Gloria Maris	57 (2)	40 - 50	Antwerp; 14 October 2014

Two new genera in the family Melongenidae from the Indo-Pacific and comments on the identity of *Hemifusus zhangyii* Kosuge, 2008 and *Pyrula elongata* Lamarck, 1822 (Gastropoda, Neogastropoda: Buccinoidea)

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Keywords: MELONGENIDAE, *Hemifusus*, *Hemifusus zhangyii, Pyrula elongata,* new genera, India (Indian Ocean), Western Pacific Ocean, taxonomy.

Abstract: It is proposed to limit the genus *Hemifusus* Swainson, 1840 to the larger, deeper-water species from the West Pacific (though not recorded in the Philippines) with up to larger than 30 cm, cream-coloured shells with a non-determined outer lip and predominantly spiral ribbing, and to place the smaller, shallow subtidal species with a range from India to the West Pacific and smaller than 17 cm brown shells in the new genera *Brunneifusus* and *Lenifusus*. These shells also have a more determined outer lip (especially in *Lenifusus* gen. nov.) and other morphological differences with *Hemifusus*.

New combinations herein: *Brunneifusus carinifer* (Habe & Kosuge, 1966); *Brunneifusus ternatanus* (Gmelin, 1791); *Lenifusus elongatus* (Lamarck, 1822).

Comments are made on the identity of *Hemifusus zhangyii* Kosuge, 2008 which is recognised as a junior synonym of *Pyrula elongata* Lamarck, 1822. A lectotype for *Pyrula elongata* Lamarck, 1822 is selected.

Introduction: The family **Melongenidae** Gill, 1871 (1854) is a small family included in the superfamily Buccinoidea (Bouchet & Recroi, 2005), roughly encompassing about 20-25 Recent species with a global, primarily tropical distribution. Members of this family commonly live in muddy and sandy bottoms, with some taxa predominantly inhabiting estuaries and bays. The genera treated in the present paper are *Hemifusus* from deeper water, *Brunneifusus* and *Lenifusus* from shallow subtidal (low tide mark to about 30 m) water. Melongenids are active predators of bivalves and other gastropods. The family includes the following Recent genera: *Melongena* Schumacher, 1817 from both sides of the United States and the Caribbean; *Hemifusus* Swainson, 1840, herein restricted to the West Pacific; *Volema* Röding, 1788 from the Indo-Pacific; *Pugilina* Schumacher, 1817 which is amphiatlantic and *Saginafusus* Wenz, 1943 from Northwestern Australia to the Gulf of Papua (Snyder et al., 2012). Landau & Vermeij (2013) revived *Volegalea* Iredale, 1938 as a valid genus name for the Indo-Pacific species previously ascribed to *Pugilina*.

Yet, based on morphological aspects, the genus *Hemifusus* Swainson, 1840 can be divided into several groups. *Hemifusus*, with *Fusus colossus* Lamarck, 1816 as a type species, is herein restricted to the large, cream-coloured shells from deeper water (from 50 m to 200 m) in the western Pacific. The mostly smaller, slenderer and partly smoother, beige to dark-brown coloured shells from shallower waters (up to 30 m) in the Indo-Pacific are hereby placed in the new genera *Brunneifusus* and *Lenifusus*.

Abbreviations:

MNHG:	Muséum d'histoire naturelle de Genève
H:	height
gen. nov.:	new genus
W:	width
ICZN:	International Code of Zoological Nomenclature, 4th edition

Systematics:

Superfamily BUCCINOIDEA Rafinesque, 1815
Family MELONGENIDAE Gill, 1871 (1854) (see ICZN 40.2.1) [= CASSIDULIDAE Gray, 1854 (synonymy of the type genus); = GALEODIDAE Thiele, 1925 (based on *Galeodes* Röding, 1798, which is a junior homonym of *Galeodes* Olivi, 1791 [Arachnida]); = VOLEMIDAE Winckworth, 1945; = HELIGMOTOMIDAE Adegoke, 1977].

Remarks: **Melongenidae** was established as a replacement name for 'Cassidulina, Tr.' [= Troschel, 1868], based on *Cassidulus* Gray, 1854, which Gill (1871) treated as a synonym of *Melongena* Schumacher, 1817. **Melongenidae** has gained general acceptance and is conserved under ICZN art. 40.2.1. (Bouchet & Rocroi, 2005).

Subfamily Melongeninae Gill, 1871 (1854).

