

A new genus of a soft coral of the family Xeniidae (Cnidaria: Octocorallia) from Japan

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Abstract A survey of octocorals belonging to the family Xeniidae collected from the coral reefs of the Ryukyu Archipelago (Japan) revealed colonies with distinct sclerites whose microstructure justifies the establishment of a new genus, *Yamazatum*. A new species, *Y. iubatum* has been assigned to it and is described and depicted. Its features include unique sclerites with previously undocumented surface architecture, comprising of one or several crests and occasionally one or several furrows, differentiating it from all known species of the family Xeniidae.

Keywords Cnidaria, Octocorallia, Alcyonacea, Xeniidae, *Yamazatum*, new genus, Japan, coral reefs

Introduction

Systematic studies on octocorals of Japan have been reviewed by Imahara (1996). Members of the family Xeniidae from Japan have been studied by Utinomi (1950, 1954, 1955, 1958, 1977), Imahara (1991) and Benayahu (1995). During the years 1991–2005 several field trips were carried out to the coral reefs of the Ryukyu Archipelago (Japan) and a comprehensive octocoral survey was conducted. A large number of xeniids were collected dur-

ing these trips, from the reefs of Okinoerabu Is. in the north (27°23'N) to Yonaguni Is. in the south (24°26'N). The results of these surveys have already been published in part (Benayahu 1995, 2002; Ofwegen and Benayahu 2006). Low-power examination of the sclerites of some colonies indicated the presence of sclerites with a previously undocumented surface microstructure. Scanning electron microscopy (SEM) has proven to be a useful tool for examining sclerites of Xeniidae species and for their identification (e.g., Benayahu 1990; Reinicke 1997; Alderslade 2001; Janes 2008), and in this case revealed the unique microstructure of the sclerites. Consequently a new genus, *Yamazatum*, is described and depicted below, along with the species, *Y. iubatum* (Fig. 1), that has been assigned to it.

Materials and methods

During the survey the reef sites were reached by boat and a careful examination of a variety of niches was carried out by scuba diving to a maximal depth of 35 m. The collection sites of the currently described new genus are presented in Fig. 2. Prior to collection some of the colonies were photographed *in situ*. The materials were fixed in 4% formalin in seawater, rinsed carefully in fresh

