

CORALLIOPHILINAE (NEOGASTROPODA: MURICIDAE) FROM THE MARQUESAS ISLANDS

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Abstract Fourteen species of Coralliophilinae (Neogastropoda, Muricidae) have been identified in the material collected by the MUSORSTOM 9 expedition to the Marquesas Islands. This coralliophiline fauna appears severely impoverished, compared to other West Pacific areas. At least half of the species (seven) are members of the shallow water fauna, an unusual pattern for the prevalently deep water coralliophilines, which may indicate an increase with depth of the effects of marginality on benthic faunas. One new species *Coralliophila nukuhiva* n. sp. is here described.

Key words Coralliophilinae, Muricidae, Marquesas, Systematics

INTRODUCTION

The Coralliophilinae, a subfamily of Muricidae with approximately 200-250 described living species, are associated with anthozoan cnidarians, from intertidal habitats down to over 1000 m depth. The Indo-Pacific region hosts the majority of the known species, especially in the core of the region, the area included in the Philippine-Borneo-Papua triangle. Yet the marginal areas in the Pacific are of great biogeographical relevance both for shallow and deep water habitats. The Coralliophilinae, successfully radiated in deep waters, an interesting pattern for a group associated with corals. The present revision, along with a similar one based on materials from the Australes Islands (Oliverio, in prep.) is aimed at providing the faunistic data for a better understanding of the biogeography of these ectobiotic gastropods at the margins of the Indo-West Pacific (see Benton & Spencer [eds], 1995). Previous records of coralliophilines from the Marquesas Islands are to be found in Hombron & Jacquinot (1852), Jardin (1858), Rehder (1969, 1985), Salvat & Rives (1975), Tröndlé (1989), and have been reviewed by Tröndlé & Cosel (2005).

MATERIALS AND METHODS

This study is based on the material collected during the expedition MUSORSTOM 9, which included a cruise and a land based workshop. The cruise (led by B. Richer de Forges, IRD, onboard R/V *Alis*) sampled a total of 168 stations by dredging and trawling. Of these, 28 stations

in the waters of seven islands, yielded coralliophiline specimens. The land based workshop (led by R. von Cosel, MNHN) was carried out on Ua Huka Island, sampling a total of 40 stations, of which 6 yielded coralliophiline specimens. For details on the expedition and the complete list of the stations see Richer de Forges *et al.* (1999). Additionally, I have had the possibility to examine the Marquesan samples in the private collections of Jean Tröndlé (La Force: who also took part in the land based workshop at Ua Huka) and Michel Boutet (Tahiti).

A total of 14 species have been identified and are treated in the systematic account. Supraspecific taxonomy in the Coralliophilinae is traditionally based, nearly exclusively, on shell morphology and is currently highly unstable. The first attempts to make a phylogenetic framework for the coralliophiline systematics (Oliverio & Mariottini 2001, Oliverio *et al.* 2002) addressed the need for a deep re-examination by refined morphology and molecular markers. The four genera used herein are thus conceived as in the "traditional" (i.e. Kosuge & Suzuki 1985) taxonomy, yet adopting some slight modifications (e.g. Tsuchiya 2000).

One species is described as new to Science. The protoconchs of 3 species are illustrated with SEM images for the first time. When more than one sample is available for a species, the depth range is given as internal range, which is the range within which the species has certainly been collected (compared to the external range, which is the range where the species may have been collected). Comparative reference is made to Oliverio (in press) for distributional and ecological data, or taxonomical notes.

ABBREVIATIONS

- AMNH America Museum of Natural History, New York, USA.
 AMS The Australian Museum, Sydney.
 BMNH Natural History Museum, London, UK.
 IMT Institute of Malacology, Tokyo
 KPM Kanagawa Prefectural Museum, Yokohama
 MNHN Muséum National d'Histoire Naturelle, Paris, France.
 SAM South Africa Museum, Cape Town
 SDSNH San Diego Society of Natural History, California, USA
 sh empty shell(s).
 spm live collected specimen(s).
 SSSM Sea Shell Specimen Museum, Shinjuku, Tokyo
 TA Toba Aquarium, Toba
 TwM Taiwan Museum, Taiwan.
 USNM Museum of Natural History, Smithsonian Institution, Washington DC, USA.
 ZMB Museum of Natural History, Humboldt University, Berlin
 ZMUC Zoological Museum University of Copenhagen

SYSTEMATICS

Superfamily Muricoidea Rafinesque, 1815
 Family Muricidae Rafinesque, 1815
 Subfamily Coralliophilinae Chenu, 1859

Genus *Coralliophila* H. & A. Adams, 1853

Coralliophila H. & A. Adams, 1853: 135. Type species: *Fusus neritoideus* Lamarck, 1816 (= *Purpura violacea* Kiener, 1836), by subsequent designation (Iredale, 1912).

Coralliobia H. & A. Adams, 1853: 138. Type species (by monotypy): *Concholepas (Coralliobia) fimbriata* A. Adams 1854; Recent, Indo-West Pacific.

Galeropsis Hupé, 1860: 125. Type species (by monotypy): *Galeropsis lavenayanus* Hupé, 1860; Lower Miocene, France.

Pseudomurex Monterosato, 1872: 15. Type species (by original designation): *Murex meyndorffii* Calcara, 1845; Recent, Northeastern Atlantic.

Quoyula Iredale, 1912: 221. Type species (by original designation): *Purpura monodonta* Blainville,

1832; Recent, Indo-Pacific.

Reliquiaecava Massin, 1987: 81. Type species (by original designation): *Leptoconchus robillardi* Liénard, 1870. Recent, Indo-Pacific.

Rhombothais Woolacot, 1954: 38. Type species (by original designation): *Rhombothais arbutum* Woolacot, 1954 Recent, Australia.

Remarks Since *Coralliophila* as traditionally conceived is clearly polyphyletic (Oliverio & Mariottini 2001, and new unpublished data), the genus is here used in a wide sense (*Coralliophila sensu lato*). Also the list of synonymies for *Coralliophila* is deemed to be revised in a phylogenetic framework. I have included in *Coralliophila* (s.l.) also *Rapana nodosa* A. Adams, 1854, which is traditionally included in *Mipus*, following Tsuchiya (2000) and particularly Oliverio (in press).

Coralliophila violacea (Kiener, 1836)

"*Murex neritoideus*" Chemnitz, 1788: 280, pl. 165, figs 1577, 1578 (non binominal).

Murex neritoideus Gmelin, 1791: 3559 (non Linnaeus, 1767).

Fusus neritoideus Lamarck, 1816: pl. 435, figs 2a, b.

Purpura violacea Kiener, 1836: 77, pl. 19, fig. 57.

Type material *Murex neritoideus* Gmelin, Chemnitz's (1788) figured specimen (not found in Copenhagen nor in S. Petersburg).

Type locality *Purpura violacea* Kiener [*Murex neritoideus* Gmelin]: Nicobar Islands, "an den Stranden der Nicobarischen Enlande" (Chemnitz 1788: 280).

Material examined — MUSORSTOM 9: Ua Huka Is.: stn 19, Hane Bay, 8°56.65'S, 139°42.40'W, 0-3 m, 2 spm; Nuku Hiva Is., intertidal 4 sh. (coll. Jean Tröndlé, La Force and Michel Boutet, Tahiti).