Genus *Hemifusus* Swainson, 1840

Synonym: *Semifusus* Agassiz, 1846. *Semifusus* is an incorrect amendation of *Hemifusus* by Agassiz (1846). Semi is Latin and hemi is Greek for the English word "half". Agassiz changed the Greek prefix into the Latin prefix. Matsubara (2009) explains why *Semifusus* is not available: "Agassiz (1846: 177, 338) amended the original spelling *Hemifusus* to *Semifusus*. Agassiz improperly amended hundreds of names that are composite of Greek and Latin, in this case substituting the Latin semi- for the Greek hemi-, combined with the Latin fusus. According to ICZN Art. 32.5.1 Agassiz's (1846) action is an unjustified amendation of the correct original spelling. In addition, *Semifusus* is not in prevailing usage. Thus, ICZN Art. 33.2.3.1 is not applicable. In conclusion, "*Semifusus* Swainson, 1840" is an unavailable name, and *Semifusus* Agassiz. 1846 is a junior objective synonym of *Hemifusus*". Bayer (1952: 280, 289) uses *Semifusus* for unclear reasons (no further information given).

Type species: *Fusus colosseus* Lamarck, 1816 by subsequent designation by Gray (1847: 135) = *Fusus collosseus* Lamarck, 1816 (Lamarck, Liste des Objects: 6) = *Hemifusus colosseus* (Lamarck, 1822). West-Pacific. Note: the original spelling was "collosseus", but "colosseus" is in prevailing usage [WoRMS, Citation: Rosenberg, G. (2015). *Hemifusus colosseus* (Lamarck, 1816). In: MolluscaBase (2015). Accessed through: World Register of Marine Species at http://www.marinespecies.org/aphia.php?p=taxdetails&id=567150 on 2015-07-15)]. Swainson (1840: 91) mentioned the species as *Fusus colossus*.

Re-description: Large to very large (over 300 mm), cream-coloured, elongated shells. Thin-walled, but strong shell. Inside of outer lip non-lirate, smooth, but the spiral lines on the outside of the whorl are visible as shallow grooves on the inside; having a thin outer lip margin ('non-determinate'), which is wavy - caused by the spiral lines on the outside and the corresponding grooves on the inside; shell with strong spiral ribbing and many axial growth lines; shoulder rounded or angled, with or without knobs or spines; long and rather broad siphonal protuberance and siphonal canal; height of aperture compared to total height of the shell roughly 50 to 60%; operculum large, thick and closing the aperture when the animal retracts; thick, smooth or hairy brown periostracum that becomes brittle and is easily lost when dried.

Range: Recent in South-East Asia: from the South China Sea (Vietnam), East China Sea to Japan, southwards to Indonesia. Not recorded in the Philippines.

Included species:
Hemifusus boucheti Thach, 2017
Hemifusus colosseus (Lamarck, 1816) [*Fusus*]
Hemifusus crassicauda (Philippi, 1849) [*Pyrula*]
Hemifusus kawamurai Kira, 1965
Hemifusus tuba (Gmelin, 1791) [*Murex*]
Hemifusus yurikantori Thach, 2017

Remarks: Swainson (1840) explained the name *Hemifusus*: "they are indeed only half fusiform, as the spire is shorter than the aperture: they are also distinguished by an internal canal and the whorls are coronated with compressed spines". The re-description of the genus *Hemifusus* is necessary to restrict the genus to the cream-coloured species with more or less similar morphology, having a thin outer lip ('non-determinate') and in general bearing spiral ribbing. The term non-determinate outer lip is not so often used and it is the opposite of the term determinate outer lip. The term determinate is used to express the outer lip has a marked ending which is mostly recognised by a thickening of the outer lip. It is the point where the animal stopped its shell growth and consequently started thickening the rim. Animals that keep on growing do not have a nicely ended aperture and this can be seen in the shells having a thin outer lip. The two newly introduced genera herein have a determinate outer lip, opposite to the genus *Hemifusus*. See below with the remarks on the next genus.

Genus *Brunneifusus* gen. nov.

Type species: *Murex ternatanus* Gmelin, 1791

Description: Shells of medium to large size (up to 170 mm), light to dark-brown coloured and elongated. Thick-walled. Shoulder angulated. Inside of outer lip non lirate and smooth, but the spiral lines on the outside of the whorl are weakly represented as shallow grooves on the inside; having a determinate outer lip with a weakly

polished margin; mostly weak axial growth lines and rather strong spiral ribbing, also on early whorls; strong knobs on the shoulder, spirally stretched; long and rather narrow siphonal canal; height of the aperture compared to total height of the shell around 2/3rd; operculum elongately round posteriorly and pointed towards the anterior of the shell; a little reduced in size at the anterior point and not closing the aperture; thick, brown, hairy periostracum.

