

Xyloredo ingolfia Turner, 1972 (Bivalvia: Xylophagidae) in Icelandic waters

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ABSTRACT. This is the first recent record of *Xyloredo ingolfia* in Icelandic waters, north of the island since its discovery in a sunken drift-wood collected by the “Ingolf” expedition, in North-East Atlantic at 61°30’N-22°30’W in 1896. A comparison is made with the paratypes of that species and with specimens of *Xylophaga* species collected off East Greenland during the “Polarstern” cruise ARK X/1 in 1994.

RESUME. Ceci constitue la première récolte récente de *Xyloredo ingolfia* dans les eaux islandaises, au nord de l’île, depuis sa découverte dans une pièce de bois coulé récoltée durant l’expédition “Ingolf” de 1896 dans l’Atlantique Nord-Est à 61°30’N-22°30’W. Une comparaison de ces spécimens a été effectuée avec les paratypes de l’espèce et avec des spécimens de *Xylophaga* species récoltés au large de la côte est du Groenland durant la croisière ARK X/1 du “Polarstern” en 1994.

INTRODUCTION

Turner (1972) described a new genus of an abyssal wood-boring bivalve: the genus *Xyloredo* Turner, 1972.

This new genus, which looks like a Teredinidae in superficial appearance, is characterized by a burrow with a fine ringed calcareous tube covered externally by a shiny periostracum, by the lack of pallets for closing the burrow and by the lack of apophyses in the internal part of the shell for the attachment of the foot muscle. The presence of mesoplax together with the above characteristics make this a new genus belonging to the sub-family Xylophaginae, recently separated from the Pholadidae and raised to a new family: Xylophagidae (Huber 2015).

Compared to the well-known *Xylophaga* genus, the genus *Xyloredo* possesses extended incurrent and excurrent canals, a thin periostracal sheath extending from the valves to the border of the tube and a long teredinid-like burrow with a calcareous ringed lining.

Three species were described at that time: *Xyloredo nooi* Turner, 1972 (Fig. 3Da) found once in the Bahamas (at 1737 m), *Xyloredo ingolfia* Turner, 1972 (Fig. 3Db) found once South of Iceland (at 1783 m - “Ingolf” expedition, 1896 - Fig. 3E1) and *Xyloredo naceli* Turner, 1972 (Fig. 3Dc) found once along the coast of California (at 2072.6 m). All these species were from deep waters and the genus was considered an abyssal one. These species were fully illustrated in Turner (2002) (Fig. 3D).

Schiøtte (2005) received two teredinid-like valves from Angelika Brandt (Director of the Zoological Museum of the University of Hamburg) coming from the “Polarstern” expedition - cruise ARK X/1-1994 (East coast of Greenland - Fig. 3E3). He concluded that these valves belonged to the genus *Xylophaga*. This was very comprehensible since no tubes were associated with these loose and damaged valves and since the valves of *Xyloredo* are quite similar to the valves of *Xylophaga* if no tube or mesoplax can be seen. In any case he remarked on the inside part of the shell a conspicuous posterior groove making it different from the “true” *Xylophaga*. It could well be that these valves are also of the genus *Xyloredo* (see discussion).

Haga & Kase (2007) assigned *Neoxylophaga teramachii* Taki & Habe, 1950 from Japan to the genus *Xyloredo*: *Xyloredo teramachii* (Taki & Habe, 1950), after having analysed specimens with ringed tubes. This is not yet endorsed by the WoRMS as *Xyloredo*.

Wikander (2008) in a presentation during an international symposium held in connection with the celebration of the 90th birthday of Dr. Jørgen Knudsen (Denmark) reported the presence of specimens of *Xyloredo* sp. (probably *X. ingolfia* as he said) in Narvik (90-40 m in 1980 - Fig. 3E4), and also at Aldersundet (Fig. 3E5), Måløy, Sognefjorden, Osterfjorden, Bergensfjorden, Sørfjorden (Fig. 3E6), localities all situated along the Norwegian coast between 59°N and 68°N and from 40 to 1250 m deep.

