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A new species of the genus *Axelella* (Mollusca, Neogastropoda, Cancellariidae) from off Japan and the Philippines; with notes on related species

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Abstract

The newly described species is very close to *Axelella nodosivaricosa* (PETUCH, 1979) and occurs off Japan and the Philippines; in the latter locality both species are sympatric. The differentiation is mainly based on the multispiral protoconch of the newly described species *versus* the paucispiral protoconch of *A. nodosivaricosa,* and on biometric data. The related *A. semipellucida* (ADAMS & REEVE, 1850) is also discussed.
Keywords: Gastropoda, Cancellariidae, Pacific, Japan, Philippines, protoconch.

Abbreviations used

AV	author's collection
DMNH	Delaware Museum of Natural History, Greenville, Delaware, USA
KBIN	Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels, Belgium
NHM	Natural History Museum, London, Great Britain
NMWC	National Museums of Wales, Cardiff, Great Britain
RG	collection Mrs. R. Goethals, Oostende, Belgium
RP	collection Richard E. Petit, North Myrtle Beach, South Carolina, USA
ZMA	Zoologisch Museum, Amsterdam, The Netherlands. (All cited ZMA material is ex coll. Samia MARTIN, acquired 1990).
s.d.	standard deviation

Introduction.

Poecilogony is the intraspecific variation involving planktotrophic vs. non-planktotrophic larval development (BOUCHET, 1989: 68). All examples reported as poecilogony in prosobranch and opisthobranch Mollusca were studied by BOUCHET (1989) who concluded that, except for Ascoglossa, no case of poecilogony was found. He also stated that "the multispiral or paucispiral form of the protoconch, which is a reflection of planktotrophic or non-planktotrophic larval development respectively, can therefore, with a very high degree of confidence, be considered a species-specific character that can be used in routine taxonomical work on both recent and fossil material" (BOUCHET, 1989: 67).

In Cancellariidae, two cases of interspecific variation in protoconch type for closely related species-pairs have been reported. In the northern subtropic western Atlantic, *Olssonella smithii* (DALL, 1888) has a multispiral protoconch, whereas *O. scalatella* (GUPPY, 1873) has a paucispiral type (VERHECKEN, 1984); both species are now placed in the genus *Axelella,* a replacement name for the preoccupied *Olssonella.* The second case is a west-African species-pair. *Solatia piscatoria* (GMELIN, 1791) is a species with a multispiral protoconch, while the paucispiral protoconch of two closely related shells (VERHECKEN, 1989) was interpreted by BOUCHET (1989: 73) as indicating a different species. A similar case is reported here.
Counting of protoconch whorls follows VERDUIN (1982).

A good study of the numerous genus-level names proposed in the family Cancellariidae is long overdue. The species studied here are classified in the genus *Axelella,* following an earlier paper (VERHECKEN, 1997: 297), but this may be open to discussion because of the insufficient knowledge of supraspecific taxonomy within this family. From Japan and the Philippines, two species which can be classified in the genus *Axelella* have been known: *Cancellaria semipellucida* ADAMS & REEVE, 1850, type locality: Japan, and *Agatrix (Olssonella) nodosivaricosa* PETUCH (1979: 11, figs. 26-27), type locality: 300 m depth off Balicasag Island, Bohol, Philippines. Both species are rarely found in museum collections. The whereabouts of the type material of *A. semipellucida* is unknown: it is not in BMNH, NMWC or USNM, the most likely museums for this material. The five shells of *A. semipellucida* studied (in coll. AV, RP) have a paucispiral protoconch.
The original description of *A. nodosivaricosa* does not specify the type of protoconch; the figured front and back views of the holotype, which could be interpreted as representing a shell with a paucispiral protoconch, in fact are not sufficiently clear to allow for a definite answer.

In a previous publication, based on shells then available for study, I had surmised *A. nodosivaricosa* to have a multispiral protoconch (VERHECKEN, 1997: 299, figs. 5-7, 60-62). As a consequence, in that paper a single Indonesian shell with a paucispiral protoconch was distinguished from the nominal species as *Axelella* cf. *nodosivaricosa*.

A relatively large number of shells from the Philippines and Japan, conforming *A. nodosivaricosa* but with both multi- and paucispiral protoconch types, have now been studied. Based on the protoconch type, two *Axelella* species can be distinguished in this material. The holotype of *Axelella nodosivaricosa* (DMNH 126397, figs. 1-2) was studied: it has a paucispiral protoconch (see also figs. 7-8, protoconch not from holotype). Consequently, the shells with a multispiral protoconch must belong to an undescribed species.

Material studied

With paucispiral protoconch, all from locality "Philippines": Holotype of *A. nodosivaricosa*, 12.9 x 8.4 mm, DMNH 126397; 1 spec. 12.9 x 8.2 mm, AV0670; 1 sh. 15.8 x 9.9 mm, Bohol, Balicasag Island, 480 m on mud, AV0620; 1 sh. 15.9 x 9.4 mm, Balicasag Island, AV0673; 1 sh., 14.8 x 9.0 mm, RG; 1 sh. 17.3 x 11.1 mm, Panglao, RP2284/3; 7 sh., 12.9 x 8.0 mm to 16.6 x 10.0 mm, ZMA; and 32 sh., 6.3 x 4.6 mm to 16.1 x 10.4 mm, West Bohol, 162 m, ZMA. (total: 45 sh.).
With multispiral protoconch: cfr. Type material, total: 23 sh.

