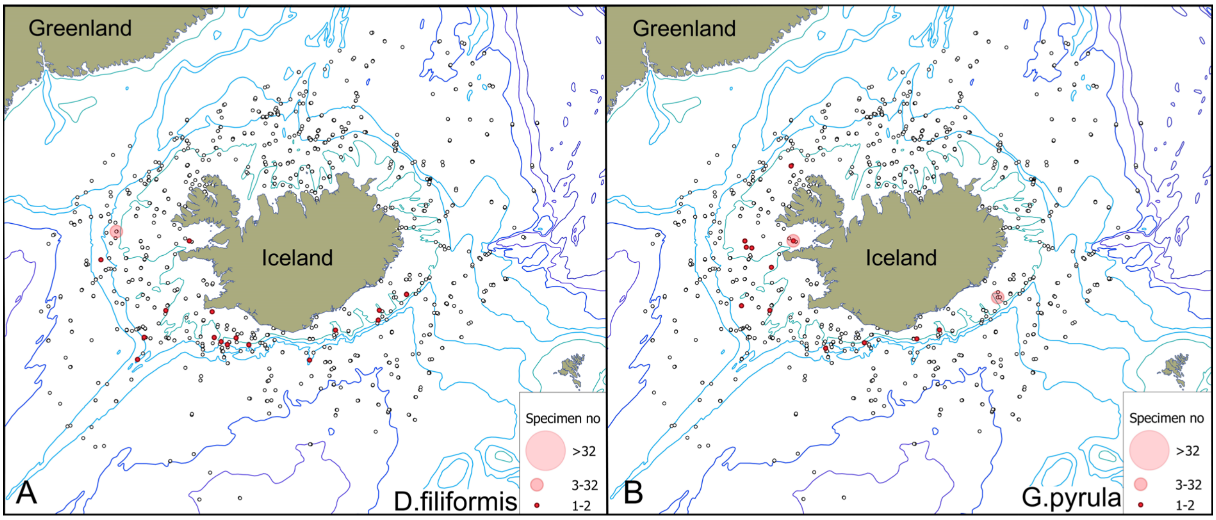

Fig. 21. Species distributions based on BIOICE samples (Icelandic waters). **A**. *Dentalina filiformis* (d'Orbigny, 1826). **B**. *Grigelis pyrula* (d'Orbigny, 1826).

Irminger Current and the cold East Iceland Current, which is a branch off the East Greenland Current (Fig. 23) (Valdimarsson *et al.* 2012; Logemann *et al.* 2013). The annual mean bottom water temperature of the Iceland shelve is highest southwest and south off Iceland (>8°C), where the Irminger Current reaches the Icelandic shelf (Figs 16C, 23). This current gradually cools as it flows westward in a clockwise direction around Iceland until it mixes with the cool East Iceland current (2°C to 3°C) that bathes the northeast and eastern shelve off Iceland. The location where the Irminger current meets the East Iceland and East Greenland currents, known as the Polar Front (Fig. 23), has fluctuated for the last 6000 years (Eiríksson *et al.* 2000; Símonarson *et al.* 2021), and for the last decades the effects of the cold East Iceland Current have diminished, especially at the northeastern part of the shelf (Astthorsson *et al.* 2007). Nevertheless, the East Iceland Current still directs relatively cold waters to the eastern parts of the Icelandic shelf (Stefansson 1962; Stefansson & Jónsdóttir 1974; Hansen 1985; Malmberg 1985; Malmberg & Désert 1999; Eiríksson *et al.* 2000, 2011; Hansen & Østerhus 2000; Jochumsen *et al.* 2016).

Relation of species distributions to water masses and ocean currents

Differences in near bottom water properties associated with the GSR shape the well-known biogeographic boundaries of the benthic faunas of the Boreal and Arctic regions (Einarsson1948; Ekman 1953; Briggs 1970, 1974; G. Guðmundsson 1998; Weisshappel & Svavarsson 1998; Brix & Svavarsson 2010). The overall distributions of the Nodosariinae species seem to follow the steep gradients in hydrographic properties, sea floor elevation, and major sea currents within the study area (Figs 16C, 22–23).