Distribution The entire Indo-Pacific. From the Red Sea and the western Indian Ocean to the tropical eastern Pacific, Panamic province to Ecuador, subtidal associated with *Porites* (e.g.: Bosch *et al.* 1995; Tsuchiya 2000; Keen 1971; Cernohorsky 1972). From New Caledonia, alive in 4-25 m (Oliverio in press). Marquesas, alive in 0-3 m.

Remarks This is the type species of *Coralliophila*. The nomenclatural history of *Coralliophila violacea* was summarized by Cernohorsky (1985) and Oliverio (in press). It has been reported from Marquesas by Jardin (1858: 188) and by Rehder (1969: 31).

Coralliophila bulbiformis (Conrad, 1837)

Purpura bulbiformis Conrad, 1837: 266, pl. 20, fig. 23.

Purpura gibbosa Reeve, 1846: sp. 78.

Coralliophila cantrainei Montrouzier in Souverbie, 1861: 282, pl. 11, fig. 11.

Coralliophila elaborata H. & A. Adams, 1863: 433.

Coralliophila nivea Oliver 1915: 536 (non A. Adams, 1853).

Coralliophila erosa Kay 1979: 255, fig. 90B (non Röding, 1798).

Type material *Purpura bulbiformis*: not found. — *Purpura gibbosa*: 3 possible syntypes BMNH 1984102, none of which matches the original illustration (K.M. Way pers. comm.), one figured by Kosuge & Suzuki (1985: pl. 47, fig. 2). — *Coralliophila cantrainei*: Kosuge & Suzuki (1985: pl. 47, fig. 1) figured an alleged "syntype" from MNHN; actually there are 4 specimens "ex. d'auteur" (determined by the author - Montrouzier - yet not type material) in MNHN, the holotype should be in the Musée de Bordeaux. — *Coralliophila elaborata*: lectotype ("type", Kosuge & Suzuki 1985, pl. 37, fig. 8) BMNH 1982057/1 and 2 paralectotypes BMNH 1982057/2-3.

Type locality *Purpura bulbiformis*: Kauai [Atooi], Hawaiian Islands. — *Purpura gibbosa*: no locality reported. — *Coralliophila cantrainei*: Art Island, New Caledonia. — *Coralliophila elaborata*: Hawaii.

Material examined — Nuku Hiva Is., intertidal 2 sh. (coll. Jean Tröndlé, La Force); Fatu Hiva Is., 1 sh. (coll. Michel Boutet, Tahiti).

Distribution Throughout the Indo-West Pacific, intertidal with hermatypic corals (Cernohorsky 1978; Brook 1999: 453). From New Caledonia, alive in 4-32 m (Oliverio in press). Marquesas, shell only, intertidal.

Remarks It was reported from Marquesas by Salvat & Rives [under *C. costularis* (Lamarck, 1816)], by Rehder (1985: 98) and by Tröndlé (1989: 19).

Coralliophila abnormis (Smith, 1878)

Figures 1-3, 30

Fusus abnormis Smith, 1878: 811-812, pl. 50, fig. 10.

Latiaxis chiangi Lan, 1982: 23, fig. 1.

Coralliophila armeniaca D'Attilio & Myers, 1984: 89, figs 21-24.

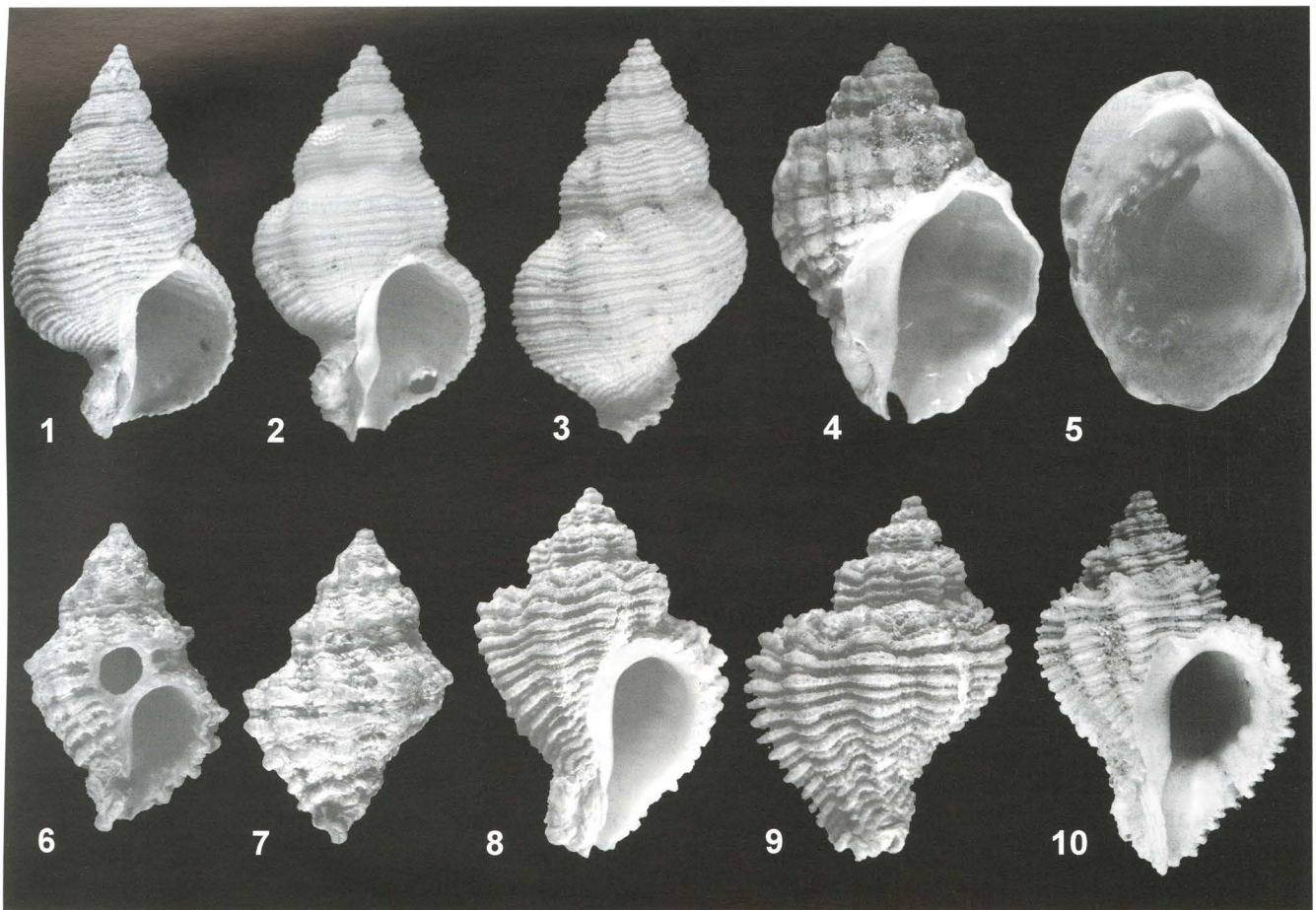
Type material *Fusus abnormis*: holotype, BMNH 1878.6.10.17, figured By Kosuge & Suzuki (1985, pl. 39, fig. 1) and Higo *et al.* (2001: 66, fig. G2403). — *Latiaxis chiangi*: holotype, TwM MT8218. — *Coralliophila armeniaca*: holotype, SDSHN 79507 and 14 paratypes (SDSHN 79504a-j, AMNH 213803a-b, USNM 819634a-b).