A. semipellucida: all from locality "Japan": 1 sh. 22.5 x 14.3 mm, Kii, AV0017; 2 sh. 14.5 x 9.7 mm, 16.7 x 10.8 mm, Cape Shiono, Wakayama Prefecture, AV0018; 1 sh. 21.7 x 14.6 mm, Kii, 126 m, RP2258; 1 sh. 14.9 x 10.1 mm, Tosa Bay, 180 m, RP1877.

Taxonomic description

Superfamily Cancellarioidea FORBES & HANLEY, 1851
Family Cancellariidae FORBES & HANLEY, 1851
Genus *Axelella* PETIT, 1988

Axelella PETIT, 1988 (= *Olssonella* PETIT, 1970, non *Olssonella* GLIBERT & VAN DE POEL, 1967)

Type species (o. d.) *Cancellaria smithii* DALL, 1888.

Axelella suduirauti spec. nov.
(Figs. 3-4, 9-12)

Axelella nodosivaricosa - VERHECKEN, 1997: 318 figs. 60-62 (not *A.* cf. *nodosivaricosa* – VERHECKEN, 1997: 299, figs 5-7.)

TYPE MATERIAL

Holotype : 18.8 x 11.7 mm, Yaku Island, Japan, 130 m, KBIN IG 27231.
Paratypes : paratype **1**: 12.2 x 8.2 mm, Yaku Island, Japan, 130 m, KBIN IG 27231. Paratypes 2-11, Japan. **2-3**: 2 sh., 15.5 x 9.2mm, 15.8 x 10.2 mm, Yaku Island, 130 m, AV0020. **4-5**: 2 sh., 21.4 x 13.5 mm, 22.0 x 12.5 mm, Minabe, Wakayama Prefecture, 50-80 m, AV0021. 6-7: Mikawa, Aichi Prefecture. **6**: 1 sh., 16.6 x 11.1 mm, 100-120 m, AV0045; **7**: 1 sh., 18.4 x 11.6 mm, 90-180 m, on muddy bottom, RP2353.
Paratypes 8-23, Philippines. **8**: 1 sh., 18.5 x 12.2 mm, ZMA Moll. 3.99.040. **9-12**: 4 sh., 14.7 x 9.6 to 16.9 x 11.0, West coast Bohol, ZMA Moll. 3.99.041. 13-15: Bohol : Panglao: **13**: 1 sh. 16.1 x 10.3 mm, AV0023; **14-15**: 2 sh., 15.1 x 9.5 mm, 12.4 x 8.2 mm, 144 m, RP2284/1-2. 16-23**:** Bohol, Balicassag Island: **16**: 1 sh, 19.5 x 12.7 mm, 480 m, on mud, AV0619; **17-18**: 2 sh., 17.1 x 11.0 mm, 19.2 x 11.2 mm, AV0022; **19-21**: 3 sh. AV0674; **22**: 1 sh. 13.2 x 8.8 mm, 144 m, RP2321. **23**: 1 sh. 13.7 x 8.7 mm, Talikod Island, Davao Gulf, Mindanao, AV0052.

TYPE LOCALITY

Yaku Island, Japan, in mud at a depth of 130 m.

DISTRIBUTION

This species is known from off Southern Japan (Yaku Island; Mikawa, Aichi Prefecture; Minabe, Wakayama Prefecture) and the Philippines (Bohol: Panglao and Balicasag Island; Mindanao, Davao Gulf, Talikod Island) in depths between 50 and 480 m.

ETYMOLOGY

This new species is named in honour of Emmanuel Guillot de Suduiraut (Balieasag Island, Bohol, Philippines), who is very knowledgeable on the marine malacofauna from the Philippines, and kindly donated specimens for study, thus triggering the study of the two protoconch types.