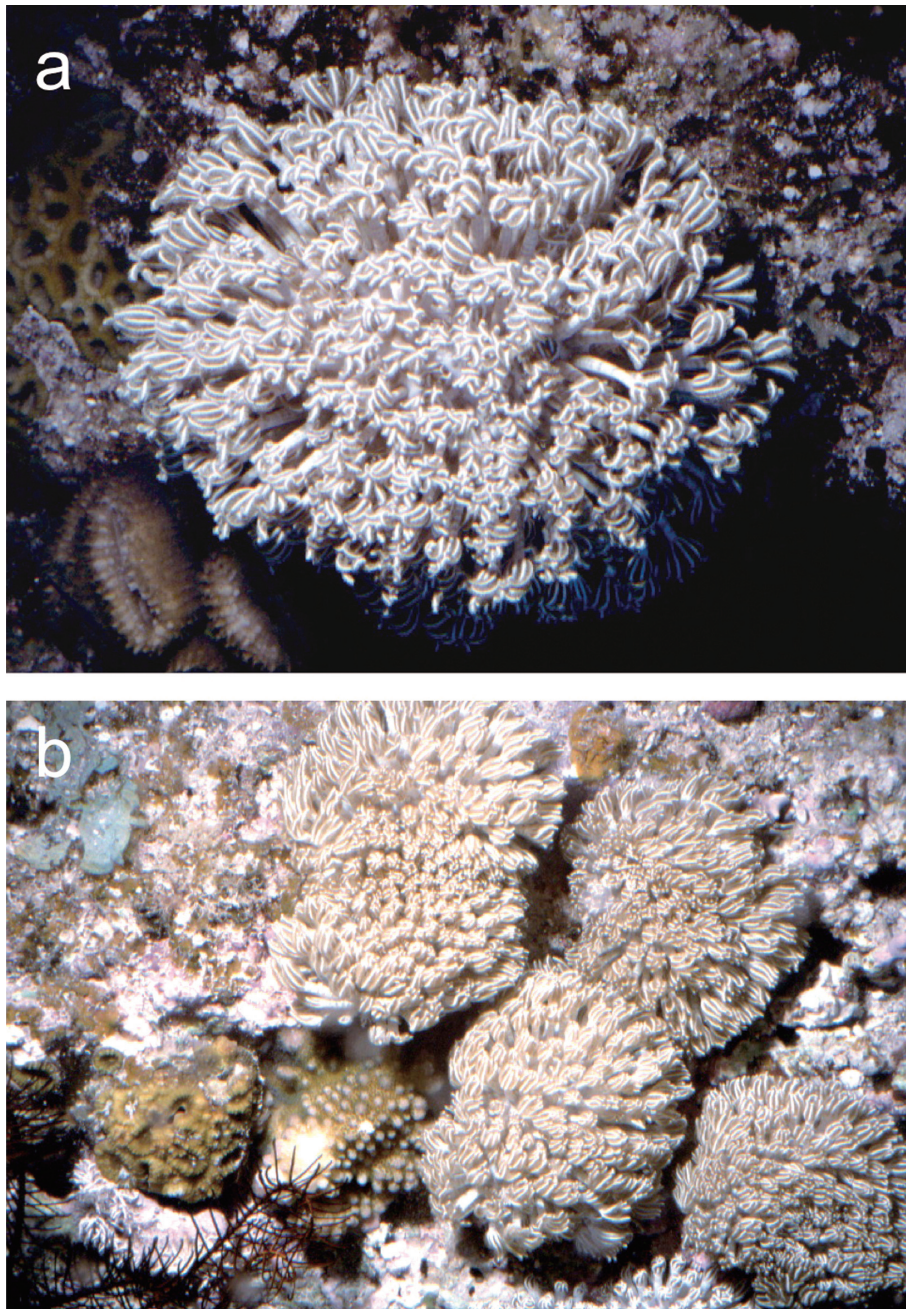


Fig. 1 Underwater photographs of *Yamazatum iubatum* gen. nov. & spec. nov.

water after 24 hours, and then transferred to 70% ethyl alcohol. In the laboratory, sclerites were examined from the polyps, the surface layer of the stalk and its interior. Pieces from the respective parts were separately placed in Eppendorf tubes filled with 10% sodium hypochlorite. After 30 minutes the organic debris and supernatant were carefully discarded and the sclerites remained at the bottom of the tubes. Fresh sodium hypochlorite was added

and the process was repeated followed by repeated rinses with distilled water (4–5 times) in order to remove any remaining hypochlorite or debris. The clean sclerites that were left at the bottom of the tubes were then removed by syringe and filtered through a Millipore filter, dried at room temperature, glued to the SEM stubs, coated with gold, and examined with a Jeol 840A electron microscope operated at 25 kV. The holotype is deposited in the

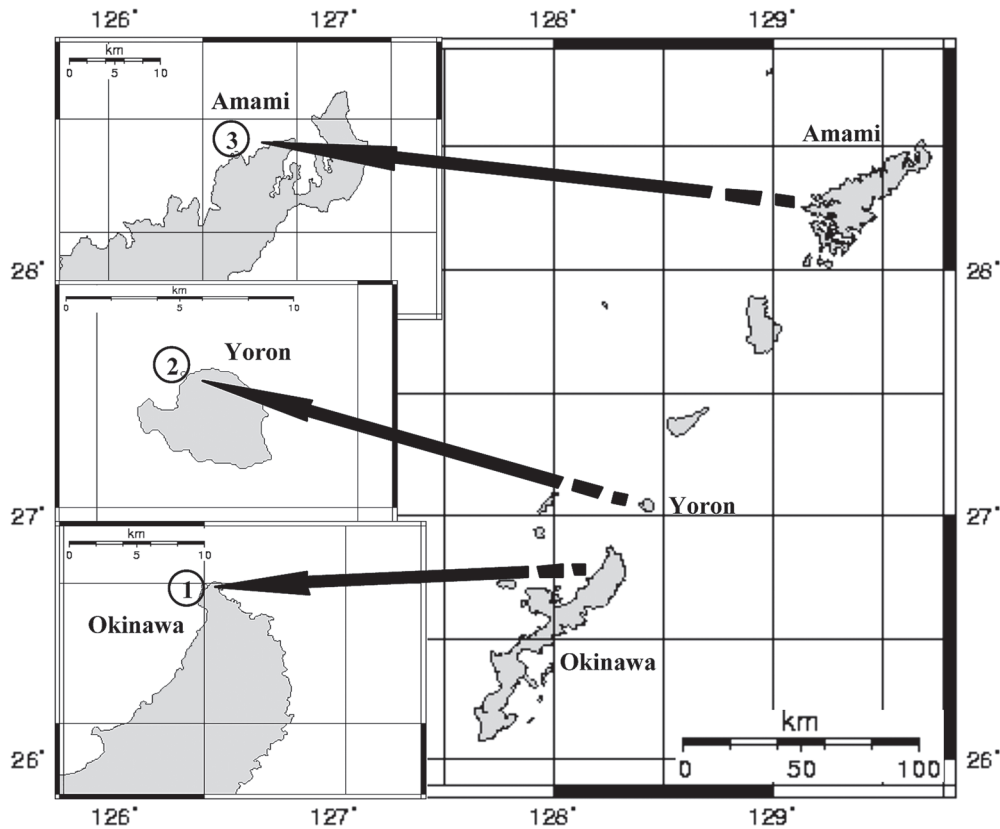


Fig. 2 Map of the collection sites of *Yamazatum iubatum* gen. nov. & spec. nov. in Japan

Zoological Museum, Department of Zoology, Tel Aviv University, Israel (ZMTAU). The paratypes are deposited at ZMTAU and at the Netherlands Center for Biodiversity, Naturalis, formerly the Nationaal Natuurhistorisch Museum, Leiden, Netherlands (RMNH).

Systematic part

Family Xenidiidae Wright and Studer, 1889

Yamazatum, new genus

Type species: Yamazatum iubatum, new species, by monotypy.

Diagnosis

Capitate xenidiids with non-retractile monomorphic polyps arising from a firm dome-shaped capitulum. The stalk is cylindrical, or laterally compressed. There are four major sclerite forms, as confirmed by SEM examination.