Range: From India eastwards to South East Asia; South China Sea, East China Sea, the Philippines to Japan; Indonesia (Java, Dharma : 108, pl. 29 fig. 2).

Included species:
Brunneifusus cariniferus (Habe & Kosuge, 1966) [*Hemifusus*]
Brunneifusus ternatanus (Gmelin, 1791) [*Murex*]

Animal: Body pale with black speckles (source: internet publication from Singapore; see remarks)

Habitat: On mud and muddy sand from about low tide mark (*B. ternatanus* in Singapore; see remarks) to about 20-25 metres.

Etymology: The genus is named for the brown or brownish colour of the shells in contrast to the species herein restricted to the genus *Hemifusus*. The genus name is a combination of the medieval Latin word "brunneus" meaning brown and "fusus" (noun, masculine) which means spool in English. Gender of *Brunneifusus*: masculine.

Comparison and remarks: In the description of the new genus, the outer lip is called 'determinate'. Perhaps this is not a very familiar term in conchology. Deterministic growth was used and perhaps introduced by Vermeij (1993: 31-32): "episodic and deterministic growth is indicated by simple outward flaring of the outer lip". The opposite is non-deterministic growth and that means that the lip is rather thin and no stop in growth is visible. Non-deterministic growth is the condition of the lip in *Hemifusus*. The new genus *Brunneifusus* is generally smaller in size in adult shells (maximum height ca. 110 – 170 mm compared to over 300 mm in *Hemifusus*) and light to dark brown in colour compared to the cream-coloured shells of the genus *Hemifusus*. The shells of the new genus are more knot-shaped, that is a relatively swollen body whorl and a thin and elongated siphonal canal compared to shells of *Hemifusus*. A further difference can be found in the operculum: species assigned to the new genus have opercula that are thinner and more reduced, not fully closing the entrance of the aperture and not fully following the outline of the aperture, whereas in *Hemifusus* the very thick operculum is almost sealing off the entrance of the aperture. The new genus is represented in the eastern Indian Ocean and also in the Philippines, whereas *Hemifusus* is not.

Species belonging to the new genus differ from *Saginafusus* Wenz, 1943 by their much smaller and slenderer shells. *Saginafusus pricei* (E. A. Smith, 1887) reaches about 230 mm in height and 110 mm in width. *S. pricei* (see Snyder et al, 2012) has a determinate outer lip, a feature shared with the newly proposed genus whereas *Hemifusus* has a non-determinate outer lip. The new genus is somewhere between *Volegalea* Iredale, 1938 and *Hemifusus*. Especially *B. carinifererus* has the spiral ribbing of the (early) spire whorls and the spirally flattened shoulder knobs as seen in *Volegalea cochlidium* (Linnaeus, 1758); the newly proposed genus also shares the brown colour of the shells with *Volegalea*. The new genus seems to be a slenderer relative of *Volegalea*.

Species belonging to the new genus are reported to live at the low tide mark in Singapore (www.wildsingapore, see references). According to this Internet publication, the long hairs on the periostracum catch surrounding sediment so that the snail perfectly blends into the mud. Another publication from Singapore (Chan, 2009) reports *B. ternatanus* alive from clean fine subtidal sands and mentions that this species is never found alive in intertidal environments, but that specimens found above the low tide mark are typically inhabited by hermit crabs, which may bring the shells from below the low tide mark. This is confirmed by observations from northern Sarawak (East Malaysia, pers. comm. Han Raven).

Sinistral specimens rarely occur (Dharma: 108, pl. 29 fig. 2b, *B. ternatanus* and one in the author's collection, also from Indonesia). Sinistral specimens in *Hemifusus* are unknown to the author.

Genus *Lenifusus* gen. nov.

Type species: *Buccinum tuba* Gmelin, 1791 = *Pyrula elongata* Lamarck, 1822

Description: Shells light-brown to dark-brown coloured, very elongate, of medium to large size (from 85 to 115 mm), thick-walled. Inside of outer lip non-lirated: smooth on the whole inside of the outer lip; having a solid outer lip with polished margin; strong axial ribs and weak spiral ribbing best visible on the spire whorls; on the body whorl, the spiral lines are almost obsolete in the central

part, but more visible on the siphonal canal and the axial sculpture consists of growth lines; on the dorsal side of the body whorl there are weakly rounded to axially elongated knobs on the rounded shoulder; long and rather narrow siphonal canal; the width of the aperture is hardly broader than the siphonal canal, the outline of the last whorl is straight, rather than rounded; height of the aperture compared to total height of the shell around 2/3.