DESCRIPTION

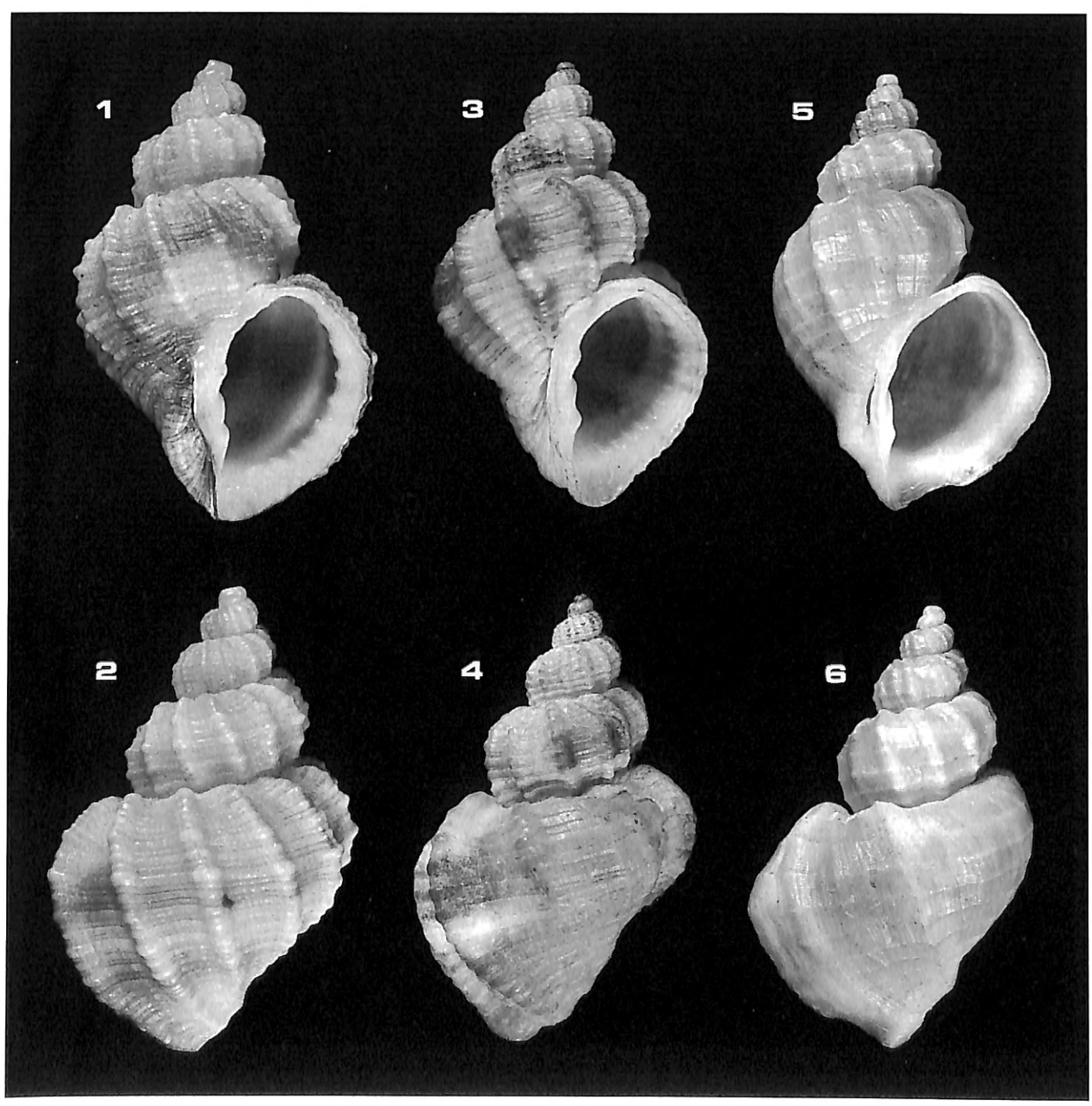
Shell rather small, up to 21.4 x 13.5 mm, grossly biconical, mean spire angle 66.5° (s.d. = 3.9°), mean spire height 75.5 % of total shell height (s.d. = 2.6%). Suture deeply impressed. Colour pale brownish with a narrow whitish spiral band, and dark brown blotches mainly on the axial ribs.
Protoconch whitish to pale fawn, but with a pale brown embryonal shell of about 0.5 whorl, nucleus diameter (d according to VERDUIN, 1982) 0.20 mm; protoconch

multispiral, mean number of whorls 1.64 (s.d. = 0.19), mean maximum diameter 0.94 mm (s.d. = 0.11 mm), mean exposed height 0.79 mm (s.d. = 0.09 mm). The protoconch is generally smooth and shiny, but sometimes a spiral striation occurs on the last whorl, the last part of which can also have narrow riblets parallel to the protoconch growth lines (fig. 9). The transition to the teleoconch is marked by the sudden appearance of the teleoconch sculpture, and often is accompanied by a sudden expansion in whorl width.

Teleoconch with up to 4 3/4 rounded whorls, suture deeply impressed. Axial sculpture of rounded ribs: on first to 4th whorl respectively: 11-13, 12-16, 11-14, 8-10.

Spiral sculpture consists of broad bands with a slightly rounded profile : on first to 4th whorl: 5-7, 6-13 (here secondary spirals can already be present), 11-18, 11-15. The last whorl has 20-29 spirals. On the younger whorls, the spacings between the spiral bands are filled by a secondary band which can become almost as wide as the primary bands. The spiral bands often have remains of a microsculpture of incremental riblets.

Aperture semicircular, mean height 53.7 % of total shell height (s.d. = 2.3 %). Outer lip slightly expanded, with lirae inside: mean number = 12, s.d.= 1.6. In 13 shells out of the 22, but not in the holotype, a weak parietal tooth is present. Columellar callus thin, white. Columella straight to slightly curved abaxially, with 3 rather strong folds, of which the adapical one is the strongest, but even