Distributions of eight species seem restricted to the cool and temperate waters at the southern side of the GSR, and without any traces of occurring in the deep cold waters north of the GSR or at northern and eastern parts of the Icelandic shelf, where colder bottom waters are prevalent (Figs 19A–B, 20A, D,

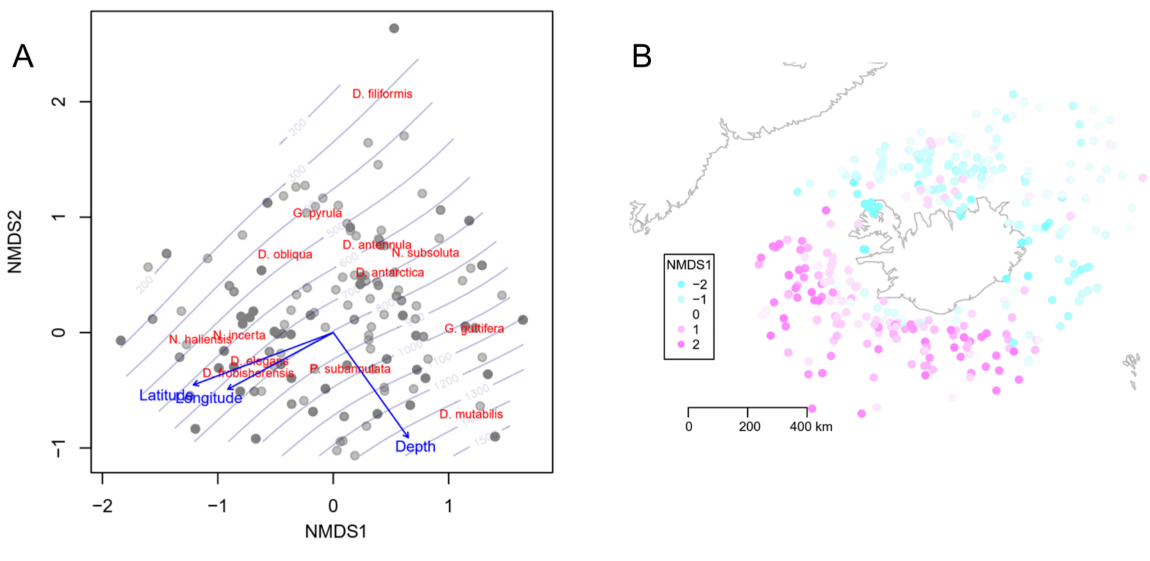

Fig. 22. Results of non-metric multidimensional scaling (NMDS) ordination of community composition based on Bray-Curtis dissimilarities on presence/absence data from BIOICE samples of the RP-epibenthic and detritus sledges. **A**. Ordination plot showing site scores as grey dots and species positions in red. Level curves for depth (pale blue) are fitted to NMDS scores with a generalized additive model (vegan function ordisurf). Blue vectors represent linear effects of environmental gradients in latitude, longitude, and depth fitted with the vegan function envfit. **B**. Map of Icelandic waters with sites colour coded by their scores on the first NMDS axis.

21A–B). Two of these species (*G. guttifera* and *D. mutabilis*) occur mostly in deep waters, whereas six are mainly found in shallower waters (*D. antarctica, D. antennula, D. filiformis, G. pyrula, N. subsoluta, G. semirugosus*?), although the depth distribution of these species overlap to varying degree (Fig. 18A).

Two species, *N. haliensis* and *N. incerta*, occur mainly on the shelf area north and east of Iceland (Fig. 19C–D), where the warmer Irminger current meets the colder East Iceland Current, also known as the Polar Front (Símonarson *et al.* 2021). Both species occur in shallower waters than 1300 m but occur nevertheless over a wide range of temperature and salinity (Fig. 18B–C), covering nearly the whole temperature and salinity spectrum of the greater shelf area around Iceland. That the distribution of these two species is mostly limited to the northern and eastern part of the Icelandic shelf might partly be their tolerance to highly fluctuating oceanographic conditions in this area, which is influenced by interannual variations in influx of Atlantic, Arctic and even Polar water masses (Astthorsson *et al.* 2007). Annual primary production is generally much lower and more variable north and east off Iceland compared to the southern and western shelf areas, or 4.3 and 9.2 mg C^{-1} m^{-3} h^{-1}, respectively (K. Guðmundsson 1998). The lower primary production is partly because of a more stratified water column that prevents adequate

