

Results of the Rumphius Biohistorical Expedition to Ambon (1990).



Part 14. The Columbellidae (Gastropoda: Neogastropoda) collected at Ambon during the Rumphius Biohistorical Expedition

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This paper lists and describes the species of columbellids (Gastropoda: Neogastropoda: Columbellidae) collected by the Rumphius Biohistorical Expedition to Ambon, Moluccas, in 1990. Columbellids are small, and Rumpf did not originally report any. The 1990 expedition collected 36 species, including three new species: *Euplica brunnidentata*, *Zafra ambonensis*, and *Zafra bilineata*. *Pardalinops* is introduced as a replacement name for *Pardalina* Jousseume, 1888, nec Gray, 1867.

Introduction

The Rumphius Biohistorical Expedition in 1990 was undertaken to sample the marine invertebrate fauna from localities around the island of Ambon in the Moluccas. These sites were originally sampled by Georg Everhard Rumpf in the 17th century, with the fauna written up in the book “D’Amboinsche Rariteitkamer”; the more recent expedition was tasked with re-inventorying the marine invertebrate fauna, to compare with and clarify the results of Rumpf.

This paper focuses on one of the lesser known marine molluscan taxa, the neogastropod family Columbellidae. Probably because columbellids are small, Rumpf’s book did not include any. However they are a highly diverse and common group of shallow marine microgastropods, and are very well represented in the recent expedition collections.

Columbellids are typically small, with most species between 3 and 20 mm in shell length. The shells vary greatly, though almost all have labial denticles and spiral cords at the base of the shell. Most species are epibenthic carnivores or scavengers, though some feed on algae and a few are infaunal. They are typically active and colourful, with a narrow foot and long siphon.

Methods

This paper is intended primarily as a taxonomic listing of morphological species, and not as a systematic revision. I have attempted as much as possible to use qualitative characters that are invariant within a species for species discrimination. Tropical columbellids often vary in shell colour and pattern within species, so I avoid placing much reliance on these characteristics. Genera are given in alphabetic order, as are species within genera. Some traditional subgenera of *Mitrella* are treated as full genera herein, because *Mitrella* is not a monophyletic group; species considered to be *Mitrella* occur in two or more distinct branches of the columbellid evolutionary tree (deMaintenon, 1999); thus there is little reason to assume the nominal subgenera are related. Each species is presented with its original name, plus a partial synonymy from the recent literature, summarizing the generic placements of each species in recent years. In general, I have followed the most recent usage. The list of stations is documented by Strack (1993); table 1 in this paper details the species collected from each station.

All material listed in this paper is stored in the collection of the Nationaal Natuurhistorisch Museum unless otherwise noted. In the case of new species, material from other areas (and other collections) is also included for the sake of completeness. Abbreviations for other museum collections include LACM (Los Angeles County Museum of Natural History, Los Angeles, California) and SBMNH (Santa Barbara Museum of Natural History, Santa Barbara, California). Some of the dry expedition material was loose in the box on arrival, due to glass vials having been broken in the mail; this is referred to generally as mixed material, because several vials were broken and there was no way to know which station each specimen was collected from.

Columbellids collected by the 1990 expedition

Family Columbelloididae Swainson, 1840

Ascalista Drivas & Jay, 1990

This genus was created to contain two minute biconic species distinguished from members of *Zafra* and *Seminella* by the lack of sculpture on the shell or protoconch, and from *Mitrella* by the lack of labial denticles (Drivas & Jay, 1990); they are otherwise similar to *Zafra* and *Seminella* in their small size and biconic shape. One of the included species has subsequently been removed to another new genus, so *Ascalista* currently comprises only the type species (by original designation) *Ascalista polita* (G. & H. Neville, 1875).

Ascalista polita (G. & H. Nevill, 1875)
(fig. 1)

Zafra polita G. & H. Nevill, 1875: 97, pl. 8 fig. 5.

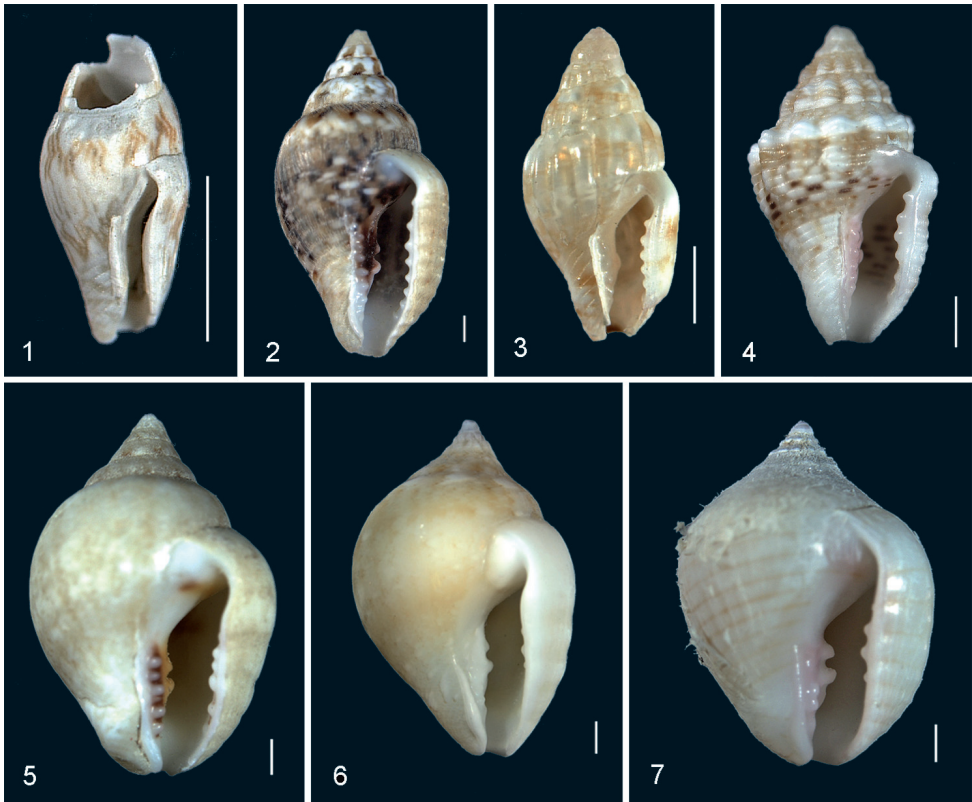
Ascalista polita (G. & H. Nevill, 1875). Drivas & Jay, 1990: 192-193, fig. 49.

This is a small species, about 4 mm shell length, with a bulbous, unsculptured protoconch. The shell is narrowly biconic, smooth and glossy, with no sculpture. The aperture is slightly sinuous and is narrowed by a thickened but not denticulate labial edge, which is shorter anteriorly than the tip of siphonal canal. Shell colour and pattern are variable.

Material: One broken adult specimen representing this species was collected at 10 m depth at Station 23, Hitu, Kaitetu (near Hila).

Euplica Dall, 1889

Members of this Indo-Pacific genus have strombiform or globose shells, usually with one or (typically) two prominent columellar folds. The parietal wall is typically



Figs 1-7, Columbelloidea. Scale bars are 1 mm. 1, *Ascalista polita* (G. & H. Nevill, 1875), Stn. 23. 2, *Euplica bidentata* (Menke, 1843), mixed material. 3, *Euplica ionida* (Duclos, 1840), Stn. 30. 4, *Euplica varians* (Sowerby, 1832), Stn. 30. 5, *Euplica brunnidentata* new sp., holotype, RMNH.MOL.109040, Stn 21. 6, *Euplica de-shayesii* (Crosse, 1859), Ceram. 7, *Euplica turturina* (Lamarck, 1822), Stn. 27.

denticulate. Some have axial threads on the protoconch. The lateral radular teeth are large, with narrowly spaced flat-tipped secondary cusps. Type species: *Euplica turturina* (Lamarck, 1822) by original designation.

***Euplica bidentata* (Menke, 1843)**

(fig. 2)

Columbella bidentata Menke, 1843: 108 (not figured); Sowerby I, 1844: 118, pl. 37 figs 53-54.

Pyrene bidentata (Menke, 1843). Wilson, 1994: 106, pl. 16 fig. 19a-d.

Euplica bidentata (Menke, 1843). Cotton, 1957: 2, fig. 28; deMaintenon, 1999: figs 5c, f; Monsecour & Kohler, 2006: 286-287, fig. 8.