Operculum elongated round, thin and reduced in size and not closing the aperture; thick brown periostracum.

Range: From Vietnam eastwards to the East China Sea; Singapore (dubious, based on a single report: www.wildsinsingapore, and one specimen in the author's collection ex. Andy Tan, Singapore); East Sumatra, Indonesia (Dharma: 108, pl. 29 fig. 3).

Included species:
Lenifusus elongatus (Lamarck, 1822) [*Pyrula*]

Animal: Animal not studied.

Habitat: On sand and muddy sand between 25-30 metres (Vietnam).

Etymology: The genus is named for the smooth shell surface compared to shells belonging to the genus *Hemifusus* and *Brunneifusus*. The genus name is a combination of the Latin adjective "lenis", meaning smooth, and the Latin word "fusus" (noun, masculine) which means 'spool' in English. Gender masculine.

Comparison and remarks: Shells belonging to the new genus share the same typical characteristic as *Volegalea*: in adult shells the surface becomes smoother towards the aperture, whereas in *Hemifusus* and *Brunneifusus* the strong sculpture persists.

Lenifusus is best compared with *Brunneifusus*. The most striking differences are the smoother shell and the rounded shoulder with weakly rounded to axially elongated knobs. The operculum is generally smaller than in *Brunneifusus* and more reduced and does not follow the outline of the aperture. The outline of the aperture is almost straight (straight columella, only slightly bent outer lip) and the transition to the siphonal canal is gradual. In members of *Brunneifusus* the columella is also almost straight, but the sinus forming the transition from the body whorl to the siphonal canal is more curved.

Shells of adult *Lenifusus* are smaller (maximum height ca. 110 – 170 mm compared to over 300 mm in *Hemifusus*) and light to dark brown whereas the shells belonging to the genus *Hemifusus* are cream coloured.

Comparison of the 3 genera: For easier comparison of the three genera, the most significant characteristics of the shells are listed in table 1.

Table 1

	Hemifusus	*Lenifusus*	*Brunneifusus*
Size	Large, 100 - + 300 mm	85 - 115 mm	up to 170 mm
Colour	Cream	Light to dark brown	Light to dark brown
Bathy-metrical range	50-200 m.	25-30 m.	Low tide mark to 25 m.
Range	Japan, East China Sea, South China Sea	South China Sea	East Indian Ocean to the Philippines
Spiral ribbing	Strong	Weak, especially at midwhorl	Medium strong
Axial sculpture	Growth lines	Growth lines	Weak growth lines
Shoulder	Rounded, with or without spines	Rounded to axially elongated knobs on the rounded shoulder	Angulated with strong knobs, spirally stretched
Outer lip	Non-determinate growth	Determinate; solid outer lip with polished margin	Determinate outer lip

Brunneifusus is in shell character closest to the genus *Volegalea* Iredale, 1938. *Lenifusus* has a little deeper bathymetrical range than the shallower-living *Volegalea* and with the smoother shell it seems more adapted to subtidal circumstances. *Hemifusus* has cream shells with strong ribbing, which seems an adaption to deep-water circumstances.