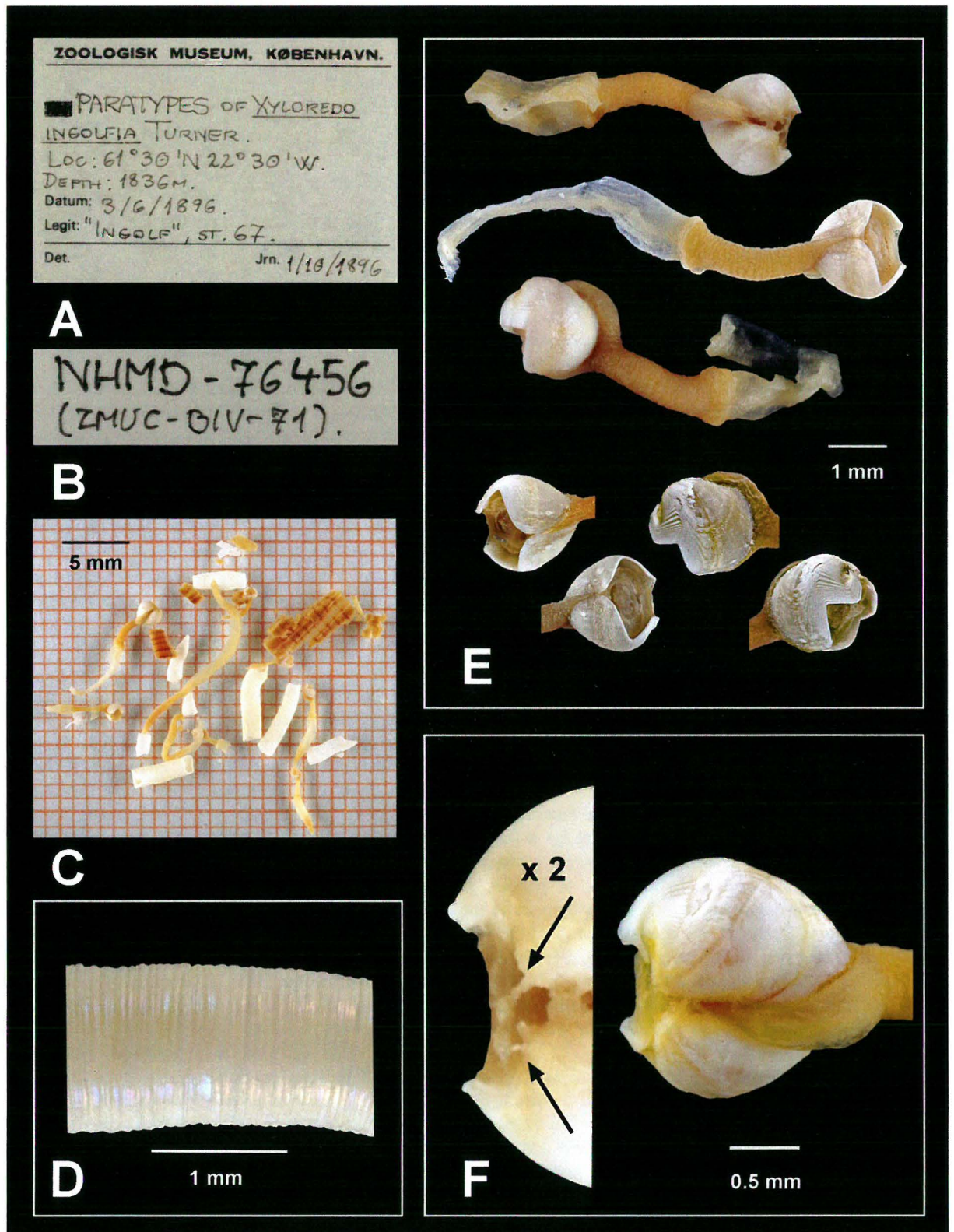


Figure 1

A-F. *Xyloredo ingolfia* Turner, 1972. Paratypes NHMD-76456. A-C. Labels, wood fragments and animals. D. Fragment of tube, diameter 1.2 mm. E. Animal, shell 1.8 mm high, ventral, lateral and dorsal views, total length with soft parts 10.4 mm. F. Shell 1.8 mm, dorsal view, mesoplax see arrows.