The first form is that of simple platelets or spheroids which are found in relatively large amounts in the polyps and less so in the surface layer and interior of the stalk. Under a light microscope these sclerites appear as the mostly typical *Xenia*-style platelets or spheroids (see Alderslade 2001). The second form consists in sclerites that are narrower across the middle, including transitional forms to those with a waist or even a double-head. The double heads are more common in the surface of the stalk. The third form features one or several crests and occasionally a furrow or several ones on the sclerite surface, that may form a compound architecture, and these occur in large numbers in the interior of the stalk, and to a lesser extent in the other parts of the colonies. The fourth form is that of short, cigar-shaped sclerites which are rather rare and found only in the surface layer of the stalk. The surface of the sclerites resembles the microstructure of *Xenia* sclerites (see Alderslade 2001), being constructed of radially arranged dendritic rods, the tips of which give the sclerite's surface its characteristic papillate appearance.

Colonies are zooxanthellate.

Etymology

The genus name (neuter) is after the late Prof. Kiyoshi Yamazato, a prominent coral reef researcher and founder of the Japanese Coral Reef Society, honoring him for his inspiration and initiative to study the octocorals of the Ryukyu Archipelago.

Remarks

The colony form is similar to *Xenia* and *Ovabunda*, featuring a distinct stalk, monomorphic polyps (with multiple rows of pinnules) that arise from a capitulum, and *Xenia*-style sclerites, thus justifying assigning the new genus to the family Xenidiidae (see also Alderslade 2001). The compound surface architecture of the sclerites, with a crest or combination of crests and furrows, has not been previously described in this family, nor have the double heads. Therefore, creation of the new genus, *Yamazatum*, was necessary in order to accommodate the currently examined xeniid material from the Ryukyu Archipelago.

Yamazatum iubatum spec. nov.

Material

Holotype. ZMTAU Co 34531, Ryukyu Archipelago, Okinawa, Japan, 26°52'29"N 128°15'06"E, 8–12 m, 2 July 2000. Paratypes: ZMTAU Co 31686, Ryukyu Archipelago, Okinawa, Japan, 26°52'29"N 128°15'06"E, depth 8–12 m, 2 July 2000 (2 colonies); ZMTAU Co 31680, Ryukyu Archipelago Okinawa, Yoron Is. Japan, 27°04'36"N 128°25'33"E, depth 14–16 m, 1 July 2000 (3 colonies); ZMTAU Co 31683, Ryukyu Archipelago Okinawa, Yoron Is. Japan, 27°04'36"N 128°25'33"E, depth 14–16 m, 1 July 2000 (3 colonies); ZMTAU Co 31679, Ryukyu Archipelago Okinawa, Amami Is. Japan 28°27.641'N 129°32.699'E depth 27 m, 15 July 2000 (4 colonies); RMNH Coel. 39660, Ryukyu Archipelago Okinawa, Amami Is. Japan, 28°27.641'N 129°32.699'E, depth 27 m, 15 July 2000.

Description

The holotype (Fig. 3a) has a *Xenia*-style growth form (see Alderslade 2001), featuring a distinct stalk (35 mm

tall) with an oval base of attachment to the substrate measuring 45×20 mm. The outer surface of the stalk is beige and the interior is brown-red. The tentacles are beige-gray and the body of the polyps, especially towards their base, has a brownish tint. The polypary is 60×45 mm in cross-section. The polyps vary in the extent of contractility, as also indicated by some presence of transverse contractions, annuli-like, along some of the polyps. The anthocodia are up to 9 mm in length and the tentacles are 4–9 mm long. The pinnules appear to be arranged mostly in three rows along each edge of the tentacles, leaving a free median space along its oral side, which is not always discernible at the distal part of the longest tentacles. In the middle of some of the longest tentacles, a fourth row may exist, but in some cases this is difficult to ascertain. Towards the base of the tentacle the number of rows of pinnules drops to two, and occasionally only a single row can be seen. The outermost row usually contains 30–42 pinnules, but in the longest tentacles it can contain ~60 pinnules, at a best estimate.

The sclerites of the polyps are platelets or spheroids, which are very densely placed, mainly in the distal pinnules. Under a light microscope three main forms of sclerites are noticed; the vast majority is brown-red, many are terracotta-like in color (Fig. 4), and some are colorless. Their microstructural features are further illustrated by SEM (Figs. 5, 6). In the polyps the common sclerites are simple platelets and spheroids, about 0.020 to 0.030 mm long and 0.014 to 0.020 mm wide (Figs. 4, 5a). Others have a slight medial narrowing, and are up to 0.030 mm long and 0.025 mm wide (Fig. 5b). Some others have a conspicuous crest (Figs. 4, 5c) or crests (Fig. 5d) on their surface, and are about 0.020 to 0.030 mm long and 0.015 to 0.020 mm wide. The latter sclerite form can feature a compound surface-architecture, resulting from multiple numbers of crests (Fig. 5d). The papillate surface of the sclerites is formed from the tips of rods that construct the sclerites (Fig. 6a). Cross-sections of sclerites reveal their internal radial dendritic rods (Fig. 6b), arising from a center which is comprised of loosely placed, randomly oriented rods (Fig. 6b, c).