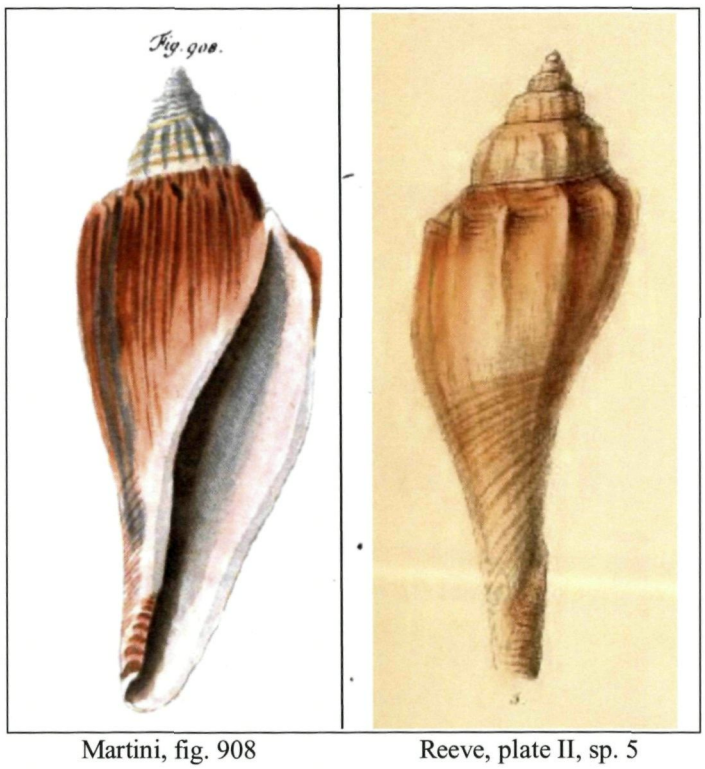
Comments on the identity of *Hemifusus zhangyii* Kosuge, 2008 and *Pyrula elongata* Lamarck, 1822

Hemifusus zhangyii was described by Sadao Kosuge (2008) and compared with *Hemifusus ternatanus* (Gmelin, 1791) and *Hemifusus carinifera* Habe & Kosuge, 1966, now both in the new genus *Brunneifusus*. Kosuge did not compare his new species with *Pyrula*

elongata Lamarck, 1822. Lamarck's description (1822: 143) was without a drawing:

> **14. Pyrule allongée. *Pyrula elongata.***
>
> ***P. testâ elongato-pyriformi, angustâ, longicaudâ, lævisculâ, luteo -rufescente; anfractibus supernè longitudinaliter plicatis: plicis anteriùs nodo terminatis; spirâ caudâque transversè striatis.***
>
> **Martini, Conch. 3. t. 94. f. 908.**
>
> ***Buccinum tuba.* Gmel. p. 3484. n°. 55.**
>
> **Habite l'Océan des grandes Indes. Mon cabinet. Ouverture étroite; bord droit lisse à l'intérieur. Longueur, 4 pouces 3 lignes.**

The reference to Martini (from the 12-volume series known as Martini & Chemnitz), volume 3, plate 94, fig. 908 is illuminating. The figure on plate 94 shows a brownish, almost smooth elongated shell with axial streaks on the visible ventral side of the body whorl. Note the spiral ribbing on the early whorls. The illustrated specimen from the author's collection (Figs. 9-10) is very similar.



Martini, fig. 908 Reeve, plate II, sp. 5

Reeve (1847: plate II, sp. 5) illustrated the dorsal side of *Pyrula elongata* Lamarck, 1822 (see figure above). A complete listing of all literature mentioning *P. elongata* is beyond the scope of this paper.

H. zanghyii Kosuge, 2008 is considered a junior synonym of *P. elongata* Lamarck, 1822. For a long time, *P. elongata* was a rather obscure species not encountered in modern literature or on international shell markets. Following the description of *H. zhangyii* by Kosuge, the species became available on shell markets. Kosuge (2008, plate 43) shows three shells: the type material originating from Vietnam; figure 1 is an almost smooth shell, just like the illustration Lamarck refers to in his description (first reference), and Kosuge's figure 3 has small knobs on the shoulder, like in Reeve's figure. It is obviously the same species, which makes Kosuge's name a junior synonym.

Han Raven (pers. comm.) collected a Holocene specimen 10 km NW of Malacca.

Bayer (1952: 290) refers to the double introduction of the species name *tuba* by Gmelin (1791), firstly as *Buccinum tuba* (page 3484, sp. 55) and secondly as *Murex tuba* (page 3554, sp. 103):

> Gmelin, on p. 3484 of the Systema naturae, has described this *Semifusus*, the *"Pyrula elongata"* of Lamarck, as *"Buccinum Tuba"* (type of the genus) thereby quoting a well recognizable figure of Martini. On p. 3554, however, Gmelin under the same species name has described another *Semifusus*, the *"Classicum legionis desultoriae"* of Martini, namely as *"Murex tuba"*. In connexion with the paging the former *"Buccinum Tuba"* ought to have priority, and thus *S. elongata* should be named *S. tuba*. Where this might cause great confusion, the *"Classicum legionis desultoriae"* by all authors being named *S. tuba*, it seems preferable not to follow here too strictly the rules of nomenclature, and to preserve for *Semifusus elongatus* the name of Lamarck.