Type locality *Fusus abnormis*: Andaman Islands, off Port Blair. — *Latiaxis chiangi*: Bohol Island, Philippines. — *Coralliophila armeniaca*: Bohol Straits, 75 m depth.

Material examined MUSORSTOM 9: Ua Pou Is., stn DW 1144, 9°19.3'S, 140°03.8'W, 85-95 m, 2 sh; Eiao Is., stn DW 1154, 7°58.5'S, 140°43.7'W, 102 m, 1 sh; Nuku Hiva Is., stn DW 1170, 8°45.1'S, 140°13.1'W, 104-109 m, 9 sh; stn DR 1181, 8°45.5'S, 140°03.2'W, 102-130 m, 1 spm 3 sh; stn DR 1182, 8°45.6'S, 140°03.9'W, 90-120 m, 3 sh; stn DR 1305, 8°54.1'S, 140°14.5'W, 90-155 m, 2 sh; Hiva Oa Is., stn DW 1208, 9°48.9'S, 139°09.5'W, 117-117 m, 1 sh; stn DW 1224, 9°44.6'S, 138°51.1'W, 115-120 m, 1 sh; Fatu Hiva Is., stn DW 1242, 10°28.1'S, 138°41.1'W, 119-122 m, 1 juv sh; Ua Huka Is., stn DR 1292, 8°54.1'S, 139°37.8'W, 95-100 m, 1 sh.

Distribution Indian Ocean, Somalia (Kosuge 1993) to the Andaman Islands (Smith 1878). Pacific Ocean, from Kii Peninsula to the Philippines (Tsuchiya 2000). From New Caledonia, alive in 15-25 m (Oliverio in press). Marquesas, one alive in 102-130 m, empty shells in 95-119 m..

Remarks Protoconch of 3.8 whorls (Fig. 30), 700 µm high and 650 µm wide at the base. Protoconch I of 0.9 whorls, sculptured with pustules over the entire



Figures 1-10 Shells of Coralliophilinae. 1-3 *Coralliophila abnormis* (Smith, 1878): 1 Nuku Hiva Is., stn DW 1170, 104-109 m [15.2×8.8mm]; 2-3 - stn DR 1181, 102-130 m [14.4×7.5 mm]. 4 *Coralliophila clathrata* (A. Adams, 1854), Ua Huka Is.: stn 20, South coast, Hinipahué Bay, 8°56.20'S, 139°32.90'W, intertidal, [11.5×8.1 mm]. 5 *Coralliophila monodonta* (Blainville, 1832), Ua Huka Is., stn 23, Haamamao Bay, intertidal [20.5×14.7 mm]. 6, 7 *Coralliophila curta* G.B. Sowerby III, 1894: Hiva Oa Is., stn DW 1204, 60-62 m [7.6×4.8 mm]. 8-10 *Coralliophila nukuhiva* n. sp.: 8, 9, Holotype stn CP 1176, Nuku Hiva Is., 260 m. (MNHN 20896), [20.8×15 mm]. 10 New Caledonia, BATHUS 4 stn CP 928 [24.0×15.5 mm].

surface (partly abraded in the figured specimen). Protoconch-II of 2.9 whorls, with two major spiral keels, and a minor subsutural one, each sculptured by a series of threads (prosocline on the minor subsutural keel, opisthocline on the major keels). The threads tend to fuse, giving rise to collabral riblets. This morphology may be considered as grossly concordant with the protoconch of *Coralliophila armeniaca*, described by D'Attilio & Myers (1984: 89, fig. 23) as multispiral (3.5 whorls) with two poorly nodulose spiral cords crossed by axial ridges. *Coralliophila abnormis* is normally found throughout its range in water shallower than about 100 m and is thus considered a shallow water species (Oliverio in press). All present specimens were collected in slightly deeper waters at Marquesas where passive transport cannot be excluded, even for the specimen collected alive.

Coralliophila clathrata (A. Adams, 1854)

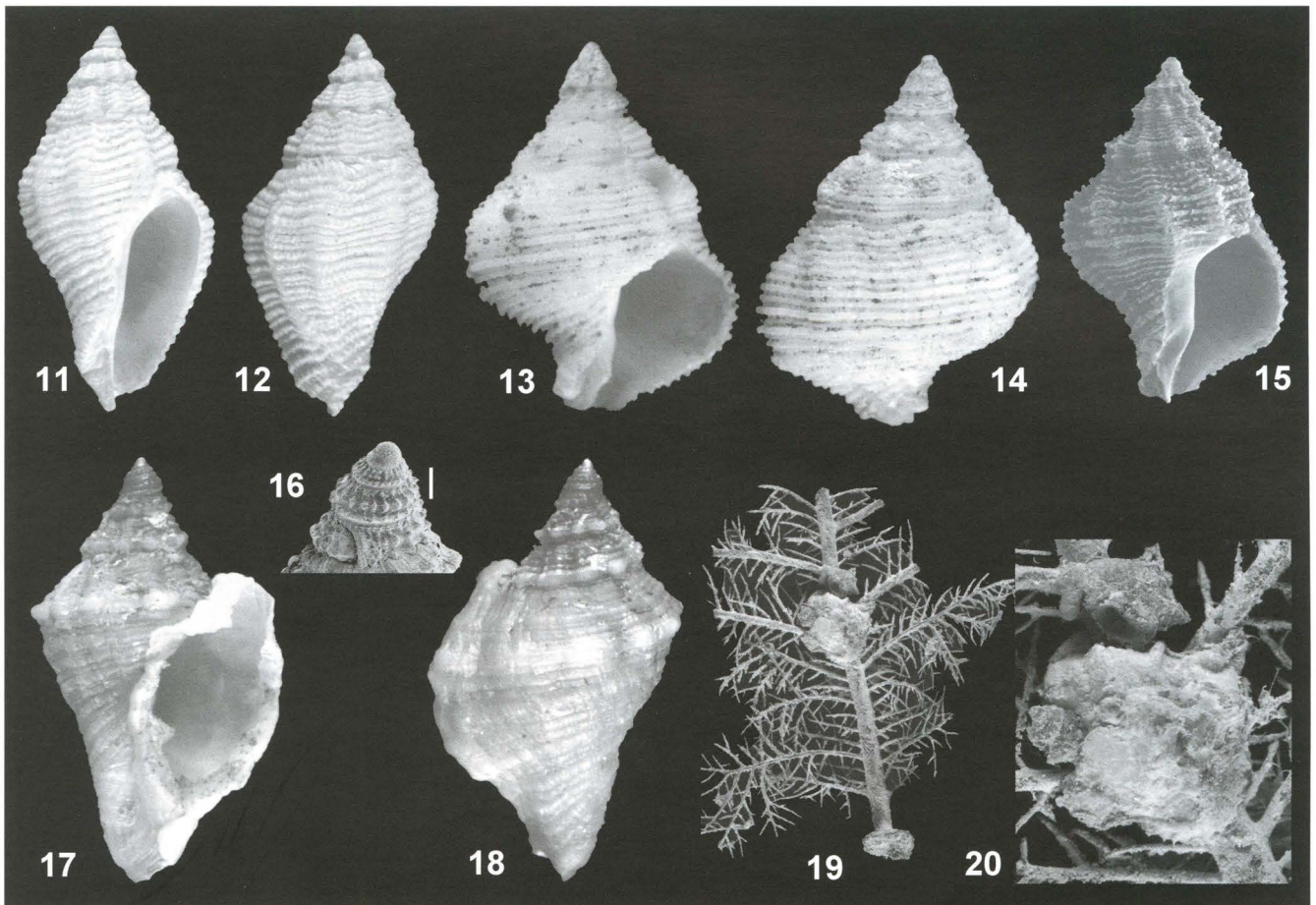
Figure 4

Rapana (*Rhizochilus*) *clathrata* A. Adams in H. & A. Adams 1853-58 [1854]: 97.