The surface layer of the stalk has similar forms of sclerites as in the polyps, but their relative abundances are different and, in addition, some have a short cigar-shape.

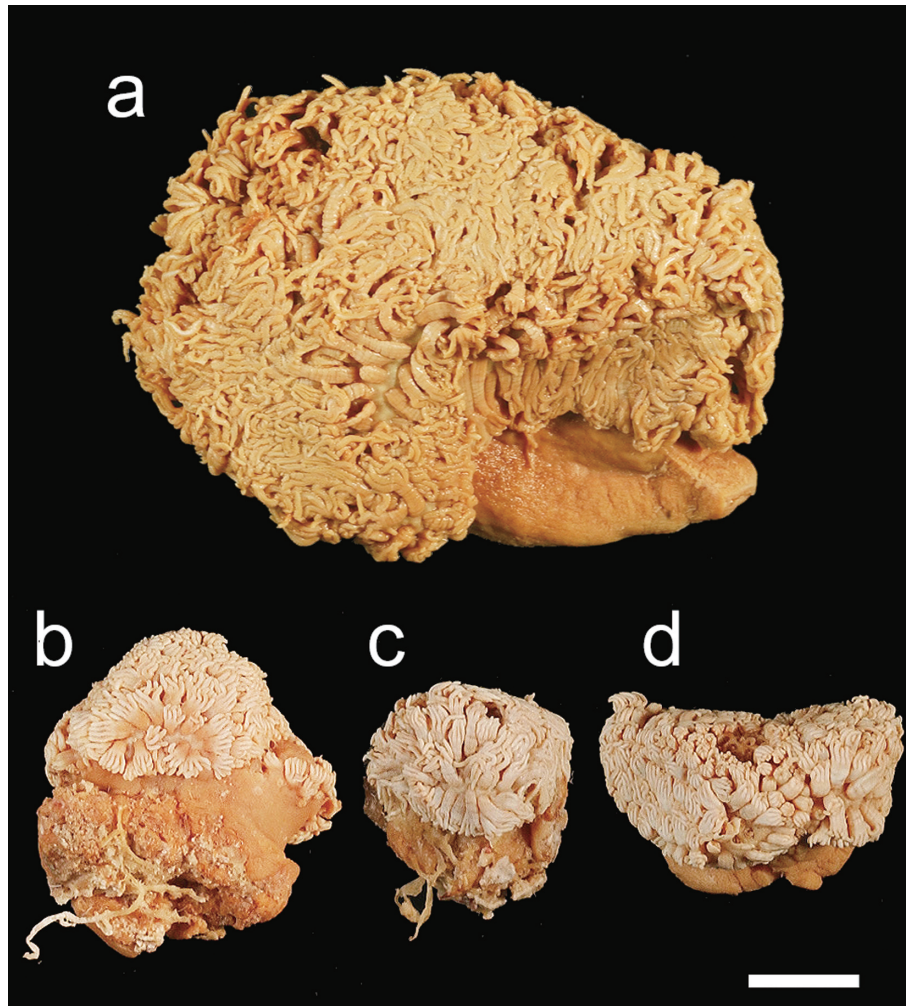


Fig. 3 Fixed specimens of *Yamazatum iubatum* gen. nov. & spec. nov. **a** holotype ZMTAU Co 34531; **b-d** paratypes ZMTAU Co 31683. Scale=10 mm

Under a light microscope the stalk surface sclerites appear mostly colorless and some are light brown (Fig. 7). There are only a few simple platelets and spheroids, up to 0.025 mm long (Figs. 7, 8a). Light microscopy reveals that most of them are medially narrowed (Fig. 7). SEM confirms this and further reveals a variation of the medial narrowing, ranging from a slight one to circumferential waist, the latter being transitional to double-head forms (Fig. 8b). These sclerites are about 0.020 to 0.030 mm long and 0.010 to 0.020 mm wide. There are also some elongated sclerites which are short, cigar-shaped, up to 0.030 mm long and about 0.010 mm wide (Figs. 7, 8c). Some of the sclerites feature crests on their surface and occasionally also have one or more furrows thus, displaying a compound and irregular surface architecture (Fig. 9). These sclerites

are 0.022 to 0.026 mm long and up to 0.023 mm wide.

Under a light microscope, the sclerites of the interior of the stalk resemble those in the stalk-surface, with some featuring irregular surface architecture (Fig. 10). There are only a few simple spheroids (Fig. 11a), other spheroids with a waist (Fig. 11b) and are up to 0.028 mm long. The most common of these sclerites reveal a compound surface-architecture (Fig. 12a, b), comprised of a crest or several crests, and occasionally also a furrow (Fig. 12b) or even furrows. These sclerites are about 0.014 to 0.026 mm long and 0.011 to 0.020 mm wide. Notably, when a single crest is found on the surface of the sclerite, it can be positioned longitudinally, transversely or in any other intermediate state.