This species is found in Western Australia and ranges through the eastern Indian Ocean. It is very similar to *Euplica scripta* (Lamarck, 1822), but differs in having nodules around the periphery of the early teleoconch whorls; the shoulder of the body whorl is weakly nodulose, and the protoconch has 2.75 to 3 smooth white whorls (*E. scripta* ranges through the Southwestern Pacific and has a bulbous or peg-like white protoconch with 1.5 to 2 whorls, and no nodules on the early whorls or the body whorl). Both species are present in Indonesia and can be difficult to discriminate, because the colour patterns of the two species are similar here, whereas they tend to differ more in other parts of their ranges (pers. obs.). Specimens collected by the expedition vary from whitish through straw coloured or tan, and most have three spiral bands of dark axial speckling; one at the base, one at the middle of the whorl and one just below the suture. Some have just pale flecks or dark axial markings on a white shell. The columella has two large dark brown stains, one at the middle of the columella and one posterior. Adult shells are 10 to 16 mm long with 5 to 7 whorls, and 3 smooth white protoconch whorls on the few specimens in which the apex was not eroded. Weak peripheral nodules are present on the first teleoconch whorl, but are not obvious on the body whorl.

This species was apparently locally common and was collected at many of the collecting sites, mostly intertidally or at shallow depths (table 1). The species is often found associated with seagrasses, on which they crawl to graze on microalgae. *Euplica scripta* (Lamarck) is common in the southwest Pacific but was not collected by the expedition.

***Euplica brunnidentata* spec. nov.**

(fig. 5)

Pyrene (Columbella) deshayesii (Crosse, 1859). Cernohorsky, 1972 (in part): 134-135, not pl. 40 fig. 6.

Pyrene deshayesii (Crosse, 1859). Wilson, 1994: 106 (in part), pl. 16, fig. 18, not 23a-b.

This species is found moderately often in Indonesia and the Philippines. Historically it has been called *Euplica deshayesii* following Cernohorsky (1972), but there are consistent differences between this species and *E. deshayesii*, as discussed below.

The shell in this species is globose, 9 to 12 (rarely to 14.5) mm long with 5 to 6 teleoconch whorls in adults. It is usually white or straw-coloured externally, often with chestnut or dark brown flecks. The globose shape is very similar to that of *Euplica turturina*, but the aperture is yellow or white internally, and has brown spots between the

labial and parietal denticles. The protoconch is smooth, white, with 3.25 to 3.5 whorls. The early spire whorls are nodulose at the periphery, similar to *E. deshayesi* and *E. turturina*.

This species differs from *E. deshayesi* in several respects; the brown speckling between the aperture denticles in this species is not present in any other *Euplica* species. It seems unlikely to be variable within a species as Cernohorsky (1972) implies, because the same character is invariably present in at least three species of Atlantic *Columbella*. Additionally, the protoconch tends to have more whorls and is white rather than purple, though these characters do vary. Finally, the shell shape is globose, and the anterior canal is never extended as it often is in *E. deshayesi*.

This species was collected by the expedition at stations 5, 18, 21 and 30, intertidally to 6 m depth. Type locality: Stn. 21, near Mamala, Hitu, Ambon.

Type material. — Holotype, RMNH.MOL.109040, Stn. 21, Ambon, Hitu, Mamala, 21.xi.1990; three additional paratypes, RMNH.MOL.109041, Stn. 21, Ambon, Hitu, Mamala, 21.xi.1990; five paratypes, LACM 3083, Java, Seribu Isls., Pelangi and Putri Islets, 14-19.v.1986, J.H. McLean and E. Abbott; two paratypes, LACM 3084, Solomon Isls., S. of Beagle Isl., Marau Sound, Guadalcanal Isl., 21.iv.1987, W.M. Thorsson; two paratypes, LACM 3085, Philippines, Mindanao, Santa Cruz Isl., off Zamboanga, 18.i.1981, J.H. McLean.

Euplica deshayesii (Crosse, 1859)

(fig. 6)

Columbella deshayesii Crosse, 1859: 382-383, pl. 14 fig. 4; Hervier, 1899: 309.

Pyrene (Columbella) deshayesii (Crosse, 1859). Cernohorsky, 1972 (in part): 134-135, not pl. 40 fig. 6.

Pyrene deshayesii (Crosse, 1859). Wilson, 1994 (in part): 106, not pl. 16, figs 18, 23a-b.

Euplica deshayesii (Crosse, 1859). Iredale, 1929: 280; Cotton, 1957: 2; Higo et al., 1999: 246; Okutani (ed.), 2000: 425, pl. 211 fig. 2.

This species is not often seen in the literature or in the field. The shell is whitish to orange or pink externally, 8 to 13 mm long in adults with 5 to 6 teleoconch whorls, some with yellow colouring deep in the aperture; the aperture edge is white. The periostracum is typically in regularly spaced tufts over the body whorl. Some specimens have spiral rows of minute white or brown flecks on the body whorl. The columellar plaits in this species are weaker than in other species and rather sharp; one may be weaker than the other. The anterior canal is usually narrowed and extended slightly laterally to a pronounced point, which in extreme specimens can make the body whorl appear crooked relative to the spire whorls. The protoconch is white or more often lilac purple, and consists of 2.75 to 3.25 (rarely 3.5) smooth whorls. Early whorls are nodulose at the periphery. The variety *anceps* was named by Hervier (1899); though this was not illustrated and I have not seen it, Hervier mentions that the shell in the variety has a purple tinge to the aperture and columellar edge; that being the case, this is more likely to be conspecific with *Euplica turturina* Lamarck, or it may be a different species altogether.

E. deshayesii was not collected by the expedition on Ambon, but four specimens were collected by Hermann Strack on Ceram Isl., at Sawai in December 1997.

***Euplica ionida* (Duclos, 1840)**
(fig. 3)

Colombella ionida Duclos, 1840: pl. 7 figs 5-8.

Euplica amirantium (E.A. Smith, 1884). Sleurs, 1982: 197-203, pl. 1 figs 1-3, text fig. 1; 1987: 276.

Euplica ionida (Duclos, 1840). Drivas & Jay, 1990: 167, figs 5a-e; 1997b: 32, fig. 3; Higo et al., 1999: 247; Okutani (ed.), 2000: 425, pl. 211 fig. 6.

This species is widespread, occurring from South Africa, through the Indian Ocean and Indonesia, and north to southern Japan and east to Hawaii. It is often found in high densities where it occurs. The shell is strombiform, with wide, rounded axial ribs. Adults are 4 to 5 mm in length with 2.75 to 3 teleoconch whorls. The columella has one strong fold rather than two. The protoconch is prominent, usually pink, with 4.5 to 5 whorls and axial threading over at least the first protoconch whorls; the axial threading tends to disappear in the middle of the later protoconch whorls, though it may simply be worn off in most specimens. The early spire whorls have similar sculpture to the body whorl, with the addition of a weak subsutural groove. The shell varies in colour and pattern, but is frequently pink with white and occasional tan markings.

Specimens of this species collected by the expedition were mostly juveniles and frequently worn. They were all collected dead, and were typically sieved out of sediments at between 3 and 22 m depth. Most were whitish to pink with white flecks and pale tan markings on the aperture edge.

***Euplica turturina* (Lamarck, 1822)**
(fig. 7)

Colombella turturina Lamarck, 1822: p. 296 (not figured); Sowerby I, 1844: 116-117, pl. 37 figs 38-40; Hervey, 1899: 308-309; Kilburn & Rippey, 1982: 96, pl. 22 fig. 6.

Pyrene (Colombella) turturina (Lamarck, 1822). Cernohorsky, 1972: 133, pl. 40 fig. 5.

Pyrene turturina (Lamarck, 1822). Wilson, 1994: 107, pl. 16, figs 24a-c.

Euplica turturina (Lamarck, 1822). Cotton, 1957: 2; Kay, 1979: 267, figs 93a, 94a; Drivas & Jay, 1990: 168, fig. 8; 1997b: 32, fig. 4; deMaintenon, 1999: fig. 5k; Higo et al., 1999: 246; Okutani (ed.), 2000: 425, pl. 211 fig. 1.

This species is also widespread and occurs from South Africa through the Indian Ocean and Indonesia, north to the Philippines and southern Japan, and east to Hawaii and French Polynesia. The shell is globose, 10 to 15 mm long at maturity, with 5 to 6 teleoconch whorls. Shell colour and pattern are quite variable, generally consisting of some pattern of light brown on white, but the aperture edge is always pink. There are two large columellar folds. The protoconch varies in colour but is frequently pink, with 3.5 to 3.75 whorls and axial threads. Early spire whorls are nodulose at the periphery, as in other *Euplica* species.

Four specimens of this species were collected by the expedition, each at a different site, at depths from 1 to 22 m.