Coralliobia sugimotoi Kuroda, 1931: 316, pl. 1, figs 5-7.

Type material Rapana clathrata: lectotype (Robertson 1980: 8, figs 8, 9) BMNH 1882.12.6.73, figured by Kosuge & Suzuki (1985: pl. 46, fig. 4). — *Coralliobia sugimotoi*: not found.

Type locality Rapana clathrata: Philippines (Robertson 1980). — *Coralliobia sugimotoi*: Okinoshima, Tosa Bay, Japan.



Figures 11-20 Shells of Coralliophilinae. **11, 12** *Coralliophila mitraeforma* Kosuge, 1985: Fatu Hiva Is., stn DR 1247, 1150-1250 m [Fig. 9 4×4.6 mm]. **13-15** *Coralliophila nodosa* (A. Adams, 1854): Nuku Hiva stn DW 1170, 104-109 m [Figs 13, 14: 16.9×12.4 mm.] [Fig. 15: 12×8.6 mm]. **16-20** *Rhizochilus* cf. *antipathum* Steenstrup, 1850: Ua Pou Is., stn CP 1159, 145 m [Fig. 17 7.5×4.4 mm]

Material examined MUSORSTOM 9: Ua Huka Is.: stn 20, South coast, Hinipahué Bay, 8°56.20'S, 139°32.90'W, intertidal, 2 spm, 1 sh; stn 19, Hane Bay, 8°56.65'S, 139°42.40'W, 0-3 m, 1 sh; stn 23, Haamamao Bay, 8°55.90'S, 139°31.45'W, intertidal, 1 sh.

Ua Pou Is., intertidal, 1 sh (coll. Jean Tröndlé, La Force); Nuku Hiva Is., intertidal, 2 sh. (coll. Jean Tröndlé, La Force) , 2 sh (coll. Michel Boutet, Tahiti); Fatu Hiva Is. 1 spm, 1 sh (coll. Michel Boutet, Tahiti : ex. coll. G. Richard).

Distribution Indo-Pacific. Indian Ocean, from Natal to Sri Lanka and Maldive Islands (Barnard 1969: 637, fig. 17c, as *Coralliophila* sp.; Robertson 1980). Pacific Ocean, from Kii Peninsula (Japan) southward to the Great Barrier Reef, through the tropical Pacific, eastward to the Marquesas Islands (Robertson 1980; Tsuchiya 2000). New

Caledonia, shells only in 4-20 m (Oliverio in press). Marquesas, living intertidal, empty shells down to 3 m.

Remarks It is known to be associated with, and to feed on, the zoanthids *Palythoa* spp. (Robertson 1980). It was reported from Marquesas by Tröndlé (1989).

Coralliophila monodonta (Blainville, 1832)

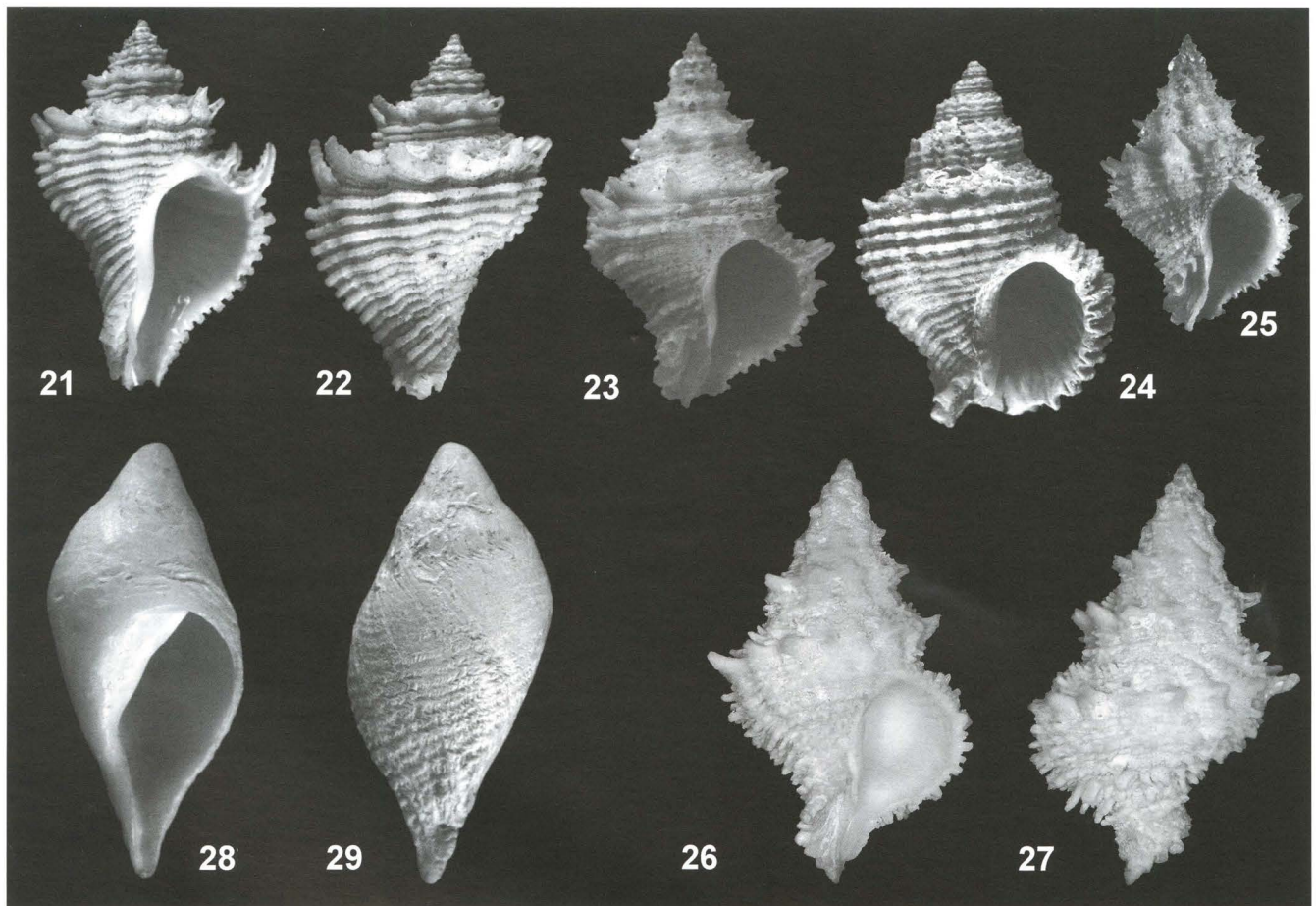
Figure 5

Purpura monodonta Blainville, 1832: 241.

Purpura monodonta Quoy & Gaimard, 1833: 561, pl. 37[1834], figs 9-11.

Purpura madreporarum G.B. Sowerby I in J. Sowerby & G.B. Sowerby I, 1834: pl. 237, fig. 12.

Quoyula madreporarium [sic] - Oliver 1915: 537.