As Bayer states, both *Buccinum tuba* and *Murex tuba* are melongenids Lamarck (1822) included in the genus *Pyrula,* but later placed in *Hemifusus* ("*Semifusus*"). However, Bayer's remark on the paging giving priority is not correct (but without harm). Apparently, Lamarck (1822: 143, no. 14) introduced the new name *elongata* for *Buccinum tuba* to prevent double use of *tuba* in his work as *Murex tuba* is also treated as *Pyrula* (Lamarck, 1822: 139 no. 5, *Pyrula tuba*). The type of *Pyrula elongata* is housed in the MHNG-MOLL-51753 (old number 1098/55 written on the shell). The label is later than Lamarck, likely from Delessert; it has an L in the upper corner, which is typical (meaning Lamarck collection). Lamarck likely had only one specimen and so this must be the type (Peter Schuchert, MHNG, pers. comm.).

Snyder (2003: 90) refers to *Pyrula elongata* Lamarck, 1822 as "[unnecessary] new name for *Buccinum tuba* Gmelin, 1791: 3484 no. 55". This interpretation is apparently based on the second reference of Lamarck: *Buccinum tuba*. Yet, Gmelin (1791: 3554, no. 103) described *Murex tuba* based on Chemnitz (1780: Vol 4. plate 143, fig. 1333). The latter is currently known as *Hemifusus tuba* (Gmelin, 1791). Here Snyder must have overlooked that *Buccinum tuba* and *Murex tuba* are two different species in the same genus at the time of Lamarck's writing, or at least in Lamarck (1822).

Reeve (1847) - following the 'Habite' of Lamarck in his description - gives as type locality: "Habite L'Océan des grandes Indes"; "Eastern Seas". I hereby further restrict the type locality to "South China Sea" because the species has been found in Vietnamese waters.

Acknowledgements: I sincerely thank Henk Dekker, Winkel, the Netherlands, for advice and constructive talks on the subject and an anonymous referee for his constructive remarks on the first version of the manuscript. I further thank Han Raven, The Hague, The Netherlands, for helping me improve the manuscript for final acceptance. Henk Menkhorst, Krimpen aan de IJssel, The Netherlands, is thanked for checking the use of Latin grammar. I thank Brian Hayes, Raleigh, USA for his photos. I thank Peter Schuchert of the MNHG for giving me the details of the type of *Pyrula elongata* Lamarck, 1822 in the MNHG and making photos of the type and the old label (not on the plate).

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Plate 1: ***Hemifusus colosseus*** (Lamarck, 1816).

1-2: 241 x 84 mm; trawled at about 120 metres on sand and mud in the East China Sea in 2011. Coll. AMD. Type species of *Hemifusus* Swainson, 1840.

3-4: 71.8 x 25.6 mm; juvenile. Trawled at about 160 metres deep in the East China Sea in 2014.

Plate 2:

5-6: ***Brunneifusus ternatanus*** (Gmelin, 1791)

143 x 54 mm. Albay Gulf, Philippines; in local fishermen's net. Coll. AMD. Type species of *Brunneifusus* gen. nov.

7-8: ***Lenifusus elongatus*** (Lamarck, 1822)

87.6 x 30.4 mm. Vietnam, trawled by fisherman in shallow water in 2011. Coll. AMD. Type species of *Lenifusus* gen. nov.; more common variant with small knobs.


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Plate 3:

9-10: ***Lenifusus elongatus*** (Lamarck, 1822)
107.0 x 37.3 mm. Vietnam, dredged at 40 metres in 2001. Coll. AMD. Type species of *Lenifusus* gen. nov.; smooth variant close to Martini (1777), volume 3, plate 94, fig. 908.
(photo by Brian Hayes, Raleigh, USA.)

11-12: ***Hemifusus crassicauda*** (Philippi, 1849)
141.7 x 71.4 mm; with periostracum; Japan, Kuchinotsu-Cho, Minami, Tahagi-fun, Nagasaki Prefecture, off Minabe Town coast. Coll. AMD.

Plate 4:

13-14: ***Hemifusus kawamurai*** Kira, 1965
155 x 83mm incl. spines; with periostracum; South Taiwan; dredged by fisherman at 40 metres in 2005. Coll AMD.

15-16: ***Hemifusus tuba*** (Gmelin, 1791)
161 mm x78 mm; with periostracum; Japan, SW Kii Peninsula, Wakayama Prefecture, off Minabe Town coast. In gill nets at 30-40 metres. March 2000. Coll. AMD.