***Euplica varians* (G. B. Sowerby I, 1832)**
(fig. 4)

Columbella varians Sowerby I, 1832: 118 (not figured); Sowerby I, 1844: 117-118, pl. 37 figs 47-50; Hervier, 1899: 311-312.

Pyrene (Columbella) varians (Sowerby, 1832). Cernohorsky, 1972: 134, pl. 40, fig. 7a, b.

Pyrene varians (Sowerby, 1832). Verco, 1910: 127; Wilson, 1994: 107, pl. 16, figs 20a-b(?).

Euplica varians (Sowerby, 1832). Cotton, 1957: 2; Kay, 1979: 267, figs 93b, 94b-d; Sleurs, 1985: 276, text figs 6a-b, pl. 1 figs 1-2; Sleurs, 1987: 276-278, pl. 1, figs 1-2, text fig. 6a-b; Drivas & Jay, 1990: 168-169, fig. 7; 1997b: 32, fig. 5; Higo et al., 1999: 246; Okutani (ed.), 2000: 425, pl. 211 fig. 5; Higo et al., 2001: 83, fig. G2843.

This is also a wide ranging species, having a similar geographic distribution to *Euplica turturina*. The shell is strombiform rather than globose, 6 to 9 mm long at maturity with 4.5 to 5.5 teleoconch whorls, spirally ribbed, with a nodulose shoulder. The columella often has a pale pink stain. Shell colour and pattern vary greatly in this species; specimens collected at Ambon tend to be white, with a pale brown band around the middle two-thirds of the whorl, and dark brown speckles overlain in the middle of the band. The protoconch is usually 4 whorls, white, with axial threads. Early whorls have similar sculpture to the body whorl; they are spirally grooved, and nodulose at the periphery.

The expedition collected 13 dead specimens of this species from four stations, at depths from 2 to 12 m.

Graphicomassa Iredale, 1929

This is often considered a subgenus of *Mitrella*. According to Wilson (1994), Iredale (1929) gave no diagnosis for the genus, so the diagnosis provided is based on the type species. The shell is tall spired, fusiform, and porcelainous, with a thick parietal callus and a weak columellar groove. The base is less constricted than in most species traditionally placed in *Mitrella*. The type species (by original designation) is *Graphicomassa ligula* (Duclos, 1840), a sand dweller on coral reefs.

***Graphicomassa albina* (Kiener, 1841)**
(fig. 8)

Columbella albina Kiener, 1841: 32-33, pl. 13 fig. 4; Sowerby I, 1844: 123, pl. 38 figs 81-82; Hervier, 1899: 320-321.

Pyrene albina (Kiener, 1841). Cotton, 1957: 1.

Mitrella albina (Kiener, 1841). Cernohorsky, 1972: 136, text fig. 11, pl. 41 fig. 2, 2a; Drivas & Jay, 1990: 169, figs 10a-b; 1997a: 28; 1997b: 33, fig. 6; Wilson, 1994: 104, pl. 16 figs 5a-b.

Mitrella (Graphicomassa) albina (Kiener, 1841). Okutani (ed.), 2000: 431, pl. 214, fig. 34; Monsecour & Monsecour, 2007: 171, pl. 1 fig. 11.

This species is most similar to *Graphicomassa ligula*, though it is often placed in *Mitrella*. The shell is porcelainous, white with brown and/or black blotches. The presence, colour and degree of colouration vary, but the species usually has a noticeable dark brown or black marking near the base of the shell. Adult shell length also varies, but is generally between 9 and 15 mm, with 6.5 to 7.5 teleoconch whorls. Unlike *G.*

ligula, the shoulder in this species is nodulose just below the suture on the body whorl and on the early spire whorls. The aperture is narrow, with parietal and labial denticles. The protoconch is narrowly conical, smooth and white, with 3.25 to 3.5 whorls.

The expedition collected one or two specimens each of this species from five different stations; most were empty worn shells. Specimens were typically collected in sand, between 1 to 12 m depth.

***Graphicomassa ligula* (Duclos, 1840)**
(fig. 9)

Colombella ligula Duclos, 1840: pl. 11, figs 11-16; Sowerby I, 1844: 123-124, pl. 38 figs 83-85.

Columbella ligula Duclos, Kiener, 1841. Hervier, 1899: 326-327.

Mitrella ligula (Duclos, 1840). Cernohorsky, 1972: 135-136, text figure 10, pl. 41, figs 1, 1a; Drivas & Jay, 1990: 174, fig. 17.

Graphicomassa ligula (Duclos, 1840). Iredale, 1929: 289; Cotton, 1957: 2; Higo et al., 1999: 251.

Mitrella (*Graphicomassa*) *ligula* (Duclos, 1840). Wilson, 1994: 104, pl. 16 figs 1a-d; Okutani (ed.), 2000: 431, pl. 214 fig. 33.

This species is found throughout the Indo-West Pacific. The shell is large, solid and smooth, 15 to 20 mm in length, with over 7 teleoconch whorls. This species lacks the shoulder nodules present in *G. albina*, and is longer and narrower. Shell colour and pattern vary greatly, though the base colour is generally porcelainous white. The protoconch is peg-like, with about 2.75 whorls. The aperture is long and narrow, the labial edge having low denticles and the columella being thickly calloused with several small parietal denticles. There is also a poorly defined columellar groove.

This species was collected from four locations by the expedition, between the intertidal zone and 7 m depth, in sand. The specimens are white with spiral rows of tan axial markings, or dark brown on the white background, with sparse white fly specks.

Indomitrella Oostingh, 1940

The only information on this genus available to me comes from Drivas & Jay (1990), who report that the included species have "axial sculpture and smooth intervals". The type species (by original designation) is *Indomitrella puella* (Sowerby, 1844), and though various authors place a number of other species in the genus, the basis for their inclusion is not known.

***Indomitrella conspersa* (Gaskoin, 1852)**
(fig. 10)

Columbella conspersa Gaskoin, 1852: 11 (not figured).

Columbella conspersa Gaskoin, 1851. Hervier, 1899: 351-353.

Columbella (*Atilia*) *conspersa* Gaskoin. Melvill, 1903: 30.

Pyrene conspersa (Gaskoin, 1852). Cotton, 1957: 1.

Mitrella conspersa (Gaskoin, 1852). Not Drivas & Jay, 1990: 172, figs 14a-b; 1997a: 28; 1997b: 33, fig. 8.

Columbellopsis conspersa Gaskoin, 1851: Higo et al., 1999: 251.

Mitrella (*Indomitrella*) *conspersa* (Gaskoin, 1852). Okutani (ed.), 2000: 431, pl. 215 fig. 43; Monsecour & Monsecour, 2007: 172, pl. 1 figs 3-4, 7-8.

This species is probably one of the most often confused of the Indo-Pacific columbellids. It is typically placed in *Mitrella*, however Okutani (2000) most recently placed it in *Indomitrella*, probably because of the axial sculpture on the early spire whorls. Because it is most often confused with *Indomitrella puella*, it seems reasonable to keep them both in the same generic group. Cernohorsky (1972) and Higo et al. (1990) treat this species as a synonym of *Indomitrella puella* (Sowerby, 1844). Drivas & Jay (1990, 1997a, 1997b) have reported finding this species at various locations in the western Indian Ocean, however their figures show shells that lack axial sculpture on the spire whorls and also lack parietal denticles; so it seems likely that their specimens are misidentified. There is very possibly a cluster of similar species which are at this point poorly differentiated in the literature. The shell is heavy, porcelainous and white, with brown markings, often arranged around a white spiral band at the middle of the body whorl. There are nodulose axial ribs on the first one or two spire whorls, and often on the back of the body whorl. The whorls are weakly shouldered. The aperture has both labial and often obscure parietal denticles, which are generally stained pink or lilac. Adults are 9 to 12 mm long with 5 to 7 teleoconch whorls; the protoconch is smooth, white, with 3.5 whorls.

Only one specimen was collected by the expedition, at station 30 in sand at 5-7 m depth.

***Indomitrella cf. schepmani* (K. Monsecour & D. Monsecour, 2007)**

(fig. 11)

Columbella (Atilia) conspersa var. *brevis* Schepman, 1911: 334, pl. 20 fig. 9 (non Monterosato, 1875).

Mitrella (Indomitrella) schepmani K. Monsecour & D. Monsecour, 2007: 166-168, pl. 1 figs 1-2.