Figures 21-29 Shells of Coralliophilinae. **21, 22** *Babelomurex japonicus* (Dunker, 1882), Nuku Hiva Is., stn CP 1176, 260-260 m [Fig. 21.8×14.9 mm]. **23-27** *Babelomurex takahashii* (Kosuge, 1979). **23, 24** Nuku Hiva Is., stn DW 1170, 104-109 m [Fig. 23: 19.5×13.2 mm; Fig. 24: 31×21.5 mm]. **25**, Hiva Oa Is., stn DW 1224, 115-120 m [SEM 9.8×5.7 mm]. **26, 27**, Holotype of *Babelomurex cookae* USNM 859322, Hawaii Islands [39.0×24.7 mm]. **28, 29** *Leptoconchus lamarckii* Deshayes, 1863, Ua Pou stn DW 1143, 18-55 m [Fig. 24.1×11.1 mm].

Coralliophila madreporara [sic] - Kosuge & Suzuki 1985: 35, pl. 46, fig. 7. — Bosch *et al.* 1995: 125, fig. 501.

Galeropsis madreporarus [sic] - Lozouet & Renard 1998: 181, figs 7/4, 5.

Coralliophila madreporaria [sic] - Tsuchiya 2000: 419, pl. 208, fig. 291.

Type material *Purpura monodonta* Blainville: lectotype (Oliverio in press) and 1 paralectotype MNHN. — *Purpura madreporarum*: 3 possible syntypes BMNH 1985104.

Type locality *Purpura monodonta* Blainville: Tonga-Tabou. — *Purpura madreporarum* Sowerby G.B. I: unknown.

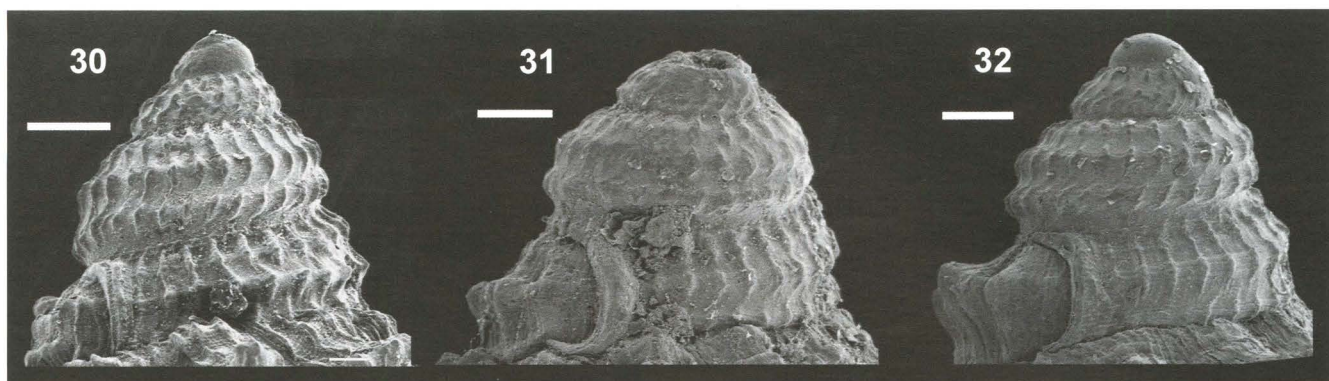
Material examined MUSORSTOM 9: Nuku Hiva Is., stn CP 1177, 8°45.1'S, 140°14.1'W, 108-112 m, 1

spm; Hiva Oa Is., stn DW 1206, 9°51.4'S, 139°09.1'W, 352-358 m, 1 juv sh; Fatu Hiva Is., stn DR 1244, 10°28.4'S, 138°42.1'W, 1015-1020 m, 1 sh.

Ua Huka Is.: stn 1, Hane Bay, Hinipahué Bay, 8°55.6'S, 139°32.1'W, intertidal, 1 sh; stn 23, Haamamao Bay, 8°55.90'S, 139°31.45'W, intertidal, 1 sh; stn 24bis, Haahue Bay, 8°53.60'S, 139°37.0'W, 20-33 m, 1 sh.

Rimatata Is. intertidal, 1 sh (coll. Jean Tröndlé, La Force); Ua Pou Is., intertidal, 1 sh (coll. Jean Tröndlé, La Force); Nuku Hiva Is., intertidal, 1 sh (coll. Jean Tröndlé, La Force).

Distribution Indo-Pacific, from the Red Sea and the eastern Africa to Indonesia, throughout the tropical Pacific (e.g.: Bosch *et al.* 1995; Cernohorsky 1972), including Hawaii (Kay 1979) and Easter Island (Rehder 1980), and extending in the eastern Pacific to the Galapagos Islands



Figures 30-32 Protoconch of Coralliophilinae. **30** *Coralliophila abnormis* (Smith, 1878): Nuku Hiva Is., stn DW 1170, 104-109 m. **31** *Coralliophila nodosa* (A. Adams, 1854): Nuku Hiva stn DW 1170, 104-109 m. **32** *Babelomurex takahashii* (Kosuge, 1979), Hiva Oa Is., stn DW 1224, 115-120 m. Scale bars 200 μ m.

(Finet 1994) and the American west coast (Keen 1971). From New Caledonia, alive in 4-40 m (Oliverio in press). Marquesas, empty shells intertidal to 33 m, with deep samples (empty shells 112-1015 !) likely to be the result of drifting down the slope.

Remarks The question of the valid name for this species is dealt with by Oliverio (in press), who established that the binomen *Purpura monodonta* Blainville was dated to 1832 and was thus the first available. Recorded from Marquesas by Hombron & Jacquinot (1852), Jardin (1858) and Rehder (1969), all under *Purpura madreporarum*, and by Tröndlé & Cosel (2005).

Coralliophila curta G.B. Sowerby III, 1894
Figures 6, 7

Coralliophila curta G.B. Sowerby III, 1894: 42, pl. 4, fig. 4.

Type material Holotype BMNH 1890.9.25.23, figured by Smriglio & Mariottini (2000: 13, figs 9, 10).

Type locality Mauritius.

Material examined MUSORSTOM 9: Hiva Oa Is., stn DW 1204, 9°52.6'S, 139°03.2'W, 60-62 m, 1 sh.

Nuku Hiva Is., intertidal, 1 sh (coll. Michel Boutet, Tahiti).

Distribution Indo-West Pacific, from Mauritius to southern Japan, the Philippine and New

Caledonia (Kosuge & Suzuki 1985; Tsuchiya 2000; Oliverio in press), intertidal to 30 m. Marquesas, empty shells intertidal to 60 m.

Remarks The protoconch of 2.6 conical whorls (Oliverio in press) indicates a planktotrophic development. This record, the easternmost for the species, extends the range to the entire western Pacific.

Coralliophila nukuhiva n. sp.
Figs 8-10

Holotype 1 spm (Figs 8, 9), from stn CP 1176, Nuku Hiva Is., Marquesas, 8°44.8'S, 140°14.5'W, 260 m, MNHN 20896.

Paratypes Ua Huka Is., stn DW 1288, 8°53.9'S, 139°38.0'W, 200-220 m, 1 spm, MNHN 20897; stn CP 1300, 8°49.9'S, 140°17.4'W, 416-430 m, 1 spm, MNHN 20898; Hiva Oa Is., stn DR 1198, 9°50.0'S, 139°09.4'W, 290-320 m, 1 spm, MNHN 20899; stn DW 1201, 9°50.6'S, 139°09.2'W, 275-300 m, 3 spm, 1 sh, MNHN 20900; Hatutaa Is., stn DW 1287, 7°54.5'S, 140°40.2'W, 163-245 m, 1 spm, MNHN 20901.