No representations allow comparing the different material, but for some findings Wikander observed only ringed calcareous tubes. He concluded that this *Xyloredo* sp. has certainly no abyssal affinities. The largest specimen reaches a length of 6.1 mm.

A publication of de Frias Martins et al. (2009) mentioned the presence of *Xyloredo* sp. in the Azorean Archipelago but examination of the pictures suggests they are specimens of another wood-boring bivalve, most probably belonging to the *Xylophaga* group.

Ockelmann & Dinesen (2011) examined specimens coming from the same material of the "Ingolf" expedition (1896) and determined by Turner as *Xyloredo ingolfia*. They could make some biological observations. A few dwarf specimens are attached to the top of bigger ones. The first small ones are males and the bigger ones are females, all at sexual maturity despite the size. Only the female had a burrow.

Material

Xyloredo. A piece of wood (no determination of the species) (Figs 2A-M) of approximately 25 x 15 cm and 3 cm high collected by the research vessel "Árni Friðriksson" (Marine and Freshwater Research Institute, Reykjavík, Iceland); st. A11-2016-596 (Fig. 3E2); net set 67°2447N-21°3710W at 487 m depth; net hauled 67°2455N-21°4480W at 492 m depth; on 19/10/2016; bottom temperature -0.3 °C. This piece of wood contained numerous ringed tubes and bivalves of different size from 1.1 mm to 4.4 mm high.

Following material was examined for comparison:

- *Xyloredo ingolfia* Turner, 1972, paratypes (Figs 1A-F). The material is deposited at the Natural History Museum, Copenhagen, Denmark and was sent for consultation by Tom Schiøtte at the Royal Belgian Institute of Natural Sciences, Brussels, Belgium. Locality of the samples: 61°30'N-22°30'W (South of Iceland); depth: 975 fathoms 1783 m (1836 m on label); "Ingolf" expedition, st. 67; NHMD-76456; 03/06/1896; bottom temperature 3 °C. The material contains (Fig. 1C) some tiny pieces of wood (pine), fragments of ringed tubes (Fig. 1D) and specimens of *X. ingolfia* with the entire animal. One specimen of 1.8 mm high (shell) was examined. The other specimens have a shell (often broken) of less than one millimeter of length. No empty shells were available for study of the internal part of the valves.

- *Xylophaga* sp. Two worn and damaged valves (Figs 3A-C), one left, one right, coming from the "Polarstern" cruise ARK X/1 - st. 31-09; net set 74°53.52'N-12°35.39'W at 1525 m depth; net hauled 74°53.63'N-12°25.39'W at 1509 m depth; NHMD-205529; 1994. The left valve (3.6 x 3.7 mm) is completely blackened for electron microscopy (SEM pictures - Schiøtte, 2005) (Fig. 3A). The right valve (2.9 x 2.6 mm) in its original state is in very poor condition and lacks some central part (Fig. 3C). These

samples were lent by Tom Schiøtte (Natural History Museum, Copenhagen, Denmark).

RESULTS

The Marine and Freshwater Research Institute of Iceland (MFRI) carries out an annual autumn ground fish survey for stock assessment of the demersal fish stocks, covering the shelf area around Iceland, as well as the deeper parts off the shelf break. On the 19th of October 2016, the research vessel "Árni Friðriksson" during one of its trawls collected a small piece of board which inner part was crowded with ringed calcareous tubes covered by shiny periostracum and containing wood-boring bivalves (Figs 2A-M). This material was kept frozen and then examined dry afterwards. The bivalves in it, still attached in pairs, contained only a few traces of soft parts. There were no pallets to be seen at the end of the tubes. Ringed tubes and absence of pallets excluded the assignation of these bivalves to the Teredinidae but rather to the Xylophagidae, genus *Xyloredo* Turner, 1972.