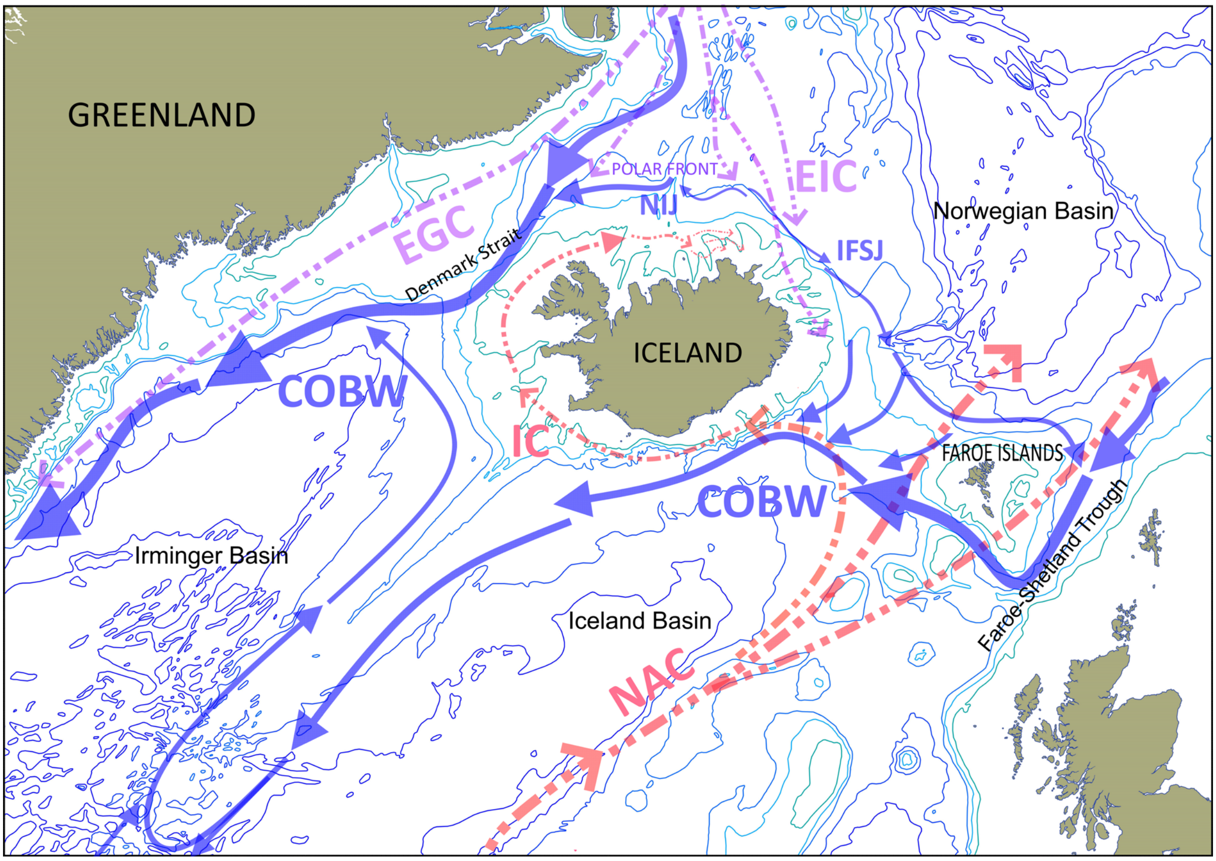

Fig. 23. Simplified scheme of the main sea currents that affect bottom water temperature in the vicinity of Iceland. Surface currents affecting the continental shelf and slopes are symbolized as dotted lines: the cold East Icelandic Current (EIC) and the cold East Greenland Current (EGC), jointly form the Polar Front north off Iceland; the warmer Irminger Current (IC), is a branch of the North Atlantic Current (NAC). Unbroken blue lines, affecting deeper bottom waters (> 500 m): the Cold Overflow Bottom Water currents (COBW), the North Icelandic Jet (NIJ) and the Icelandic-Faroe Slope Jet (IFSJ) (compiled after Valdimarsson *et al*. 2012; Logemann *et al*. 2013; Jochumsen *et al*. 2017; Semper *et al*. 2019; Símonarson *et al*. 2021).

transfer of nutrients to the surface layers. This may, to some degree, shape the benthic habitat type of the north-eastern shelf regions to be more suitable to *N. haliensis* and *N. incerta*.

Two species, *D. obliqua* and *P. subannulata*, are frequent and widely dispersed within the sampling area (Fig. 20E–F), especially *P. subannulata* which occurs within the whole range of depth, temperature and salinity that is spanned by the BIOICE samples (Fig. 18). The apparent high morphologic variation within *P. subannulata*, and wide tolerance limits to physical variables, might indicate that it is a complex of two or more species. *D. obliqua* occurs mainly in shallower waters than 1500 m but with a wide tolerance range for temperature and salinity (Fig. 18), that are characteristic of the Icelandic shelf (Fig. 16C).

The relatively strong overflow current of cold bottom waters from the north and to the southern sides of the GSR may facilitate southward dispersal and sporadic distribution of deep water arctic species, especially for those that have a floating larval stage (Bouchet & Warén 1979). The annual mean core speed of the bottom water current in the Denmark Strait is 25–30 cm s^{-1}, with maximum speed of 100 cm s^{-1} off East Greenland (Dickson *et al.* 1990; Jochumsen *et al.* 2017). The distribution of *D. elegans* and *D. frobisherensis* might be shaped by this overflow current (Fig. 23). The main occurrences of both species are in the subzero waters north and east off Iceland, but with scattered occurrences to the south and west off Iceland (Fig. 19E–F), which might be facilitated by a winnowing and cooling effects of the cold-water overflow currents, and perhaps also providing slightly more favorable environmental conditions at the southern sides of the GSR for cold affinity species like *D. elegans* and *D. frobisherensis* (Fig. 18B). A few specimens of *D. elegans* and *D. frobisherensis*, collected at the southern side of the GSR, may contain traces cytoplasm, indicating that perhaps these northern species can maintain viable breeding populations.