Living features. The polyps are gray to light beige (Fig. 1)

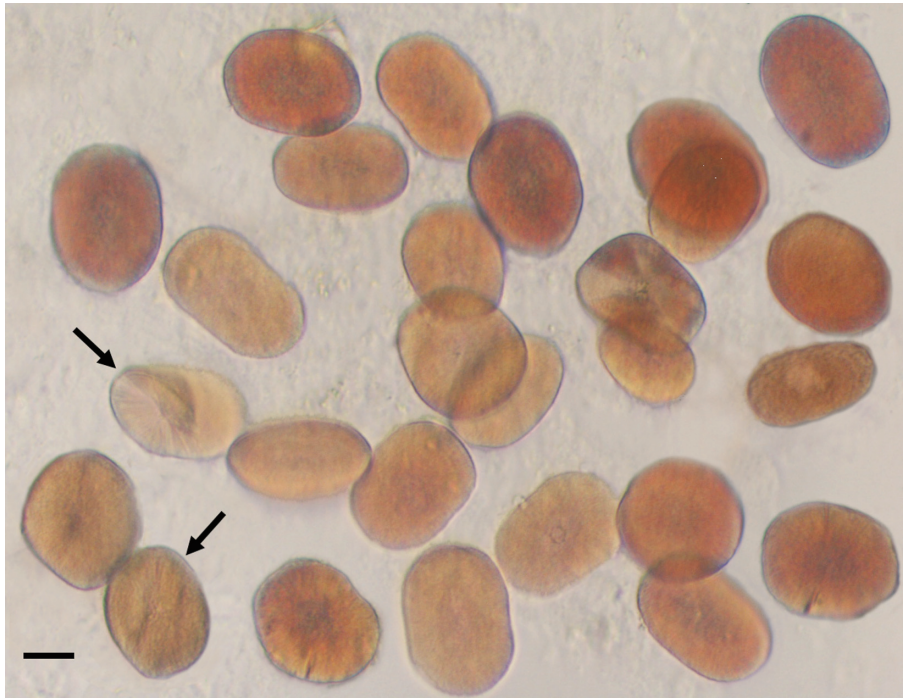


Fig. 4 Light microscope images of polyp sclerites of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. Arrows indicate sclerites with crest. Scale=0.010 mm

and the stalk is a little darker. The colonies are quite small, mostly no more than 35–50 mm in diameter.

Variation. The preserved paratypes differ in size (Fig. 3b-d) and in the color of their polyps, which are slightly brighter compared to the holotype (Fig. 3a). The coloration of the fleshy interior of the stalk of the paratypes ranges from light brown to dark terracotta-like. Sclerite form and size range are consistent throughout all colonies. None of the paratypes has a branched stalk.

Etymology. The Latin “iubatam” (neuter), crest, refers to the crests that appear on the surface of the sclerites.

Remarks

Assigning the new genus *Yamazatum* to the family Xenidiidae is based on the morphological features of the colonies and their sclerites. Its colony form resembles that found in other monomorphic xenidiids with a stalk and a domed polyp-bearing region (Figs. 1, 3; Alderslade 2001). Within this family the simple platelets of *Yamazatum* n. gen. (Figs. 4, 5a) are common and have been previously recorded, also by SEM, in the genera *Heteroxenia* K lliker, 1874; *Xenia* Lamarck, 1816 (see Alderslade 2001) and *Symphodium* Ehrenberg, 1834 (see Reinicke 1997). Simi-

larly, those that are narrower medially (Figs. 5b, 8b) have been noted in *Heteroxenia* and *Sansibia* (Alderslade, 2000) (see Fabricius and Alderslade 2001, p. 140 and 150 respectively) as well as for *Ingotia* Alderslade, 2001 and *Ixion* Alderslade, 2001. Sclerites that feature a waist or double-heads, as found in *Yamazatum* n. gen. (Figs. 7, 8b, 11b), previous to the current study, were not described for xenidiids and thus are considered to be diagnostic for that genus. Moreover, the sclerites with a surface crest or multiple crests, possibly combined with a furrow or multiple ones (Figs. 5c, d, 9, 12) are distinctive and depicted here for the first time for Octocorallia.

The diagnostic features of the family Xenidiidae (Fabricius and Alderslade 2001: p. 53) do not include the possibility of the presence of more than one type of sclerite per genus. Although Alderslade (2001) included a number of genera and species with polymorphic sclerite architecture in the family, he did not add a redefinition of the family. The xeniid genera, therefore, with different sclerite-types in the polyps, the stalk or the basal interior of colonies are: *Asterospicularia* Utinomi, 1951; *Bayerxenia*, Alderslade, 2001; *Ixion* Alderslade, 2001, *Ingotia* Alderslade, 2001 and *Fasciclia* Janes, 2008. The current