Type locality Nuku Hiva Is., Marquesas, 8°44.8'S, 140°14.5'W, 260-260 m, [MUSORSTOM 9: stn CP 1176].

Material examined **Marquesas** MUSORSTOM 9: Ua Huka Is., stn DW 1288, 8°53.9'S, 139°38.0'W, 200-220 m, 1 sh. **North of New Caledonia** BATHUS 4: stn DW 927, Grand Passage, 18°56'S, 163°22'E, 444-452 m, 1 sh; stn CP 928, 18°55'S,

163°24'E, 420-452 m, 1 sh (Fig. 10). **Norfolk Ridge** BATHUS 3: stn CP 811, Banc Jumeau Ouest, 23°41'S, 168°15'E, 383-408 m, 1 sh.

Measurements Size of the type specimens (height × width, mm). Holotype: 20.8×15. Paratypes: 22.1×14.4, 21.2×13.3, 12×8.1, 14×8.6, 11.2×7.1, 12.3×7.5, 13.9×9.1, 12×7.6. Average height/width ratio 1.5 (std 0.08).

Description Shell of medium size for genus, height 20.8 mm and width 15 mm, thick, rhomboidal in shape, with angled shoulder.

Protoconch missing in the holotype. *Teleoconch* of 4.2+ whorls (tip missing in the holotype). Spire relatively high, conical, with flat sides, suture very incised. Aperture more than half of total height, last whorl over $\frac{3}{4}$ of total height. Spire strongly curved at the shoulder, base constricted. Aperture long, narrowly oval. Outer lip externally crenulated. Inner lip straight, callous. Siphonal canal moderately long, open; umbilical area moderately wide with imbricate fasciole, umbilicus narrowly open. Sculpture on the teleoconch whorls consisting of closely set spiral cords with minute, densely packed imbricate scaly spines. One cord on the first whorl, then additional cords appearing, gradually increasing in size. Five major cords and two minor cordlets above the aperture and a total of 23 cords on the last whorl, 17 major and 6 minor, irregularly alternating. Axial sculpture of 8 broad, slightly prosocline ribs per whorl. Ground colour ivory white, inside the aperture bright white.

Animal and operculum unknown.

Derivation of name The epithet *nukuhiva* refers to the island (Nuku Hiva Is.) where the holotype was collected. Used as a noun in apposition.

Distribution *C. nukuhiva* n. sp. is known from the Marquesas, alive in 220-416 m, and New Caledonia and Norfolk Ridge, empty shells in 408-444 m.

Remarks The protoconch was totally missing in all specimens except for a remnant in one paratype. This much eroded whorl of the protoconch had traces of two keels and sinusigera lip, indicating a multispiral type and thus a planktotrophic development. *C. nukuhiva* is similar to *C. nivea* (A. Adams, 1853) from which it differs in its

coarser spiral sculpture of more closely set cords, its less slender spire, with a more pronounced shoulder and incised suture. From *Coralliophila ovoidea* (Kosuge, 1985) it differs in its less elongated spire, proportionally higher aperture and more stepped shoulder. It is also similar to *C. fritschi* (Martens, 1874), from South Africa, in the pattern of teleoconch sculpture but differs in its less slender outline, in having coarser sculpture and a less constricted base. From *C. roseocephala* Kosuge, 1986, it differs in its less slender spire with more convex whorls.

Coralliophila mitraeforma Kosuge, 1985

Figs 11, 12

Coralliophila mitraeforma Kosuge, 1985: 56, pl. 21, figs 1-2.

Type material Holotype IMT 85-21, figured by Higo *et al.* (2001: 66, G2401).

Type locality Mactan, Cebu, Philippines.

Material examined MUSORSTOM 9: Fatu Hiva Is., stn DR 1247, 10°34.0'S, 138°41.6'W, 1150-1250 m, 1 sh.

Distribution Pacific Ocean, from off Danjo Islands, Western Ki sh to the Philippines (Higo *et al.* 1999: 217, Tsuchiya 2000). From New Caledonia, alive in 245-400 m (Oliverio in press). Marquesas, one empty shell in 1150-1250 m.

Remarks The protoconch, which was partly eroded and of 2.5+ conical whorls, indicates a planktotrophic larval development. This species is very similar to *C. solutistoma* Kuroda & Shikama, 1966, the main difference being the higher value of the ratio "total height/apertural height" (h/a). Specimens with a ratio of 1.7 or less exist and these can hardly be separated from slender specimens of *C. solutistoma*. Specimens with a ratio greater than 1.7 are easily identified as *C. mitraeforma*. This record significantly extends the range eastward in the Pacific.

Coralliophila nodosa (A. Adams, 1854)

Fig. 13-15, 31

Rapana (Latiaxis) nodosa A. Adams, 1854: 98.

Type material Two syntypes, BMNH 1984114, figured by Kosuge & Suzuki (1985: pl. 25, fig. 8, pl. 46, fig. 10).

Type locality Philippines.

Material examined MUSORSTOM 9: Nuku Hiva stn DW 1170, 8°45.1'S, 140°13.1'W, 104-109 m, 1 spm, 2 sh.

Distribution Western Pacific, Philippines to Hawaii (Kay 1979). New Caledonia, empty shells in 230-266 m (Oliverio in press). Marquesas alive in 104-109 m.

Remarks A single, partly eroded (last 2.6 whorls remaining) measured 720 µm wide at the base and 790+ µm high (Fig. 31). Protoconch I is missing. Protoconch II has two major spiral keels covered by nodulose tubercles and a series of subsutural tubercles visible. A sinusigera lip at the protoconch-teleoconch boundary is present.

The referral of the present shells to Adam's taxon is not definitive. The general outline is similar to that of *Coralliophila crebrilamellosa*, the main difference being the less scabrous spiral sculpture. The specimens listed here seem constant in their characters. *Rhombothais arbutum* Woolacot, 1954, from Australia, and *Latiaxis rosaceus* Smith, 1903, from South Africa, are similar. All are commonly placed in *Mipus*, and possibly represent a complex with an Indo-West Pacific distribution.

Coralliophila fimbriata (A. Adams, 1854)

Figs 47, 163

Concholepas (*Coralliobia*) *fimbriata* A. Adams, 1854: 93.

Coralliobia cancellata Pease, 1861: 399.

Coralliobia sculptilis Pease, 1865: 513.

Coralliobia smithi Yen, 1942: 226.

Coralliobia densicostata Shikama, 1963

Type material *Concholepas fimbriata*: syntype BMNH 1985103, figured by Kosuge & Suzuki (1985: pl. 48, fig. 8). — *Coralliobia sculptilis*: not found (Kay 1965: 86). — *Coralliobia cancellata*: not found (Kay 1965: 85). — *Coralliobia smithi*: holotype BMNH 94.4.5.17, figured by Kosuge & Suzuki (1985: pl. 45, fig. 5). — *Coralliobia densicostata*: syntype KPM NG0120043, figured

by Kosuge & Suzuki (1985: pl. 45, fig. 6) and by Higo *et al.* (2001: 66, G2411).

Type locality *Concholepas fimbriata*: Cagayan, Mindanao, Philippines. — *Coralliobia sculptilis*: Hawaiian Islands [Sandwich Islands]. — *Coralliobia cancellata*: Hawaiian Islands [Sandwich Islands]. — *Coralliobia smithi*: Macclesfield Bank, China Sea. — *Coralliobia densicostata*: Nase, Amami-Oshima, Japan.