In this study, specimen counts include both living and dead tests, but worn and damaged tests were excluded. That practice is prone to overestimate distributional ranges of living populations, especially for species residing on the shelf and close to steep continental slopes. It has been demonstrated that dead tests of smaller foraminifers are to some degree translocated from the north to the southward side of the GSR, by the winnowing action of the relatively strong overflow currents (Mackensen 1987) and this would also apply to the larger tests of Nodosariinae. Clear patterns of a variety of surface bedforms and related depositional features match the direction and intensity of the cold overflow currents on the southern flanks of the GSR; like obstacle marks, sand ribbons, barchan-like features, dune fields, and asymmetrical channel fillings (Dorn & Werner 1993). The potential sources of these sands lie upstream, including the IFSJ and the NIJ (Fig. 23) which might be translocating sediment runoffs from the several glacial rivers in the north and east off Iceland, and also foraminifera tests, both dead and living.

Other variables affecting species distributions

Apart from temperature, salinity and depth, other environmental parameters may affect the local distribution of the species of Nodosariinae at hand, like sediment characteristics, local influx of particulate organic matter, predation, and competition, as has been suggested for other foraminifers (Svavarsson *et al.* 1993; Guðmundsson *et al.* 2000, 2003; Rytter *et al.* 2002; Jennings *et al.* 2004). Little is known about life habits of the Nodosariinae, nor if the relatively large test has some adaptive significance, perhaps serving as protective case around accumulated reserves of nutrients in the cytoplasm. The function of the peculiar radiate aperture is largely unknown: it might serve as a defence mechanism to keep out predators or parasites from entering the test, similar to what has been suggested for the apertural tooth-plate in *Globobulimina turgida* (Bailey, 1851) (Glock *et al.* 2019); or perhaps radiate apertures serve some purpose in a feeding strategy of burrowing species. A box core sample from 1075 m depth, off Nova Scotia contained living *Pseudonodosaria* sp. with a maximum frequency around 2 cm depth in the sediment (Corliss 1991). The morphology of Nodosariinae shares some of the characteristics that have been associated with a burrowing habit, like circular circumference, rectilinear chamber arrangement and evenly dispersed pores over the test (Corliss 1985). If the species of Nodosariinae have a burrowing habit, then the physicochemical properties of the sediment may significantly affect their distribution, as has been suggested for other infaunal foraminifera (Corliss 1985; Jorissen *et al.* 1995). Nodosariinae are often absent in samples taken in shallower waters, especially in the Denmark Strait, between Iceland and Greenland, and in the sound between Iceland and the Faroe Islands (Fig. 16A), perhaps because the bottom types in these areas consist mainly of coarse sediments and sand (ICES 2019), where strong currents of COBW are prevailing (Fig. 23).

Mean annual primary production is higher in the Atlantic waters off the southern and western shores, than in the more variable waters north and east off Iceland, and it is higher closer to land than farther offshore (Astthorsson *et al*. 2007). This may also contribute to variable occurrence and abundance of the species of Nodosariinae within the sampling area (Fig. 16A), along with effects of predation and competition, although the extent of such relations remains unclear.

Each of the fourteen species of Nodosariinae is present in two or more samples, where *G. semirugosus*? has the lowest incidence, occurring in only two samples and the Chao2 estimator of species richness indicates that further sampling using the present procedure will hardly unveil any undetected species. However, several shallow water species of Nodosariinae that occur in the east and the west Atlantic were not encountered in the present study, although the environmental conditions in these areas resemble those of the Icelandic waters. The species *Dentalina melvillensis* and *Dentalina ittai* (now *Botuloides ittai*) described by Loeblich & Tappan (1953) from shallow waters (< 100 m) off Baffin Island, in Frobisher Bay, and off east Greenland, were not found in the present material. The species *Nodosaria emaciata* (Reuss, 1851) has been recorded in samples from the Barents Sea and in the eastern and the western parts of the North Atlantic, and *Pseudonodosaria aequalis* (Reuss, 1863) has been reported from the Arctic and off Norway, but not from the western side of the Atlantic (Cushman 1923). It seems that these species are absent from Icelandic waters, although the possibility remains that further sampling with different gears and sample processing might unveil these and some other little known Nodosariinae in Icelandic waters.

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