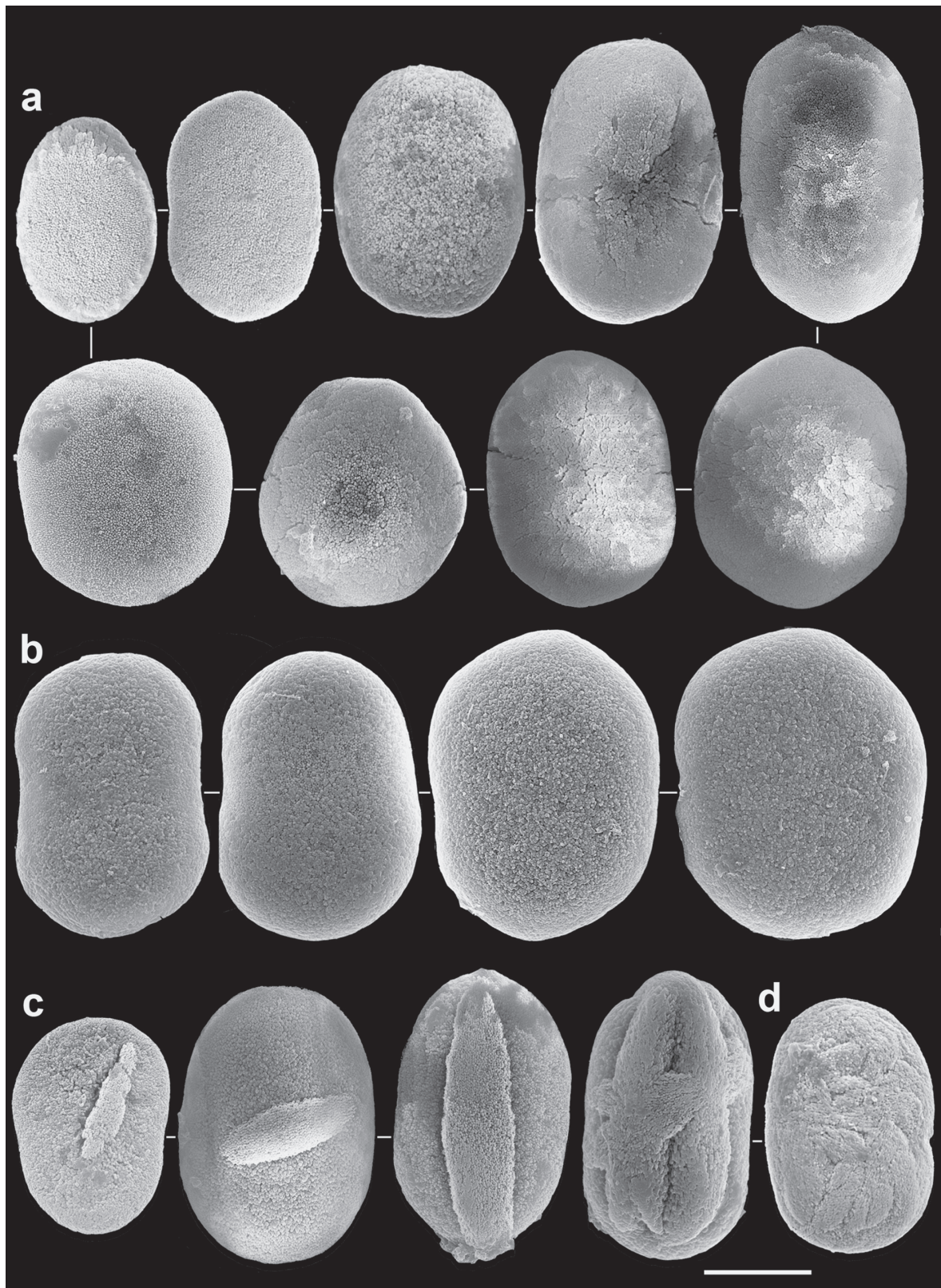


Fig. 5 Scanning electron micrographs of polyp sclerites of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. **a** platelets; **b** spheroids with medial narrowing; **c** with crest; **d** with compound surface architecture. Scale=0.010 mm