A single individual was collected of this species. The shell is similar to those of *Indomitrella conspersa* and *Indomitrella schepmani* (Monsecour & Monsecour, 2007), with the major difference being that it lacks the parietal denticles. Like *I. schepmani*, it is small, only 5.27 mm long. It does have nodulose axial ribs on the first teleoconch whorl. It also has a brown and white band just below the suture that Drivas & Jay (1990) report as a diagnostic character for *I. conspersa*, so this species may be the same as what they found; but parietal denticles are clearly visible on the type specimen of *I. conspersa* and *I. schepmani*, so the lack of them in this specimen is important. The shell has 4 teleoconch whorls, with the suture barely impressed, and a smooth brown protoconch with 4.25 whorls. The teleoconch has vague brown patches arranged axially. The outer lip is thickened and white, denticulate within. The specimen collected by the expedition was collected dead from Stn. 23 at 10m depth.

***Indomitrella puella* (G.B. Sowerby I, 1844)**

(fig. 12)

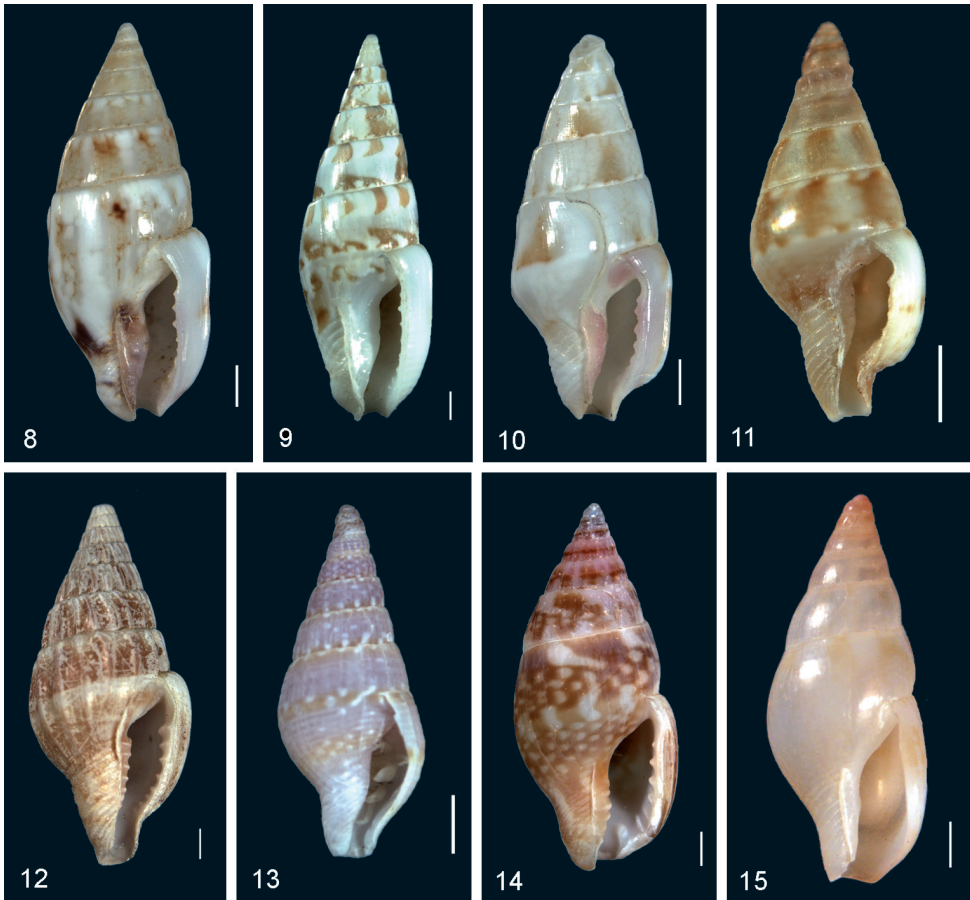
Columbella puella Sowerby I, 1844: 141, pl. 40 figs 160-161; 1844b: 52 (not figured).

Mitrella puella (Sowerby, 1844). Cernohorsky, 1972: 137, pl. 41 fig. 5(?).

Columbellopsis puella (Sowerby, 1844). Higo et al., 1999: 250; Higo et al., 2001: 84: fig. G2893.

Mitrella (Indomitrella) puella (Sowerby, 1844). Okutani (ed.), 2000: 433, pl. 215 fig. 44; Monsecour & Monsecour, 2007: pl. 1 figs 5-6.

Indomitrella puella (Sowerby, 1844). Drivas & Jay, 1997b: 34, fig. 23.



Figs 8-15, Columbelloididae. Scale bars are 1 mm. 8, *Graphicomassa albina* (Kiener, 1841), Stn. 5. 9, *Graphicomassa ligula* (Duclos, 1840), Stn. 30. 10, *Indomitrella conspersa* (Gaskoin, 1851), Stn. 30. 11, *Indomitrella* cf. *shepmani* (K. Monsecour & D. Monsecour, 2007), Stn. 23. 12, *Indomitrella puella* (Sowerby, 1844), Stn. 35. 13, *Lavesopus cumingii* (Reeve, 1859), Stn. 27. 14, *Metanachis jaspidea* (Sowerby, 1844), Stn. 17. 15, *Metanachis laingensis* (Sleurs, 1985), Stn. 23.

This species has a confused taxonomic history. Cernohorsky (1972), Wilson (1994) and Higo et al (1999) synonymize *Indomitrella conspersa* (Gaskoin, 1852) and several similar forms with this species, but as Drivas & Jay (1990) point out, those species completely lack axial sculpture, whereas *I. puella* is usually strongly axially sculptured over the entire shell. *I. puella* also has a strong oblique columellar fold lacking in *I. conspersa*, and more pronounced parietal denticles. There are also some slight differences in protoconch and teleoconch whorl counts. Monsecour & Monsecour (2007) summarize the differences between these two species and *I. shepmani* (Monsecour & Monsecour, 2007) in their paper. Wilson's (1994) figure of *I. puella* appears to be *I. conspersa*. The shell in *I. puella* is biconic, 10 to 15 mm long at maturity, with 6 to 8 teleoconch whorls. The body whorl is strongly constricted at the base. The shell is covered in most cases with narrow

axial ribs; these are weaker or almost lacking on the body whorl in some specimens. The shells are white or tan in colour, with tan specimens having white bands at mid-whorl and below the suture. The aperture is narrowed by a protruding ridge of large parietal denticles, and the columella has a strong internal fold; there may also be a weak columellar groove anterior to the stronger fold in some. The labial edge in some individuals has a diffuse purple stain. The protoconch has about 3 whorls, lacks sculpture except for growth lines, and is white or pale purple.

Specimens of this species were collected by the expedition at five stations, sieved or dredged from deeper water (4 to 28 m) where reported. Most were in good condition but typically had the apex missing.

Lavesopus Iredale, 1929

Lavesopus was designated by Iredale in 1929 without any description, with the type species "the Queensland form" of *Lavesopus cumingii* (Reeve, 1859), referring to var. *queenslandica* Hedley, 1913. Iredale was uncertain whether Hedley's varietal form was the same species as *L. cumingii*, and it has more recently (K. Monsecour & D. Monsecour, unpubl.) been determined to be a synonym of *L. clausiliformis* (Kiener). Wilson (1994) speculates that *Lavesopus* is a junior synonym of *Aesopus* Gould 1860, and he may be correct; the question awaits further study.

Lavesopus cumingii (Reeve, 1859)

(fig. 13)

Columbella cumingii Reeve, 1859; pl. 25, sp 156.

Aesopus spiculus (non Duclos, 1846). Drivas & Jay, 1990: 197, fig. 54; 1997b: 37, fig. 40.

Aesopus (*Lavesopus*) *spiculus* (non Duclos, 1840). Okutani (ed.), 2000: 437, pl. 217 fig. 76.

This species has a tall-spined pink shell, with spiral rows of brown markings above and below the suture. The shell is axially sculptured on the early teleoconch whorls, and has shallow spiral grooves over most of the shell. Adults are 13 to 16 mm long, with 9 to 11 teleoconch whorls. The aperture has labial denticles, but none on the columella or parietal wall. The parietal wall has a rounded posterior ridge. The protoconch is pink with chestnut markings, peg-like, with rough axial threading, and has 2.5 to 2.75 whorls. The species is very similar to *Lavesopus clausiliformis*, which is smaller, has a smooth, paucispiral protoconch and typically 6 to 8 teleoconch whorls (K. Monsecour & D. Monsecour, unpubl.).

The expedition collected one shell of a juvenile with a hermit crab, from Stn. 27 at 2 m depth.