Material examined MUSORSTOM 9: Hiva Oa Is., stn DW 1204, 9°52.6'S, 139°03.2'W, 60-62 m, 1 sh.

Distribution Tropical and subtropical Indo-West Pacific (Kay 1979; Kosuge & Suzuki 1985). New Caledonia, alive in 90-305 m, empty shells in 12-447 m. Present material, alive in 90-367 m, empty shells in 5-487 m.

Remarks *Coralliophila fimbriata* is the type species of *Coralliobia* H. & A. Adams, 1853, but I prefer to keep it in *Coralliophila* [s.l.] until the systematics of coralliophilines is clarified and relationships with other nominal genera (e.g. *Emozamia*) have been reviewed. *Coralliophila fimbriata* is associated with hermatypic scleractinians, yet it has frequently been collected alive at depths well over 100 m.

Genus *Rhizochilus* Steenstrup, 1850

Rhizochilus Steenstrup, 1850: 75. Type species (by monotypy): *Rhizochilus antipathum* Steenstrup, 1850; Recent, Indo-Pacific.

Rhizochilus cf. *antipathum* Steenstrup, 1850
Figs 16-20

Rhizochilus antipathum Steenstrup, 1850: 75.

Rhizochilus teramachii Kuroda, 1953: 118, 125-126, text figs 1, 2.

Type material *Rhizochilus antipathum*: 7 syntypes ZMUC, one figured by Kosuge & Suzuki (1985: pl. 50, fig. 6). — *Rhizochilus teramachii*: holotype in TA 1921, figured by Kosuge & Suzuki (1985: pl. 45, fig. 12) and Higo *et al.* (2001: 66, G2412s).

Type locality Rhizochilus antipathum: No locality is given either with the type material (Ole Tendal, pers. comm.) or in the original description.— *Rhizochilus teramachii*: East of Ashizuri-Misaki, Japan, 80-90 fms [146-165 m].

Material examined MUSORSTOM 9: Ua Pou Is., stn CP 1159, 7°58.3'S, 140°43.7'W, 145 m, 1 spm, 1 juv spm; Eiao Is., stn CP 1271, 7°53.6'S, 140°42.2'W, 600 m, 2 spm (on coral branch); stn DW 1274, 7°54.6'S, 140°40.1'W, 100-120 m, 2 spm (on coral branch).

Distribution Indo-Pacific, Indian Ocean (Réunion Is., MO, unpublished) and western Pacific, from Japan, (Tsuchiya 2000), to Hawaii (Gage 1962; Kay 1979). New Caledonia, shells only in 25-400 m. Marquesas, alive in 120-600 m.

Remarks The multispiral protoconch of 3.2 conical whorls is indicative of a planktotrophic development. This species was recorded for the Marquesas by Tröndlé (1989: 25, referring to material from the PELE expedition based on a pers. comm. by H.A. Rehder). All recorded associations refer to antipatharians (e.g. "on *Antipathes japonica* Brook": Higo *et al.* 1999: 217, G2412; on *Antipathes grandis*: Gage 1962). Beyond the typical deformation in the adults, there is some variability in shell features including colour and sculpture. I cannot exclude the possibility that more than one species is involved, with different black coral hosts.

Genus *Babelomurex* Coen, 1922

Babelomurex Coen, 1922: 68. Type species (by original designation): *Fusus babelis* Requier, 1848; Recent, north-eastern Atlantic and Mediterranean.

Langfordia Dall, 1924: 89. Type species (by original designation): *Murex cuspidifera* Dall, 1924.

Tolema Iredale, 1929: 186. Type species (ICZN, 1970): "*Tolema australis* Laseron, 1955" (incorrect name used = *Rapana lischkeanus* Dunker, 1882).

Remarks The species of *Babelomurex* have been classified in the past into several subgenera, based on shell features (e.g. Kosuge & Suzuki 1985; Higo *et al.* 1999, 2000). I have preferred a more conservative position, pending the establishment of a reli-

able phylogenetic scheme for these putative taxa.

Babelomurex japonicus (Dunker, 1882)

Figs 21-22

Rapana japonica Dunker, 1882: 43, pl. 13, figs 24-25.

Latiaxis sallei Jousseaume, 1884: 186-187, pl. 10, fig. 3.

Type material Rapana japonica: holotype ZMB 103.966, figured by Kosuge & Suzuki 1985: pl. 27, fig. 1. — *Latiaxis sallei*: holotype MNHN, figured by Kosuge & Suzuki 1985: pl. 27, fig. 2.

Type locality Rapana japonica: Seto Inland Sea, Japan. — *Latiaxis sallei*: Japan.

Material examined MUSORSTOM 9: Nuku Hiva Is., stn CP 1176, 8°44.8'S, 140°14.5'W, 260-260 m, 2 sh.

Distribution West Pacific, from Japan to the Philippines and Australia, and through the Pacific to Hawaii (Cernohorsky 1978; Kay 1979; Tsuchiya 2000). From New Caledonia, alive in 250-253 m (Oliverio in press). Marquesas, empty shells in 260 m.

Remarks Diagnosis of the nominal taxa included in the *Babelomurex japonicus* group is traditionally based on the direction of the spines, the scabrousness of the spiral sculpture, the slenderness of the shell and the presence or absence of a scabrous ridge on the shoulder. There seems to be some variation throughout the range in teleoconch features and also in dimensional parameters of the protoconchs. The two shells of the present material are, as seems common in the SW Pacific *B. japonicus*, smaller than those from the Philippines. Shells of *B. japonicus* with an intact apex that I have examined from throughout the range always had a multispiral protoconch of 3.2-3.3 conical whorls indicating a planktotrophic larval development.

Babelomurex takahashii (Kosuge, 1979)

Figs 23-27, 32

Latiaxis (Echinolatiaxis) takahashii Kosuge, 1979: 4, pl. 3, figs 4-5.

Babelomurex cookae Kosuge, 1988: 99 pl. 39 figs 1-4

Type material *Latiaxis takahashii*: Holotype IMT 79-7, figured by Kosuge & Suzuki (1985: pl. 16, fig. 13, pl. 33, fig. 4). — *Babelomurex cookae*: Holotype USNM 859322

Type locality *Latiaxis takahashii*: "Of Mactan Id., Cebu, Philippines, at about 100 m deep" (Kosuge, 1979: 5). — *Babelomurex cookae*: "French Frigate Shoals, 525 miles N. E. of Ohau Island, Hawaii Islands at the depth of about 75 to 175 fathoms" [136-318 m] (Kosuge, 1988: 100).

Material examined MUSORSTOM 9: Nuku Hiva Is., stn DW 1170, 8°45.1'S, 140°13.1'W, 104-109 m, 15 sh; stn CP 1177, 8°45.1'S, 140°14.1'W, 108-112 m, 1 sh; stn DR 1182, 8°45.6'S, 140°03.9'W, 90-120 m, 1 sh; stn DR 1183, 8°45.5'S, 140°03.8'W, 86-120 m, 1 sh; Hiva Oa Is., stn DW 1224, 9°44.6'S, 138°51.1'W, 115-120 m, 1 sh; Ua Pou Is., stn CP 1265, 9°20.4'S, 140°07.3'W, 90-92 m, 1 spm, 1 sh; Nuku Hiva Is., stn DR 1298, 8°49.1'S, 140°17.1'W, 305 m, 1 sh; stn DR 1305, 8°54.1'S, 140°14.5'W, 90-155 m, 1 sh.