The *Xyloredo* specimens from North Iceland (Figs 2A-M) are characterized by small *Xylophaga*-like shells, up to 4.4 mm high, more or less as high as large, with a low rounded posterior slope, having (visible for specimens of 1 mm high) a wide golden-brown protoconch (Fig. 2I), by having a mesoplax composed by a thin layer of transparent periostracum including two small stylet-shape calcified parts placed dorsally where the anterior adductor muscle is usually situated (Figs 2E-F - see arrows). There is a fine and transparent periostracum covering the disc and extending to the posterior part of the valves (Fig. 2G - see arrow). The inner part of the shell presents a marked groove separating the disc from the posterior slope (Figs 2C-D - see arrow). The posterior adductor muscle scar is large, broad and elliptical extending almost to the ventral margin of the shell with irregular and marked transverse corrugations (Fig. 2H - see arrow). The corrugated tubes are relatively heavy (diameter up to 4.5 mm), with the rings regularly closed set-up to each other, covered by a fine, tan, iridescent periostracum extending to the end of the tube (Figs 2J-M) which at this place is at the level of the wood surface and gives the impression to be bilobate (Fig. 2B).

DISCUSSION

These samples of *Xyloredo* were compared with specimens coming from the "Ingolf" expedition (South of Iceland) and from one of the "Polarstern" cruises (off East Greenland).

Concerning the comparison with the paratypes coming from the "Ingolf" expedition, all characters described here above, except size (max 2.5 mm for *X. ingolfia*), width/height ratio (shell slightly longer than high for *X. ingolfia*) and internal groove (barely marked in *X. ingolfia*) agree with those of the original description of

X. ingolfia Turner, 1972. Concerning these discrepancies, Turner (1972) herself mentioned the difficulty to determine which character of *Xyloredo* species will prove most stable and useful for taxonomic purposes: "Size in borers, however is often not a reliable taxonomic character and an understanding of the size requires the examination of large series. ... Stenomorphic adults often result from over-crowding or from penetration of an unusually hard substance". In the same vein establishing the width/height ratio on so few and so small individuals can prove to be difficult, even unreliable due to the almost spherical shape of the shell. The same applies to the degree of extension of the internal groove on so small specimens.

We have located the mesoplax on the paratype (1.8 mm), under the cover of mucosal debris situated at the top of the shell (Fig. 1F - see arrows). The mesoplax observed on the specimen collected by the MFRI is paired, long, slightly calcified and quite similar to the one of *Xyloredo teramachii* illustrated by Haga & Kase (2007 - p. 112 fig. 6A-B). This excluded similarity with *X. nooi* which does not have calcified mesoplax but only periostracal mesoplax (Turner 2002). On the internal part of some MFRI specimens the posterior adductor muscle scar is clearly visible. It extends to the ventral margin and bears transverse corrugations (Fig. 2H) while the corresponding muscle scar of *X. nooi* is placed higher in the reflected portion of the posterior slope and is formed of two distinct imprints, the superior one with irregular corrugations and the inferior one with chevron-shaped impressions (Fig. 3Da).

Concerning the comparison with the "Polarstern" specimens, these ones are a little damaged especially at the level of the anterior slope, where the close set of denticulate ridges have partially disappeared and portions of which are still visible on the SEM photography (Fig. 3A). For the rest these valves are entirely comparable to those coming from South of Iceland.

When comparing these three East Atlantic specimens ("Ingolf" paratypes, MFRI and "Polarstern" specimens) with *Xyloredo nacei* Turner, 1972 (Fig. 3Dc) from California, only known by 8 small specimens (1.5 mm), we note Turner's opinion that finds them closely related to *X. ingolfia* from South of

Iceland in particular with respect to width/height ratio with the exception of both anatomical details and a smaller, smooth protoconch which is not the case for our specimens from North Iceland (Fig. 2I).

By these conchological comparative arguments and by the geographical proximity of the different samples observed ("Ingolf", MFRI and "Polarstern") we can reasonably link the shells examined from North Iceland and East Greenland with those from the "Ingolf" expedition to the same species *Xyloredo ingolfia*. The small conchological variations between all specimens do not seem big enough to make different species.