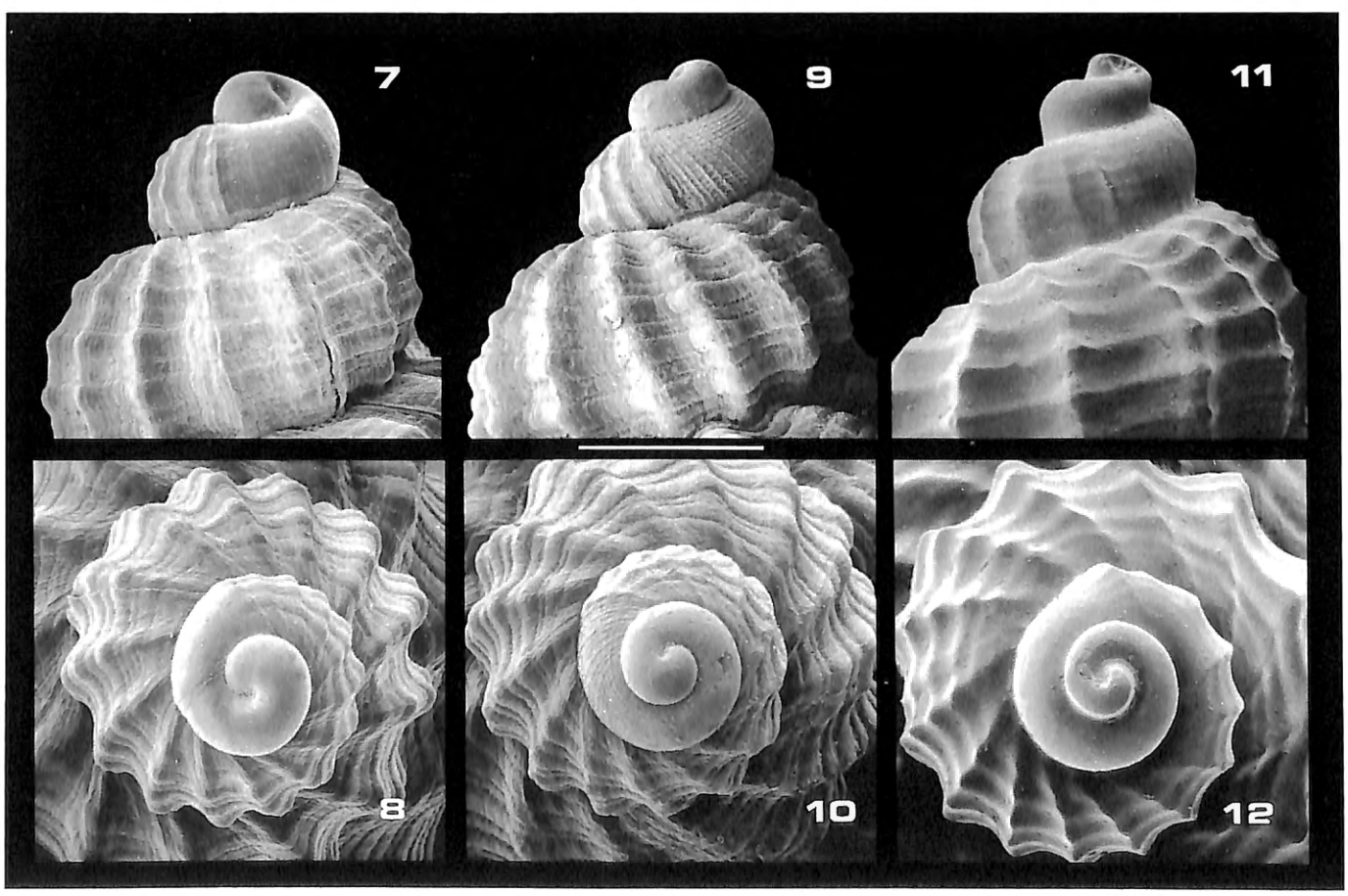
Figs. 1-2. – *Axelella nodosivaricosa*, holotype, DMNH 126397, 12.9 x 8.4 mm, 300 m, Balicasag Island, Bohol, Philippines.
Figs. 3-4. – *Axelella suduirauti* spec. nov., holotype, KBIN IG 27231, 18.8 x 11.7 mm, 130 m, Yaku Island, Japan.
Figs. 5-6. – *Axelella semipellucida*, AV0017, 22.5 x 14.3 mm, Kii, Japan

the one at the rim of the siphonal canal is rather well developed. Umbilicus narrow to almost closed by the thin columellar callus. Siphonal fasciole of weak to medium strength.
In an alcohol specimen (AV0670), the whitish animal has relatively big black eyes (diameter 0.2 mm) at the outer basis of the (in the retracted state) flat triangular tentacles. The proboscis contained an elongated "mandible" (length 1.5 mm, largest width 0.2 mm) of the type well know for Cancellariidae (as described by e. g. HARASEWYCH & PETIT, 1982, and several authors before them). No radula was found.

DISCUSSION

Protoconch.- Within the type-series of *A. suduirauti*, the protoconch varies from naticoid whorls with only slightly impressed suture (figs. 9-10) to forms with more scalar whorls because of a deeply impressed protoconch suture (fig. 11-12). All known shells of the latter type are from the Philippines.
The multispiral protoconch, indicating a planktotrophic development, is the main feature distinguishing this new species from *A. nodosivaricosa,* the whitish protoconch of which is clearly of the paucispiral type (figs. 7-8) with a nucleus diameter of 0.26 mm, 1-1.5 whorls (mean = 1.06, s.d. = 0.15), a maximum diameter of 0.9-1.1 mm (mean = 0.97 mm, s.d. = 0.06 mm) and an exposed height of 0.7-0.9 mm. Biometric data on the protoconchs of *A. nodosivaricosa* (22 sh.), *A. semipellucida* (5 sh.) and *A. suduirauti* (22 sh.) are presented in fig. 13, showing a rather clear distinction between the three species. When viewed from the direction of the teleoconch shell axis, the protoconch outline of *A. nodosivaricosa* is somewhat elongated because of the relatively large last part of the whorl. Its surface is smooth, but a few shells show remains of spiral striae. The protoconch of *A. semipellucida* has a nucleus diameter of 0.50 mm, a mean whorl count of 1.08 (s.d. 0.05), a maximum diameter of 1.3 – 1.6 mm (mean = 1.46 mm, s.d. = 0.13 mm), and mean exposed height of 1.26 mm (s.d. = 0.11 mm). Visually, this protoconch is quite larger than that of *A. nodosivaricosa*, and it does not have the elongated outline of the latter species' protoconch.