Metanachis Thiele, 1924

Species placed in this genus typically have high spires, axial sculpture on the early teleoconch whorls, a weak columellar fold, and some have a denticle on the posterior parietal wall. That being said, the type species has no posterior parietal denticle, and one of the species below has no axial sculpture. Type species (by original designation) *Metanachis jaspidea* (G.B. Sowerby II, 1844).

***Metanachis jaspidea* (Sowerby I, 1844)**
(fig. 14)

Columbella jaspidea Sowerby I, 1844: 132, pl. 39 fig. 125; 1844b: 50 (not figured).

Columbella jaspidea Sowerby, 1847. Hervier, 1899: 356-357.

Pyrene jaspidea (Sowerby, 1844). Cotton, 1957: 1.

Mitrella marquesa (Gaskoin, 1852). Cernohorsky, 1972, text fig. 12, pl. 41 fig. 3-3b (misidentification).

Zafraona acleonta (Duclos, 1840). Wilson, 1994: 97, pl. 16, figs 10a-b.

Metanachis acleonta (Duclos, 1840). Higo et al., 1999: 250.

Metanachis jaspidea (Sowerby, 1844). Sleurs, 1985: 271-274, figs 2-3; Okutani (ed.), 2000: 427, pl. 213 fig. 19.

This species is found occasionally in the southwestern Pacific and eastern Indian Ocean. The shell is 10 to 12 mm long in adults, with 5 to 6.25 teleoconch whorls. The shell has axial ribs on at least the early teleoconch whorls, sometimes over the entire shell. Shell colour and pattern are variable, but typically the base colour is pink, with chestnut or white markings. Spiral chestnut lines are frequently present on the early teleoconch whorls. The protoconch is usually lilac in colour, smooth, with 3 to 3.25 whorls. The aperture has low labial denticles and a short ridge of parietal denticles, a single columellar fold close to its anterior end, and the lip is not much thickened. There is no posterior parietal denticle as is found in some species of *Metanachis*. Higo et al. (1999) report that *M. jaspidea* is a synonym of *Metanachis acleonta* (Duclos, 1840), and Wilson (1994) uses this as the senior name, however the type of *acleonta* (Duclos) has not been located (K. Monsecour, pers. comm.), and this species is often confused with at least one other, *Metanachis marquesa* (Gaskoin, 1852) (e.g., Cernohorsky, 1972; Sleurs, 1985 synonymized them). If the synonymy of *acleonta* (Duclos) and *jaspidea* (Sowerby) can be confirmed, then *M. acleonta* will be the senior name.

One specimen was collected by the expedition, a live adult found under coral at the low water mark, at station 17.

***Metanachis laingensis* Sleurs, 1985**
(fig. 15)

A second species provisionally considered to be *Metanachis laingensis* was found in low frequency. The shell is similar to that of *M. jaspidea*, but has no axial sculpture and is slightly narrower. It is also similar to the species listed by Okutani (2000) as *Pseudomycla formosa* (Gaskoin, 1852), and may be conspecific with that, however individuals of the species I have seen tend to have more protoconch whorls (3.5 to 3.75). The shell is 7 to 9 mm long with about 5 teleoconch whorls. Shell colouration is pale orange white; one specimen has two spiral rows of square chestnut blocks. The protoconch is smooth, orange or pinkish, with about 3 whorls. The aperture has a weak columellar fold, and barely discernible denticles on the parietal wall and labial edge. There is no posterior parietal denticle.

Eight specimens of this species were collected from stations 17 and 23 at unknown depths. All were adult, and almost all were worn shells filled with coral sand.

***Mitrella* Risso, 1826**

This genus serves as a polyphyletic collective for high spired, biconic columbellid

species with smooth, unsculptured shells. Type species (by subsequent designation) *Mitrella scripta* (Linnaeus, 1758) from the Mediterranean.

***Mitrella* cf. *loyaltyensis* (Hervier, 1899)**
(fig. 16)

Columbella loyaltyensis Hervier, 1899: 347, pl. 13 fig. 4.

Mitrella loyaltyensis (Hervier, 1899). Sleurs, 1987: 58-60, figs 14-15, pl. B fig. 1, pl. D fig. 4; Drivas & Jay, 1990: 175-176, fig. 21.

Mitrella loyaltyensis is a small species with a highly varied colour pattern, which has led to many synonyms, as reported by Drivas & Jay (1990). The shells typically have a ring of opaque white spots at the suture, and a thickened aperture edge with an indentation behind it. The single specimen collected by the expedition is similar to this species. However, rather than being patterned, the shell in this specimen is white with just a vague patching of brown on the body whorl. It also has fewer protoconch whorls; whereas typical *M. loyaltyensis* have 3.5 to 4 protoconch whorls, this specimen has only 3.25. The protoconch is smooth and white. The shell is 4.8 mm long with 4.5 teleoconch whorls. The specimen was in the mixed material so its habitat can not be known with certainty.

***Mitrella* *moleculina* (Duclos, 1840)**
(fig. 17)

Colombella moleculina Duclos, 1840: pl. 9 figs 1-2.

Columbella moleculina Duclos in Chenu, 1858. Hervier, 1899: 330-331.

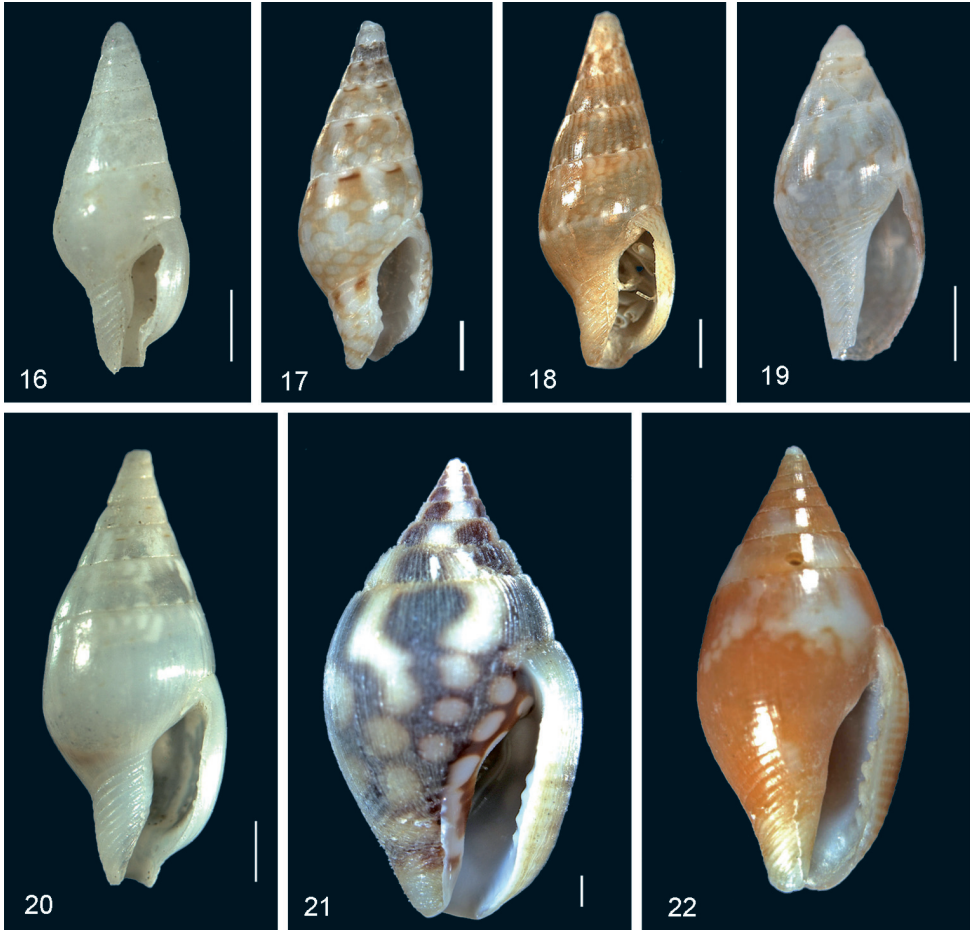
Nitidella moleculina (Duclos, 1835). Cotton, 1957: 2.

Metanachis moleculina (Duclos, 1840). Higo et al., 1999: 250.

Mitrella moleculina (Duclos, 1840). Sleurs, 1987: 60-62, figs 16, 17, pl. C fig. 6, pl. d fig. 10; Drivas & Jay 1990: 174-175, figs 19a-b; 1997: 33, fig. 13; Okutani (ed.), 2000: 429, pl. 213, fig. 26.