For the specimens of *Xyloredo* sp. reported by Wikander (2008) it should be of interest to have precise descriptions of the shells and tubes to compare them with the Icelandic and Greenlandic specimens.

CONCLUSIONS

Turner (1972) regretted not having large series of individuals from several localities representing all growth stages available for study. Her wishes are here modestly and in part only fulfilled. *Xyloredo* specimens from two additional sites geographically close to the one from which the holotype of *Xyloredo ingolfia* originated were investigated and illustrated. Taking into account the great similarities but also the small differences observed, it seems wise to adopt a conservative approach and to attribute *Xyloredo ingolfia* as the species name for all the samples examined until more material is collected and DNA studies can confirm or invalidate this hypothesis.

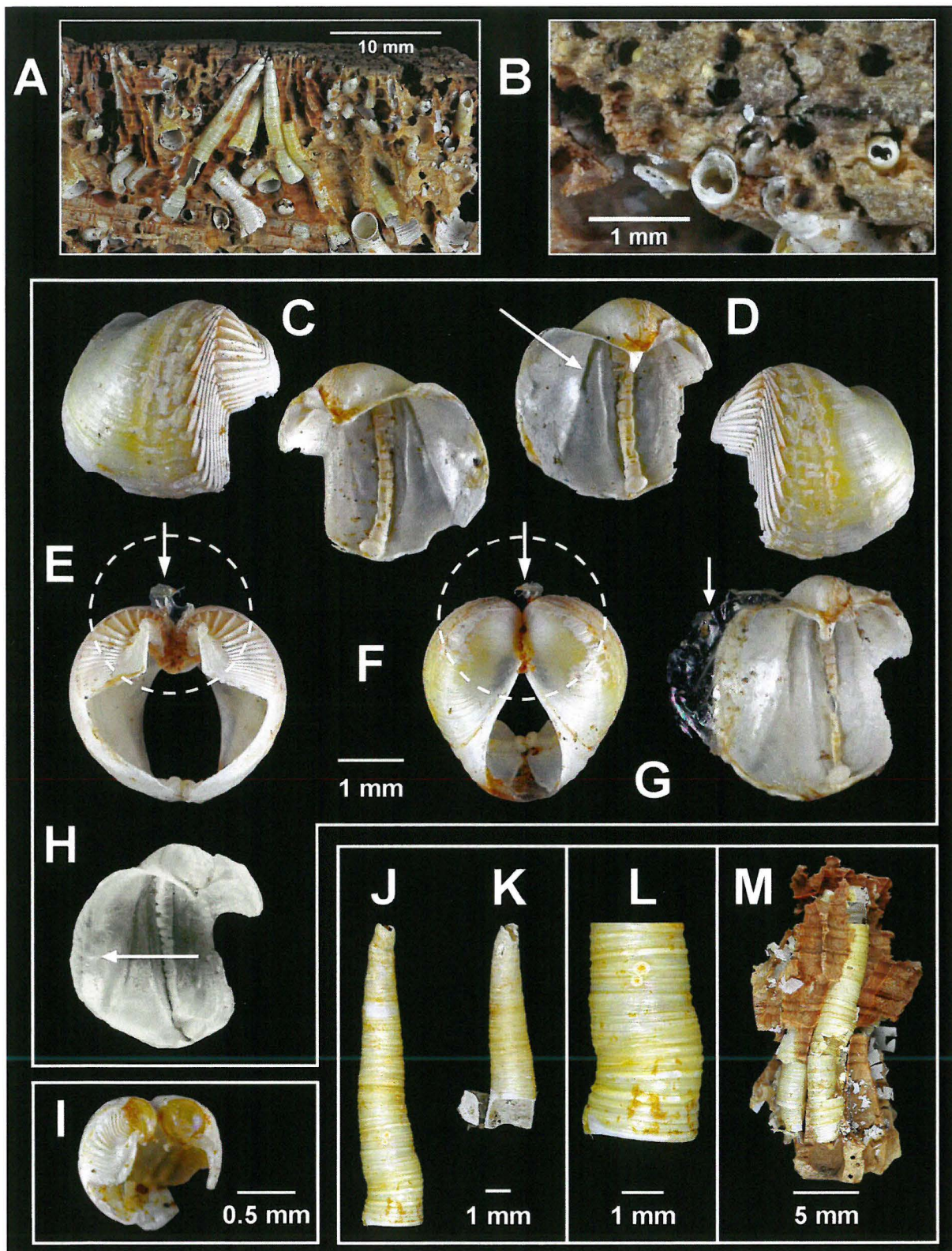
Nevertheless this led to a re-examination of the paratypes of *Xyloredo ingolfia* which for the first time are now the subject of an extended iconography.