It must be pointed out that the terms 'multispiral' and 'paucispiral' can be somewhat ambiguous, if based only on the number of protoconch whorls. BOUCHET (1989: 75) gives as general classification: usually 'multispiral' consists of 2 to 4 whorls and 'paucispiral' of 0.5 to 1.5 whorls. In the case studied here, paucispiral (non-planktotrophic



Figs. 7-12 – Protoconch and teleoconch early whorls. Scale bar = 1 mm. 7-8: *Axelella nodosivaricosa*, W. Bohol, Philippines (ZMA). 9-12: *A. suduirauti* spec. nov. 9-10: naticoid protoconch type, paratype 6, Yaku Island, Japan. 11-12: scalar protoconch type, paratype 17, Balicasag Island, Bohol, Philippines.

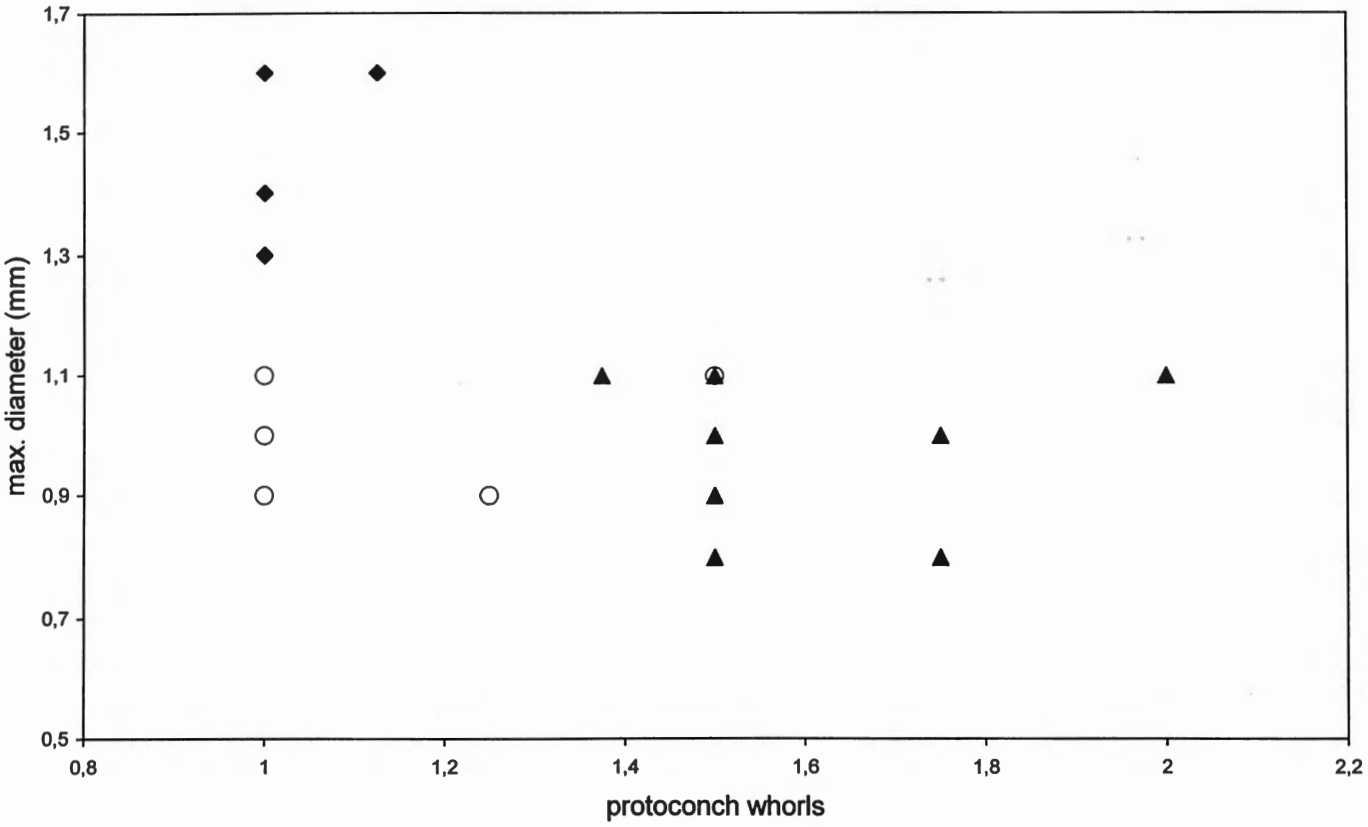


Fig. 13 – protoconch of *Axelella nodosivaricosa* (circles), *A. semipellucida* (diamonds) and *A. suduirauti* (triangles): maximum protoconch diameter *versus* number of protoconch whorls.