This is a small species with a very characteristic colour pattern, except in the Philippines where it is polymorphic (pers. obs.); it is common and often found in large numbers. It is, however, occasionally confused with other species in the literature; Wilson (1994) shows a drawing of *M. moleculina* as his figure of *Mitrella venulata* (Sowerby, 1894). Higo et al. (1999) place this species in *Metanachis*, however it lacks any axial sculpture, columellar folds, or aperture denticles that would support that designation.

The shell is typically 4.5 to 6 mm long (though may be rarely up to 7.5 mm) with about 4 teleoconch whorls. The aperture is almost half the shell length. The shell has a base colour of white overlain by a broad band of yellowish tan. Over the middle of the body whorl there is a band of large, close-set round white spots. There is an additional row of alternating small and large white spots just below the suture. Below the smaller white spots there is a narrow dark brown stripe, interrupted by the larger spots so that it becomes a series of dashes. There is also a brown band at the base of the shell interrupted by large white spots. The base of the shell has wavy chestnut axial markings. The aperture is white, with denticles on both the labial edge and usually four large denticles on the parietal wall. The protoconch is usually white, often with a brown suture, and wider than the first teleoconch whorls; it is smooth, and has 3.75 to 4 whorls.



Figs 16-22, Columbelloidea. Scale bars are 1 mm. 16, *Mitrella* cf. *loyaltyensis* (Hervier, 1899), mixed material. 17, *Mitrella moleculina* (Duclos, 1840), Stn. 30. 18, *Mitrella nympha* (Kiener, 1841), Stn. 27. 19, *Mitrella rorida* (Reeve, 1859), juvenile, Stn. 44. 20, *Mitrella venulata* (Sowerby, 1894), Stn. 30. 21, *Pardalinops testudinaria* (Link, 1807), Stn. 23. 22, ?*Pardalinops marmorata* (Gray, 1839), Stn. 5.

This species was apparently locally common and was collected at many of the collecting sites, mostly intertidally or at shallow depths. Sieving produced a number of specimens.

***Mitrella nympha* (Kiener, 1841)**
(fig. 18)

Columbella nympha Kiener, 1841: 33-4, pl. 10, fig. 4; Hervier, 1899: 335-336.

Columbella eximia Reeve, 1859: sp. 222 (syn. nov.).

Mitrella nympha (Kiener, 1841). Drivas & Jay, 1990: 175, figs 20a-d; 1997a: 28; 1997b: 33, fig. 14.

Mitrella (*Indomitrella*) *nympha* (Kiener, 1841). Okutani (ed.), 2000: 431, pl. 215 fig. 41.

This species has a small, straw coloured shell, usually with paired axial brown lines and small white markings at the suture. Some almost completely lack the brown lines, and some are mostly white, often with an interrupted spiral brown line at the posterior third of the whorl. The species lacks any axial sculpture that would place it in *Indomitrella* as suggested by Okutani (2000). Unfortunately the type of *M. nympha* appears to be lost (Monsecour, pers. comm). The original drawing of *M. nympha* show a convex-sided shell, described as about 11.3 mm long with 9 or 10 whorls, with axial chestnut lines grouped in pairs and a dark-rimmed aperture. Most specimens currently identified as this species are considerably smaller. Specimens collected by the Rumphius expedition are mostly juveniles. They vary from being tan with a row of white spots at the apical suture and almost no vestige of axial brown lines to being spotted with white over a pattern of brown lines, to being entirely white with paired brown axial lines and an interrupted brown spiral line slightly above the middle of the whorl. Shells of adults are 6.5 to 8 mm long, with about 5.5 to 6.5 teleoconch whorls. The protoconch is narrowly conical, 3.75 to 4 whorls, smooth with a large velar sinus, and either white, or transparent brown with a paler tip.

Because of its variability and superficial similarity to some other columbellid species, *M. nympha* has been implicated in a number of synonymies. Drivas & Jay (1990) for instance list twelve synonyms for *M. nympha*. *Mitrella venulata* (Sowerby, 1894), described below, is often synonymized with *M. nympha* (e.g. by Sleurs, 1987), and it does indeed have a similar colour pattern. *M. venulata* however is larger and considerably wider, with a larger body whorl; so I will keep it separate at present. *Mitrella carolinae* (E.A. Smith, 1876) appears to be a synonym of *M. venulata* rather than *M. nympha* as suggested by Drivas & Jay (1990). *Mitrella eximia* (Reeve, 1859) is a synonym of *M. nympha*, based on an unscaled photo of the type at the British Museum.

Specimens of *M. nympha* collected by the expedition were mostly taken intertidally, in various habitats, from five different stations.

Mitrella rorida (Reeve, 1859)

(fig. 19)

Columbella rorida Reeve, 1859: sp. 176.

Mitrella rorida (Reeve, 1859). Kay, 1979: 270, figs 93c, 94j; Drivas & Jay, 1990: 178, figs 24a-b; 1997b: 33, fig. 15.

Pseudamycla rorida (Reeve, 1859). Higo et al., 1999: 251; Okutani (ed.), 1999: 427-428, pl. 213, fig. 20; Higo et al., 2001: 84, fig. G2904.

This is a unique species that research may prove belongs in a different genus. It is often placed in *Pseudamycla* Pace, 1902b (e.g. Higo et al., 1999), however *Pseudamycla* is differentiated by its unusual radular morphology (Pace, 1902b; Thiele, 1929-35), which this species does not share (pers. obs.). It is found throughout the Indo-Pacific. The shell varies in colour and pattern, but is typically transparent, biconic in shape, with opaque white and/or brown markings. The shell is broad at the base, with almost no anterior constriction, and the aperture edge is only weakly toothed. The protoconch is pinkish or white, conical, with about 4 whorls, covered overall with fine axial ridges. The teleoconch has 3.5 to 4 whorls.

One specimen of this species, a large juvenile, was collected at 3m depth at Sta. 44.

***Mitrella venulata* (G. B. Sowerby III, 1894)**
(fig. 20)

Columbella venulata Sowerby, 1894: 153, pl. 12 fig. 4.

Columbella carolinae E.A. Smith, 1876: 541-542, pl. 30 fig. 9 (syn. nov.).

Mitrella venulata (Sowerby, 1894). Cernohorsky, 1972; Drivas & Jay, 1990: 180, figs 27a-b; 1997b: 34, fig. 17.

This species is often confused with several others (especially *M. nympha*) because the markings are similar. Sleurs (1987) synonymizes it with *M. galaxias* (Reeve, 1859), which Drivas & Jay (1990) place in synonymy with *M. nympha* (Kiener). Based on a photo of the type, *Mitrella carolinae* (E.A. Smith, 1876) is this species rather than *Mitrella nympha* as suggested by Drivas & Jay (1990). The shell in this species is relatively large, to about 10 mm long, with about 7 teleoconch whorls. The protoconch is usually broken off, but is smooth and usually white or brown, with about 3.75 whorls. The shell is white, usually with paired chestnut axial lines over the entire shell, and often opaque white spots near the suture. There is also often an interrupted chestnut spiral line slightly posterior to the middle of the whorl, similar to that in *M. nympha* and *M. moleculina*. The most noticeable characteristics of the species are the large aperture, which is almost half the length of the shell, and the distinctly concave spire profile; these features differentiate the species from *M. nympha*.

This species is rare, and appears to be most common around New Caledonia. The expedition collected two specimens, both mostly white in colour, at stations 30 and 34; one was intertidal and the other in sand at 5 to 7 m depth.

***Pardalinops* nom. nov.**

The genus *Pardalina* was created by Jousseume (1888), with the type species *Columbella pardalina* Lamarck, 1822, a synonym of *Columbella testudinaria* Link, 1807. *Pardalina* is unavailable under ICZN Article 52, due to its prior use by J.E. Gray (1867) for a genus of wild cat (now known as *Oncifelis* Severtzow, 1858). Though the felid genus *Pardalina* has long been placed in synonymy, the use of the name for this particular group of columbellids has not had a long enough history according to the provisions of ICZN Article 23.9.1 to allow its conservation under Article 23.9.2. I propose the name *Pardalinops* to replace it with the type species *Columbella testudinaria* Link, 1807.

***Pardalinops testudinaria* (Link, 1807)**
(fig. 21)

Columbella testudinaria Link, 1807: 95 (not figured).

Pyrene pardalina (Lamarck, 1822). Sowerby I 1844: 124-145, pl. 38 figs 90-92; Cotton, 1957:1.

Pyrene testudinaria (Link, 1807). Cernohorsky, 1972: 133, pl. 40 figs 4-4b; Kilburn, 1975: 588, 592, fig. 10a; Wilson, 1994: 107, pl. 16 figs 22a-d.