Distribution Pacific Ocean, from southern Japan (Osumi Islands) to the Philippines, 50-120 m (Higo *et al.* 1999: 220), eastward to the Hawaii in 136-318 m (as *B. cookae*). Marquesas, alive in 90-92 m, empty shells down to 305 m.

Remarks A protoconch of 3.2 conical whorls measured 810 µm high and 700 µm wide at the base. Protoconch-I consisted of 0.9 whorls sculptured with pustules over the entire surface. Protoconch-II consisted of 2.3 whorls with two spiral keels sculptured by a series of subsutural nodulose prosocline threads and a series of opisthocline nodulose threads over each keel. The threads frequently appear to originate from the fusion of two-three tubercles. This protoconch is of the same type as that seen in the Philippines specimen examined. I am unable to separate *B. cookae* from Hawaii (Figs 27, 27) from within the variation of *B. takahashii* and I consider them as synonyms. Furthermore, *B. garrardi* (D'Attilio, 1968) from northern Australia is also similar and it may well be another synonym of *B. takahashii*. The published depth ranges for *B. takahashii* indicating relatively shallow waters (50-120 m) are congruent with the Marquesas records (alive in 90-92 m). The data for Hawaii (136-318 m, as

B. cookae) are more congruent with the dealers' data from the Philippines (alive in 150-300 m). Only by this indication do I classify *B. takahashii* as a deep water species, (Table 1) albeit with caution.

Genus *Leptoconchus* Rüppell, 1834

Leptoconchus Rüppell, 1834: 105. Type species (by subsequent monotypy of Rüppell, 1835): *Leptoconchus striatus* Rüppell, 1835; Recent, Red Sea.

Magilopsis G.B. Sowerby III, 1919: 77. Type species (by original designation): *Leptoconchus lamarckii* Deshayes, 1863; Recent, Indo-Pacific.

Remarks Massin (1982, 1983, 1990, 1992, 2000) studied the ecology and taxonomy of the species in this group. A revision of the *Leptoconchus* species, currently being undertaken by Arjan Gittenberger at the National Museum of Natural History (Naturalis, Leiden, the Netherlands), is revealing a cryptic, adaptive radiation in the genus at least within the species associated with mushroom corals (Fungiidae). Identification of the species seems possible only by molecular markers and/or data on the associated coral (Gittenberger 2006).

Leptoconchus lamarckii Deshayes, 1863 Figures 28, 29

Leptoconchus lamarckii Deshayes, 1863: 127, pl. 13, figs 1, 3.

Type material Five syntypes MNHN.

Type locality Bourbon [Réunion Island].

Material examined MUSORSTOM 9: Ua Pou stn DW 1143, 9°20.9'S, 140°02.7'W, 18-55 m, 3 sh.

Distribution Throughout the Indo-West Pacific (uncommon in the Seychelles: Jarrett 2000), including Hawaii (Kay 1979). New Caledonia and Loyalty Islands, empty shells in 2-60 m.

Remarks Only a few shells of *L. lamarckii* are present in the samples studied, despite it being considered the most common *Leptoconchus*

Table 1 Species of Coralliophilinae from Marquesas Islands, with their record in T&C (Tröndlé & Cosel, 2005) and in the present revision, along with their larval development and depth range (†: based on empty shells only) in the Indo-Pacific (summarized mostly after Oliverio in press) and Marquesas Islands. Habitat: shallow, <100-150 m; deep, >100-150 m (see text for details).

species	T&C	Present	Larval development	Depth range		Habitat
				Indo-Pacific	Marquesas	
<i>Coralliophila violacea</i> (Kiener, 1836)	*	*	P	4-25	0-3 m	shallow
<i>Coralliophila bulbiformis</i> (Conrad, 1837)	*	*	P	4-32	intertidal	shallow
<i>Coralliophila abnormis</i> (Smith, 1878)		*	P	15-25	102-119	shallow
<i>Coralliophila clathrata</i> (A. Adams, 1854)	*	*	P	intertidal-98	intertidal	shallow
<i>Coralliophila monodonta</i> (Blainville, 1832)	*	*	P	intertidal-30	intertidal-33	shallow
<i>Coralliophila curta</i> G.B. Sowerby III, 1894		*	P	intertidal-30	60-62	shallow
<i>Coralliophila nukuhiva</i> n. sp.		*	P?	408-444 †	220-416	deep
<i>Coralliophila mitraeforma</i> Kosuge, 1985		*	P	245-400	1150-1250	deep
<i>Coralliophila nodosa</i> (A. Adams, 1854)		*	P	230-266	104-109	deep
<i>Coralliophila fimbriata</i> (A. Adams, 1854)		*	P	90-305	90-367	deep
<i>Rhizochilus</i> cf. <i>antipathum</i> Steenstrup, 1850	*	*	P	25-400	120-600	deep
<i>Babelomurex japonicus</i> (Dunker, 1882)		*	P	250-253	260	deep
<i>Babelomurex takahashii</i> (Kosuge, 1979)		*	P	50-318 m	90-92	deep?
<i>Leptoconchus lamarckii</i> Deshayes, 1863		*	?	2-60	18-55	shallow

species in the Indo-West Pacific (Massin 1982). More focused sampling on coral boring gastropods would probably give a better idea of their regional diversity.

CONCLUSIONS

Tröndlé & Cosel (2005) reviewed the bibliographic records of molluscs from Marquesas Islands (Hombron & Jacquinet, 1852; Jardin, 1858; Rehder, 1969, 1985; Salvat & Rives, 1975; Tröndlé, 1989), and listed 5 species of Coralliophilinae. Of these, one (*C. bulbiformis*) was not directly collected during the MUSORSTOM expedition, but is reliably recorded from shells in private collections. A total of 14 species have been identified and are treated in the systematic account.

In terms of species richness, the total number of species (14) is in agreement with the total estimate for French Polynesia by Tröndlé (1989), who listed 14 species, with an apparently higher rate of endemism for southern Polynesia. Nevertheless, this survey (part of the MUSORSTOM 9 expedition) used intensive sampling which increased the number of deep water species. The total number of species is about 15% the total number of species from the New Caledonia area (Oliverio in press), and it is 50% of the number of species from southern French Polynesia (Australes Islands: Oliverio in prep.), another marginal area in the Pacific. None of the species is apparently

endemic to Marquesas, and all species probably have a planktotrophic larval development.

The Coralliophilinae display a significant radiation in deep water. Deep habitats in the Indo-West Pacific are considered to be those deeper than 100-150 m, which is the lower limit for the hermatypic scleractinians and where the latter are out competed by Alcyonaria, Stylasterids and Porifera. At least seven species can thus be considered as shallow water (including *C. abnormis*, but, conservatively, not *C. fimbriata*). The proportion of deep water species (50%) is significantly smaller than is usual for the Coralliophilinae (65-80%, with an average on a global scale of 75%: Oliverio unpublished). This may be an artefact of the small number of species. Alternatively, it may be an indication that marginality of Marquesas affects the deep water faunas more than the shallow water ones. For epizoic organisms, such as the coralliophilines, this can in turn be related to a reduced availability of suitable hosts in deep waters. The total lack of species with non-planktotrophic development or with a severely shortened pelagic larval phase (which together constitute 10-20% of the Indo-Pacific species: Oliverio in press) seems to support this interpretation. A stronger effect of marginality in deep water is a hypothesis to test with larger databases, when more faunistic inventories are available.

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