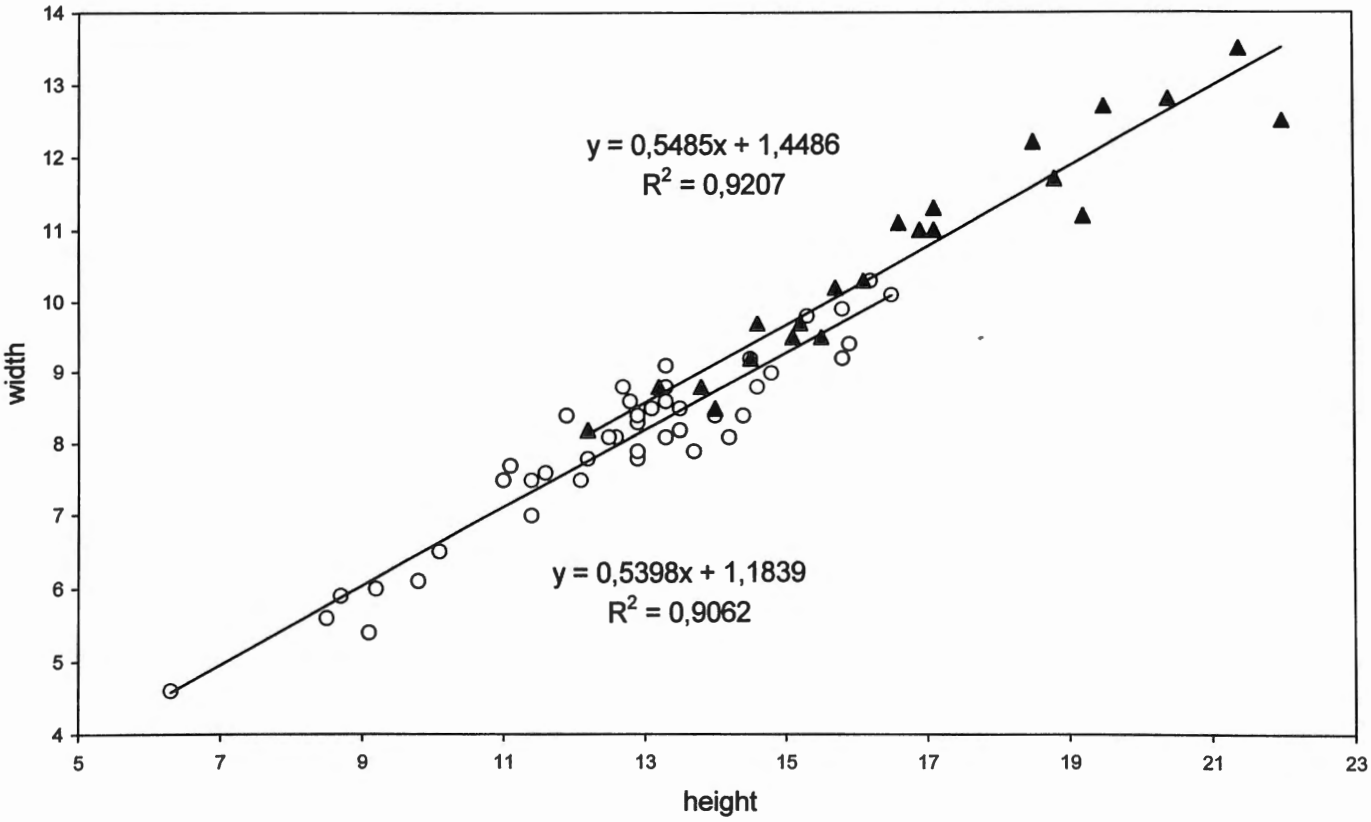


Fig. 14 – Shell width *versus* height (mm). *Axelella nodosivaricosa* (circles), *A. suduirauti* (triangles).