Pyrene testudinaria testudinaria (Link, 1807). Higo et al., 1999: 247; Okutani (ed.), 2000: 427, pl. 212 fig. 10.

Pardalina testudinaria (Link, 1807). deMaintenon, 1999: fig. 4a, d.

This is an easily recognized species found through the Southwest Pacific and eastern Indian Ocean. The shell is thick and smooth overall with a thin, straw coloured,

felt-like periostracum. There is no axial sculpture except occasionally for growth lines. Adult shell length ranges from 14 to 17 mm with 6 to 7 whorls, and an unsculptured white protoconch having 2 to 2.5 whorls. The shell varies considerably in colour and pattern, but is typically either black, dark brown, reddish tan or olive gray on white. The pattern consists of white spots on the darker field or less commonly dark spots on white, with a white aperture edge, apex and anterior tip. The aperture is white with a row of low labial denticles; there are no parietal denticles.

Specimens collected by the expedition were typically dark brown on white, with white spots, or dark brown spots and axial blotches on white. Specimens were commonly found by the expedition and occurred at 13 stations, mostly intertidally under dead coral or rocks.

?*Pardalinops marmorata* (Gray, 1839)
(fig. 22)

Columbella marmorata Gray in Beechey, 1839: 129, pl. 36 fig. 11; Sowerby I, 1844: 122, pl. 37 figs 72-73.
Pyrene marmorata (Gray, 1839). Okutani (ed.), 2000: 427, pl. 212 fig. 13.

This is another species that may belong to *Pardalinops*; however the species has not been studied in depth. It lacks the characteristics that are diagnostic for *Pyrene*, as described below, so can not be placed there. The shell is very similar to that of *Pardalinops testudinaria*, but is typically monochromatic orange-brown on white, sometimes with white spots or patches. Specimens collected by the expedition were mostly orange-brown, some with scattered white patches. This species is also smaller; adult specimens are typically 9 to 12 mm long with 6 to 7 teleoconch whorls, and a conical white protoconch with about 3 whorls.

All specimens collected by the expedition were in the dry material, taken from four stations at depths of 3 to 22 m.

***Pictocolumbella* Habe, 1945**

This genus contains a single species, the type species *Pictocolumbella ocellata* (Link, 1807). As the name suggests, the shell looks similar to tropical American/East Atlantic *Columbella* species, though it lacks spiral ribs often present in *Columbella*.

***Pictocolumbella ocellata* (Link, 1807)**
(fig. 23)

Columbella ocellata Link, 1807: p. 94 (not figured).

Pyrene ocellata (Link, 1807). Cernohorsky, 1972: 132-133, pl. 40 figs 3-3a; Wilson, 1994: 107, pl. 16, figs 26a-d.

Pictocolumbella ocellata (Link, 1807). Higo et al., 1999: 247.

This species is very common in the southwest Pacific, particularly in Indonesia and the Philippines. Like the previous species, the shell is typically monochromatic black or red-brown on white, however this species is strombiform rather than ovate and has a lilac stain around the aperture edge, which is markedly thickened at the middle and

denticulate. The shell is unsculptured, and is similar to *Euplica*, though it lacks columellar folds. Adults are 10 to 15 mm long, with 5 to 7 teleoconch whorls and are often heavily eroded, even if collected live. The protoconch has 1.75 to 2 smooth whorls; these may be white or coloured and patterned like the teleoconch.

Specimens collected by the expedition varied in colour and pattern. The most common pattern was small round white spots on red-brown or black, however a few specimens had zigzag axial white stripes rather than spots, and some intermediates (axially elongated spots) were also present. Specimens were collected from eight stations, all intertidally, on and under rocks and on mangroves.

Pyrene Röding, 1798

Members of the genus *Pyrene* have a large, pupoid or biconic shell with a narrow aperture, an ascending suture at the aperture, and a strong spiral cord just below the suture on the early teleoconch whorls. Like *Columbella* in the Atlantic and Eastern Pacific, this genus has been used as a place to dump many columbellid species with similar radulae, however it likely consists of only about eight large southwest Pacific species having the above characteristics. Type species *Pyrene rhombiferum* Röding, 1798 (by monotypy), a synonym of *Pyrene punctata* (Bruguière, 1789).

Pyrene punctata (Bruguière, 1789) (fig. 24)

Buccinum punctatum Bruguière, 1789: 281 (not figured).

Pyrene discors (Gmelin, 1791). Cotton, 1957: 1, fig. 1.

Pyrene punctata (Bruguière, 1789). Cernohorsky, 1972: 132, pl. 40 fig. 1; Kilburn, 1975: 588, 592, fig. 8b;

Wilson, 1994: 107, pl. 16 figs 27a-c; Okutani (ed.), 2000: 425, pl. 211 fig. 7.

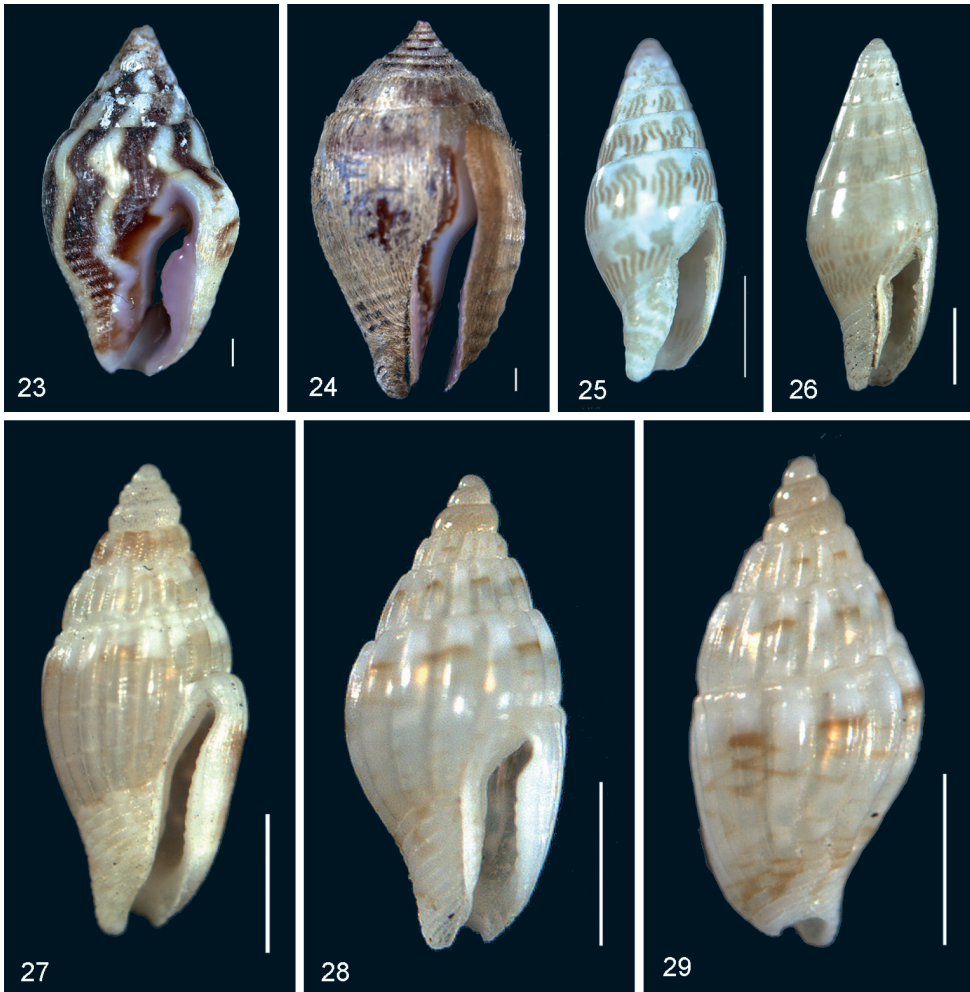
Pyrene punctata (Bruguière, 1792). Higo et al., 1999: 247.

This species is relatively large, pupoid, with a convex spire profile. The shell is typically reddish brown with white blotches, a pink or lilac aperture, and a pink apex. Adult shell length ranges from 16 to 22 mm, with over 9 teleoconch whorls, and the shell is often encrusted with calcareous material. The subsutural spiral cord in this species is quite pronounced, but only occurs on the first few teleoconch whorls. The shell is otherwise unsculptured, though the spiral ribs at the base of the shell cover the entire lower half of the body whorl. The periostracum in this species is axially lamellose and often tufted near the suture, and the suture often ascends markedly at the aperture edge. The protoconch is smooth, orange-pink, and has 2 to 2.25 whorls.