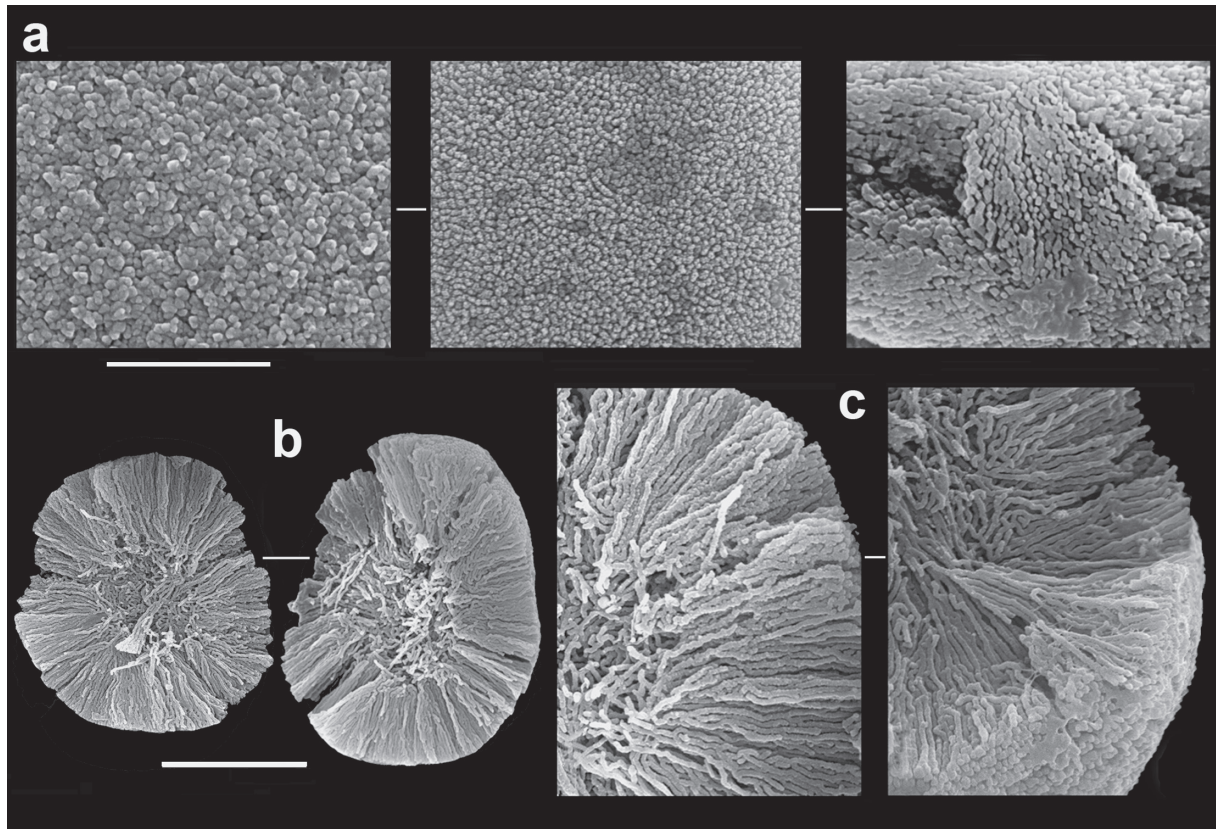


Fig. 6 Scanning electron micrographs of polyp sclerites of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 3453. **a** surface with minute papillae; **b** cross-section with radial dendritic rods; **c** detail of center of cross-sections with radial dendritic rods and surface papillae. Scale at **a**=0.005 mm, also applies to **c**, scale at **b**=0.010 mm

findings reinforce the necessity for careful examination of sclerites from different parts of the xeniid colonies (i.e., polyps, surface stalk and interior stalk), especially also using SEM, a practice that has been routinely employed during recent decades for other octocoral families. Therefore, it is possible that such variation in sclerites within taxa has been overlooked in past descriptions, and in the current instance, comparisons are needed between this new species and previously described species of the Xeniidae where sclerite ultrastructure is unknown.

Several species of the family Xeniidae from Japan and Formosa (Taiwan) were described by H. Utinomi: i.e., *Anthelia formosana* Utinomi, 1950; *A. tosana* Utinomi, 1958; *Asterospiculria laurae* Utinomi, 1951; *Xenia kusimotoensis* Utinomi, 1955 and *X. fimbriata* Utinomi, 1955. The first three species clearly differ distinctly from *Y. iubatum* spec. nov. The latter two *Xenia* species are also

different, as *X. kusimotoensis* Utinomi, 1955 features two rows of pinnules with 10-12 pinnules in the aboral row and *X. fimbriata* three rows with 15 pinnules in the aboral row and no sclerites, compared to 3-4 rows, a much higher number of pinnules, and sclerites in *Y. iubatum* spec. nov.. There are several *Xenia* species with 3 or 4 rows of pinnules, such as *X. lepida* Verseveldt, 1971 which has 3 rows of pinnules and with an aboral row that consists of 28-32 pinnules. Its sclerites are usually oval shaped, up to 0.015 mm long, and thus starkly differ from the much larger sclerites of *Y. iubatum* spec. nov. (up to 0.030 mm). None of the other known *Xenia* species has polyps with morphological features that fall within the ranges exhibited by *Y. iubatum* spec. nov. Based on the above comparisons it is concluded that *Y. iubatum* gen. nov. & spec. nov. is distinguished from any known xeniid species.



Fig. 7 Light microscope images of sclerites of the surface of the stalk of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. Scale=0.010 mm