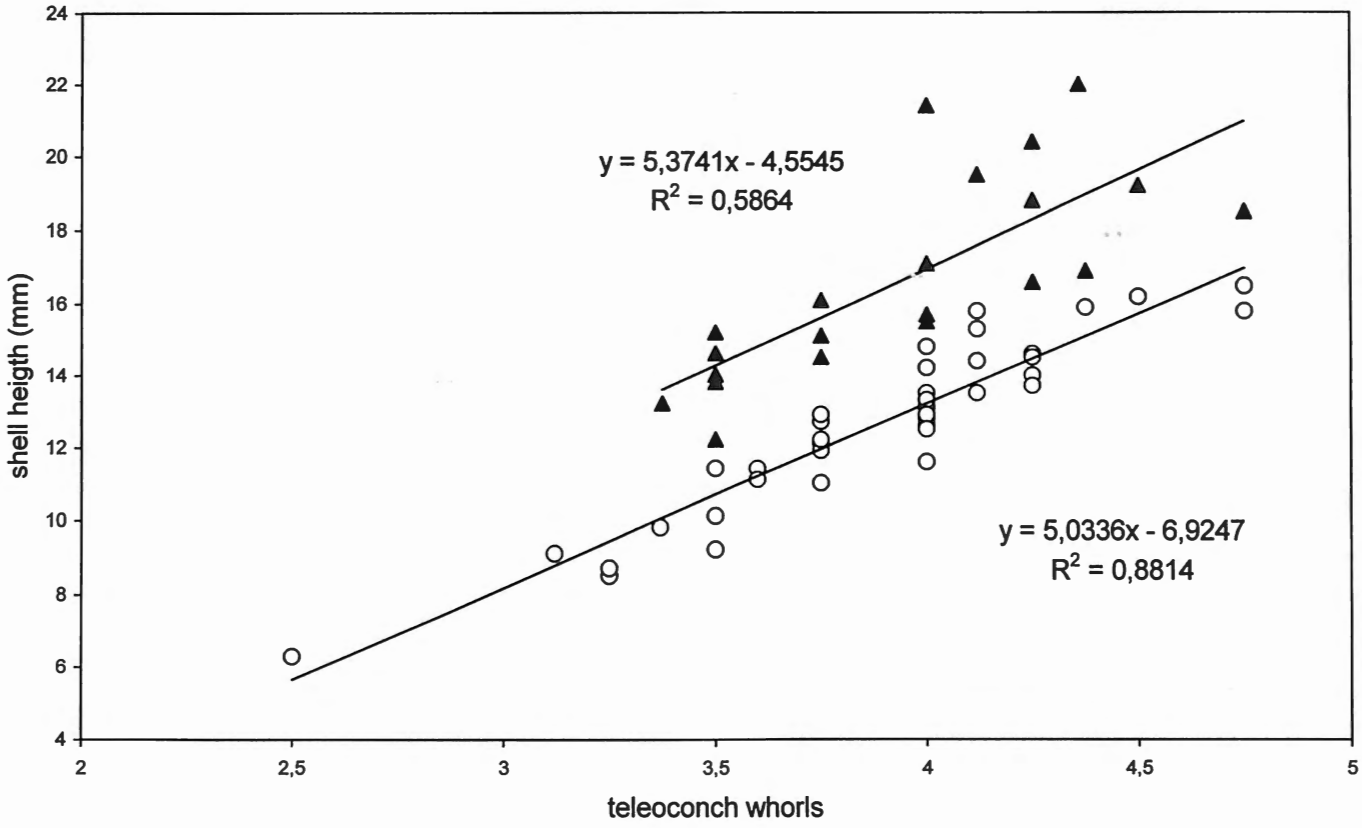


Fig. 15 – Shell height *versus* number of teleoconch whorls. *Axelella nodosivaricosa* (circles), *A. suduirauti* (triangles).