The finding of North Iceland offers also the advantages of having in the same sample a series of growth of individuals from 1.1 mm to 4.4 mm together with their tubes in place in the wood (Fig. 2A), but unfortunately only with very few remnants of soft parts.

The number of citations from North and South of Iceland, along East Greenland and possibly along the coasts of Norway gives to *Xyloredo* sp. a large North-East Atlantic distribution (Fig. 3E).

Figure 2

A-M. *Xyloredo ingolfia* material from North Iceland. **A-B.** Fragment (42.0 x 22.0 mm) of the piece of wood. **A.** Cut showing internal view, tubes and burrows. **B.** Surface view showing tubes opening. **C-D.** Specimen 1. 3.3 x 3.2 mm. **C.** Right valve. **D.** Left valve. **E.** Specimen 2. 3.2 mm high, anterior part, frontal view, arrow showing the mesoplax. **F.** Specimen 2. 3.2 mm high, posterior part, frontal view, arrow showing the mesoplax. **G.** Specimen 3. 3.7 x 3.6 mm, left valve, internal view, arrow showing the periostracum. **H.** Specimen 4. 3.2 x 3.1 mm, left valve, internal view, arrow showing posterior adductor muscle scar. **I.** Specimen 5. 1.1 x 1.1 mm, golden-brown protoconch. **J-M.** Portions of tubes. **J.** 12.3 x 2.5 (diameter) mm. **K.** 8.4 x 1.8 (diameter) mm. **L.** Enlarged portion of specimen J. **M.** Fragment of wood (25.0 x 14.0 mm) containing tubes (diameter 2.9 mm).



Originally described from South of Iceland as an abyssal wood-boring Xylophagidae, our bathymetric information combined with those of Wikander (2008) makes the genus *Xyloredo* (and in particular the species *Xyloredo ingolfia*) a genus with a bathymetric distribution wider than only abyssal.

As to the examination of isolated *Xylophaga*-like valves, the presence inside the valves of a groove separating the disc from the posterior slope of the shell would support their assignment to *Xyloredo*.

Finally this piece of wood confirms the presence of *Xyloredo ingolfia* in Icelandic waters and even if the shells it contains have not been able to bring anatomical advances due to the lack of soft parts, they have had the merit of stimulating investigations at the conchological level.

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Figure 3

A-C. *Xylophaga* species. NHMD-205529 "Polarstern" cruise ARK X/1. A. Isolated left valve 3.6 x 3.7 mm, copyright Natural History Museum of Denmark, ex. Schiøtte (2005). B. Labels. C. Isolated right valve 2.9 x 2.6 mm.

Da-c. *Xyloredo* species described by Turner (1972). a. *Xyloredo nooi*. b. *Xyloredo ingolfia*. c. *Xyloredo naceli*. Drawings reproduced and adapted from Turner (2002). E. Map location of North-East Atlantic specimens of *Xyloredo*. 1-3. Material examined. 1. "Ingolf" expedition. 2. MFRI sample. 3. "Polarstern" cruise. 4-6. Material from literature (Wikander 2008). 4. Narvik (N). 5. Aldersundet (N). 6. Måløy, Sognefjorden, Osterfjorden, Bergensfjorden, Sørffjorden (N).