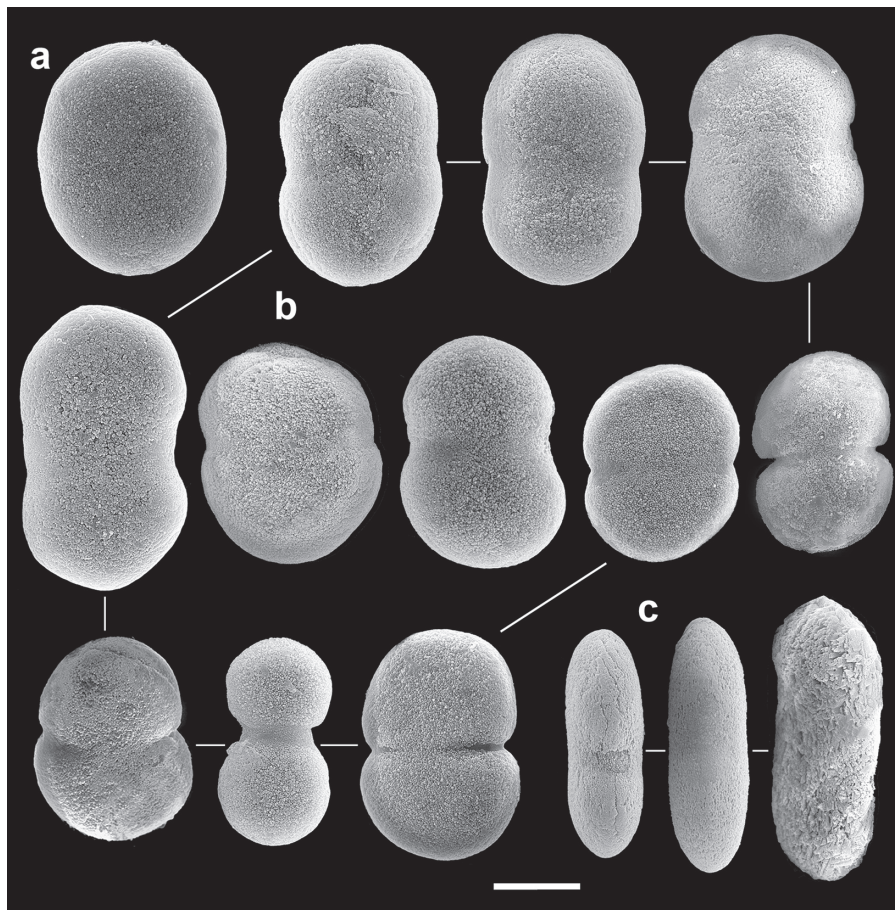


Fig. 8 Scanning electron micrographs of sclerites of the surface of the stalk of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. **a** platelet; **b** spheroids with medial narrowing, with waist and double-heads; **c** cigar-shaped. Scale=0.010 mm



Fig. 9 Scanning electron micrographs of sclerites of the surface of the stalk of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. Sclerites with crest or crests and furrow or furrows (arrows) featuring compound surface-architecture. Scale=0.010 mm

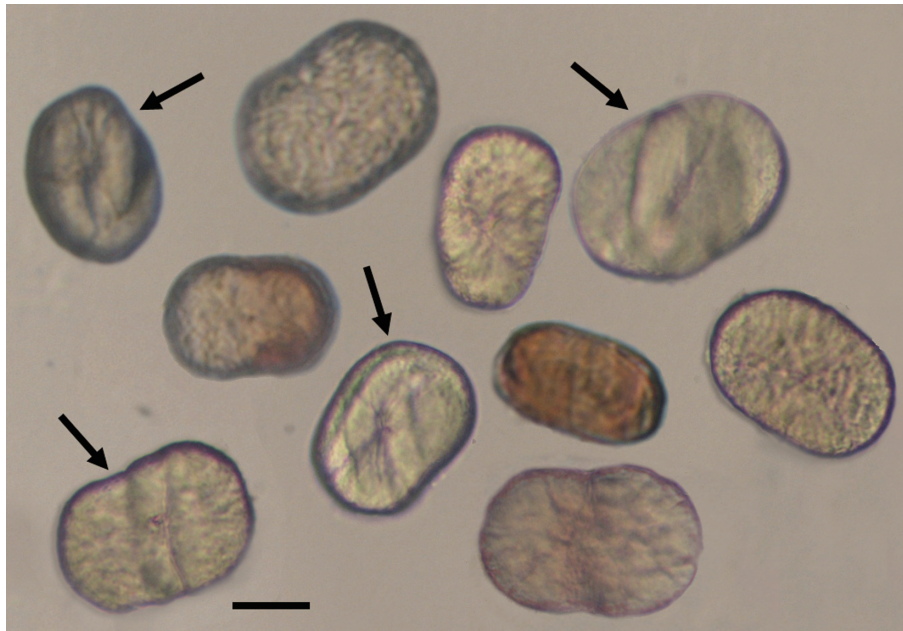


Fig. 10 Light microscope images of sclerites of the interior of the stalk of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. Arrows indicate sclerites with crest. Scale=0.010 mm

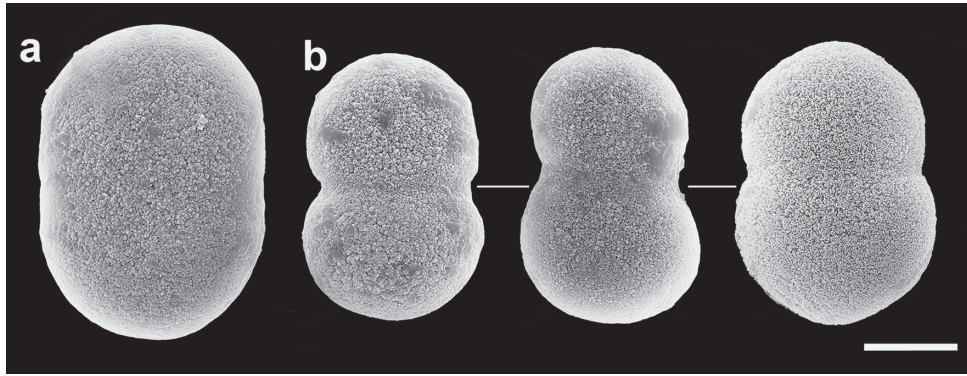


Fig. 11 Scanning electron micrographs of sclerites of the interior of the stalk of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. **a** simple spheroid; **b** with medial narrowing. Scale=0.010 mm



Fig. 12 Scanning electron micrographs of sclerites of the interior of the stalk of *Yamazatum iubatum* gen. nov. & spec. nov., holotype ZMTAU Co 34531. **a** with crest or crests and compound surface-architecture; **b** with furrow on the narrower side (arrow). Scale=0.010 mm

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