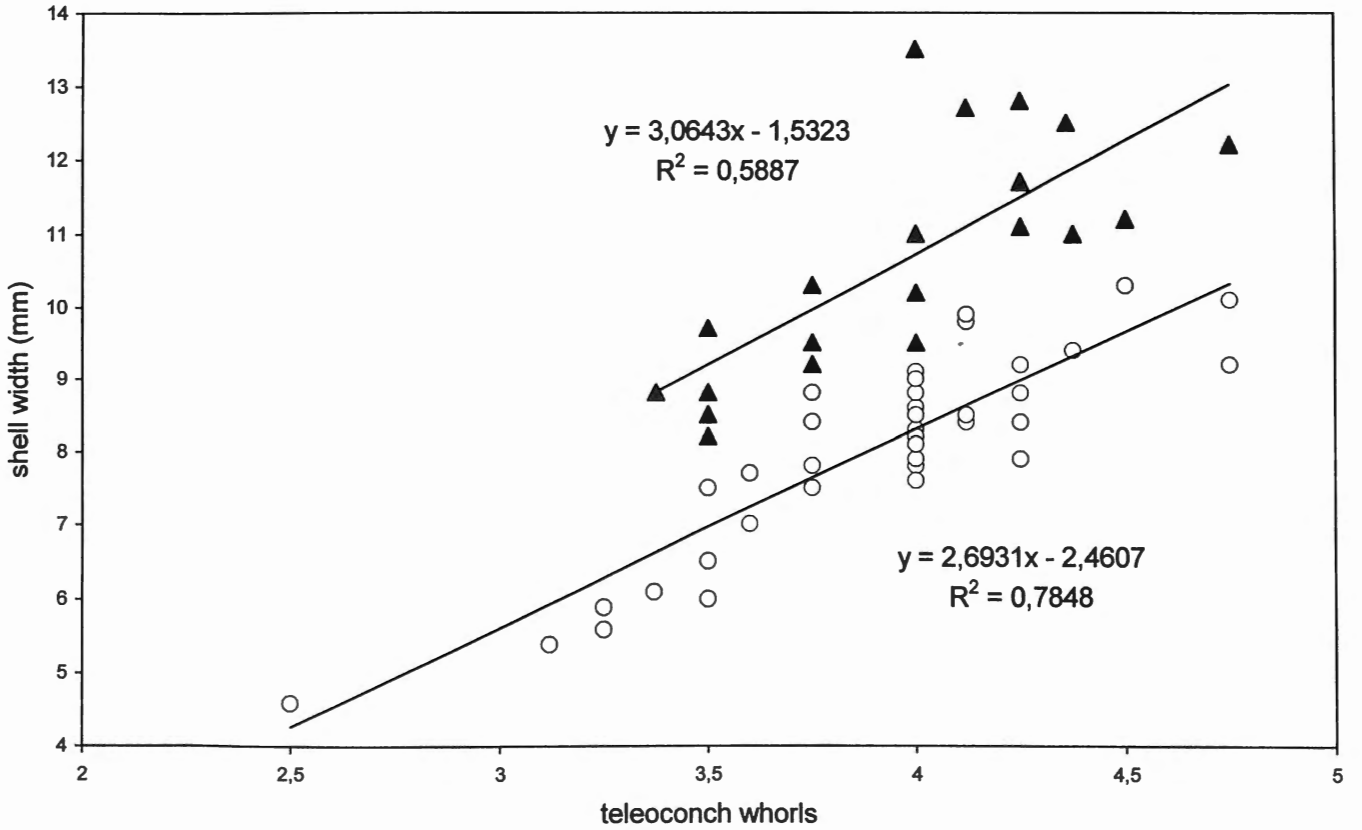


Fig. 16 – Shell width *versus* number of teleoconch whorls. *Axelella nodosivaricosa* (circles), *A. suduirauti* (triangles).

development) was found to mean 1 - 1.5 whorls, and multispiral (planktotrophic development) 1.5 – 1.75 whorls; these figures alone do not allow a clear-cut separation. However, based on the simultaneous presence of the following characters it can be safely accepted that the protoconch of *A. suduirauti* is multispiral indeed: the visual aspect of this protoconch as compared to the paucispiral one of *A. nodosivaricosa* (figs. 7-8 *versus* 9-12); the embryonal whorl formed in the capsule (protoconch I, [BOUCHET, 1989: 75]) is distinct from the rest of the protoconch (although only clearly visible in fresh shells); the different sculpture patterns on the different parts of the protoconch; and the smaller nucleus diameter compared to the complete protoconch size: the value of d/ D_0 according to VERDUIN (1982: 129) is 0.21 for *A. suduirauti* (multispiral), but 0.26 and 0.34 for *A. nodosivaricosa* and *A. semipellucida* respectively (both paucispiral).

The shell referred to as *A.* cf. *nodosivaricosa* from Indonesia (VERHECKEN, 1997: 299) is now considered to belong to the nominal species. Because of the confusion about the protoconch types, the remarks then given actually apply to *A. nodosivaricosa*, and the shell then figured as that species (VERHECKEN, 1997: figs. 60-62) is paratype 3 of *A. suduirauti.*

Teleoconch.- *A. suduirauti* grows taller than *A. nodosivaricosa*; but the linear regression lines between shell height and width do not yield a clear distinction between both species (fig. 14). However, for a same number of teleoconch whorls, both shell height and width are larger for *A. suduirauti* than for *A. nodosivaricosa* (figs. 15-16), with the same correlation to the linear regression line. Thus, a larger shell height or width for a certain number of teleoconch whorls is a strong – though not absolute – indication for *A. suduirauti.*

No significant differences could be found between the sculpture of both species, and also their coloration is very similar. The sculpture of *A. semipellucida*, very variable in the five shells studied, is much weaker than that of the two related species.

Aperture: Based on the holotypes of *A. nodosivaricosa* and *A. suduirauti*, the ratio width/height of the aperture appears to be higher (i.e. a relatively wider aperture) for *A. nodosivaricosa*. However, statistical data on samples of 22 shells show only a marginal difference: mean and s.d.: 0.58 and 0.04 for *A. suduirauti*, 0.56 and 0.05 for *A. nodosivaricosa*. For *A. semipellucida,* these figures are (n= 5): 0.61 and 0.03. These data overlap, so that no distinction is possible based on these measurements.

A. suduirauti and *A. nodosivaricosa* are sympatric in the Philippines, even occurring at the same locality and depth (Balicasag Island, 480 m, on mud); from Japan there are no records of correctly identified material of the latter species.

Four *Axelella* species are now known from the area Japan-Philippines-Indonesia; none have been reported from Australia (GARRARD, 1975; WILSON, 1994). Their distribution, as actually known, is: *A. semipellucida*: Japan; *A. suduirauti*: Japan and Philippines; *A. nodosivaricosa*: Philippines and Arafura Sea, Indonesia; *A. kastoroae* VERHECKEN, 1997: Arafura Sea. Except for *A. suduirauti*, all have a paucispiral protoconch.

Genus.- The generic placement in *Axelella* is not evident: in the type-species *A. smithii* the posterior columellar fold is the strongest, and generally there are only two folds. However, *Axelella funiculata* (HINDS, 1843), a related species from the western Panamic area also has a third fold near the siphonal canal. Both *A. nodosivaricosa* and *A. suduirauti* clearly have three folds, and the anterior one, although the smallest, is generally rather well developed. The columella of *A. smithii* and the related *A. funiculata* is quite straight and parallel to the shell axis, whereas in the cited Asiatic species the columella is often slightly curved abaxially. Also, the American species have the suture still deeper impressed than the Asiatic species studied here. The generic position of the Asiatic species seems to be somewhere intermediate between *Axelella* PETIT, 1988, and *Agatrix* PETIT, 1967.

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