Specimens were collected by the expedition at five stations, intertidally to 2 m deep associated with coral or coral rubble, or in one case with a shipwreck on a mud flat. Most specimens were reddish brown, some with axial rows of tiny white spots, and with two spiral rows of large white blotches, one just below the suture and the other at the middle of the body whorl.

Pyreneola Iredale, 1918

Members of the genus *Pyreneola* have minute shells, 5 mm or less long. They are elongate biconic in shape and smooth, with a narrow aperture, a thickened columella,



Figs 23-29, Columbelloidea. Scale bars are 1 mm. 23, *Pictocolumbella ocellata* (Link, 1807), Ceram. 24, *Pyrene punctata* (Bruguière, 1789), Ceram. 25, *Pyreneola delineata* (Thiele, 1925), Stn. 27. 26, *Pyreneola melvilli* (Hedley, 1899), Ceram. 27, *Seminella peasei* (von Martens & Langkavel, 1871), Stn. 27. 28-29, *Zafra ambonensis* new sp., holotype, RMNH.MOL.109042, Stn. 30.

and a parietal shield that is detached along the edge. Markings typically include axial brown lines or nested sets of chevrons on a white or unpigmented shell. Type species (by monotypy) *Pyreneola abyssicola* (Brazier, 1877).

***Pyreneola delineata* (Thiele, 1925)**

(fig. 25)

Columbella delineata Thiele, 1925: 177, pl. 31 fig. 10.

This species has been suggested to be a junior synonym of *Pyreneola abyssicola* by Sleurs (1987) and of *Pyreneola semipicta* (Sowerby, 1894) by Monsecour and Kohler (2006). Thiele's specimens and those collected by the expedition are tall and narrow, with two rows of nested chevrons on the body whorl. Between the brown markings, at the level of the suture, there is an unpigmented spiral line flanked by opaque white spots on both sides. The photos I have of the types of *P. semipicta*, from Hong Kong, are stouter shells, thicker in the body whorl, with only one row of chevrons, posterior to the suture. *Pyreneola abyssicola* (Brazier, 1877), the type species of the genus, is also similar, but the nested chevrons vary in size, whereas those on the Ambon specimens do not; and *P. abyssicola* also lacks the white spots at the suture line. These species may indeed be synonymous, but because species in this poorly known genus are at this time separated by very minor differences in markings and shape, it seems preferable to maintain all three species separate for now, especially as the expedition material matches one group much more than the other. Thiele's species was collected in the Malacca Strait.

The material collected by the expedition consists of four individuals taken from sediments to 20 m deep, at stations 5, 23 and 27. Shells in these lots were elongate, biconic, 3.3 to 4.5 mm long, with up to 5 teleoconch whorls. Protoconchs were pink, with 3.5 to 4 whorls.

***Pyreneola melvilli* (Hedley, 1899)**
(fig. 26)

Columbella melvilli Hedley, 1899: 463, fig. 38.

Zafra melvilli Hedley, 1899. Cotton, 1957: 2.

Pyreneola melvilli (Hedley, 1899). Drivas & Jay, 1997b: 34, fig. 19.

This species was originally recognized from Funafuti in the Ellice Islands. It is similar to *P. delineata* but has a different colour pattern. Sleurs (1987) has it as a synonym of *P. abyssicola* (Brazier, 1877), but the color pattern is quite different. The upper part of each whorl in this species has narrow, widely spaced axial brown lines around large, rectangular unpigmented spaces. The lower part of the body whorl has spiral rows of thicker axial lines, interrupted axially in several series. There are two rows of opaque white spots at the suture level. *P. delineata* does have unpigmented spaces close to the suture, but they are much smaller, and the lower row of brown markings is not broken up into series. The shell is tall and narrow, biconic, 4 to 6 mm long with 5 to 5.5 teleoconch whorls, and a broadly conical protoconch of 3.5 to 4 whorls. The protoconch may be white, pink, or unpigmented, and has a midline spiral cord.

The expedition did not collect any specimens of this species on Ambon, but Hermann Strack collected one large specimen in Piru Bay near Hatuharan, Ceram Island, in November 1997.

***Seminella* Pease, 1867**

Members of the genus *Seminella* are minute, less than 5 mm long, and narrowly biconic. The shells are similar to those of *Zafra* A. Adams, 1860, but tend to be narrower,

with slit-shaped apertures and very fine spiral grooves that can be seen between the axial ribs. The protoconch is also uniquely sculptured with fine axial threads and a midline spiral thread. Type species by monotypy *Cythara varia* Pease 1860. As this name was preoccupied, it was replaced by *Seminella peasei* (von Martens & Langkavel, 1871).

***Seminella peasei* (von Martens & Langkavel, 1871)**
(fig. 27)

Columbella (Seminella) peasei von Martens & Langkavel, 1871: 23, pl. 1 fig. 17. *nomen nov.* for *Cythara varia* Pease, 1860.

Columbella peasei v. Martens, 1871. Hervier, 1899: 368-371.

Seminella peasei (von Martens & Langkavel, 1871). Cotton, 1957: 2; Sleurs, 1987: 50-53, fig. 11, pl. B fig. 3, pl. D fig. 11; Drivas & Jay 1990: 190-191, figs 47a-h; 1997b: 36, fig. 34.

Zafra (Seminella) peasei (von Martens & Langkavel, 1871). Okutani (ed.), 2000: 437, pl. 217 fig. 69.

This is one of the more common columbellid species in the Indo-Pacific. The shell is glossy, narrowly biconic, strongly axially ribbed, with faint spiral scratches between the axial ribs over the entire shell. Shells in this species are 3 to 4 mm long at maturity with about 3.5 teleoconch whorls. There is a deep subsutural groove crossing the axial ribs that creates a line of beads below the suture. Colour and pattern are highly variable. The aperture edge is thickened in the middle and denticulate, and the protoconch is white, 3.5 to 3.75 whorls, with a strong midline spiral thread and axial threads. The columella has a weak spiral groove.

The material collected by the expedition included over 80 dry shells from six stations. They tended to be found a little deeper than most species, and most were found by sieving from 3 to 20 m depth.

***Zafra* A. Adams, 1860**

This genus was named by A. Adams for very small axially ribbed species with high spires. Protoconchs in these species generally have a midline spiral thread, but no other sculpture. Type species: *Zafra mitriformis* A. Adams, 1860.

***Zafra ambonensis* spec. nov.**
(figs 28-29)

This species is very similar to *Zafra selasphora*, but has a subtle difference in pattern. The shell is glossy, 2.75 to 3 mm long with 3 to 3.25 teleoconch whorls. There is an opaque white band below the suture and a narrow white band one at the height of the suture on the body whorl, and unpigmented areas between and anterior to the narrower white band on the body whorl. The white subsutural band is bordered anteriorly by an interrupted brown spiral line. The unpigmented areas are overlain by a pattern of two brown bands with large white spots; these bands are barely visible over most of the shell, becoming most obvious dorsally behind the aperture edge (fig. 29). There is a weak subsutural groove, and about 14 broad axial ribs on the body whorl. The labial edge is regularly denticulate and the parietal edge is weakly denticulate. The protoconch is off-white, with 3 to 3.25 whorls.

The species is similar to several others. As stated above, it is perhaps most similar to *Z. selasphora*, but has a subtle difference in colour and pattern; specimens of *Z. selasphora* are occasionally unpigmented rather than straw-coloured over the middle of the body whorl, and in this case the pattern on the dorsal side of the shell can be used to separate them. There are several species that have an interrupted brown spiral line above the periphery, including *Z. selasphora*, *Z. troglodytes* and *Z. babajimana*. *Zafra troglodytes* can be differentiated from this species by the spiral grooves high up on the body whorl, particularly noticeable on the ventral side. *Zafra babajimana* can be differentiated by its more abundant axial ribs, and the smooth area dorsally over a quarter whorl behind the labial edge.

Dead shells of this species were collected at three stations by the expedition, in sediments at 3 to 20 m depth.

Type material.— Holotype, RMNH.MOL.109042, Stn 30, Ambon, Hitu, Suli, 6 m depth, 29.xi.1990, A. Fortuin; nine additional paratypes, RMNH.MOL.109043, Stn. 30, Ambon, Hitu, Suli, 6 m depth, 29.xi.1990, A. Fortuin; 23 paratypes, RMNH.MOL.109044, Stn. 27, Ambon, Leitimur, Hutumuri, 20 m depth, 26, 27.xi.1990, A. Fortuin; 15 paratypes, RMNH.MOL.109045, Stn. 44, Ambon, Leitimur, Latuhalat, 3 m depth, 12, 18. xii.1990, A. Fortuin.

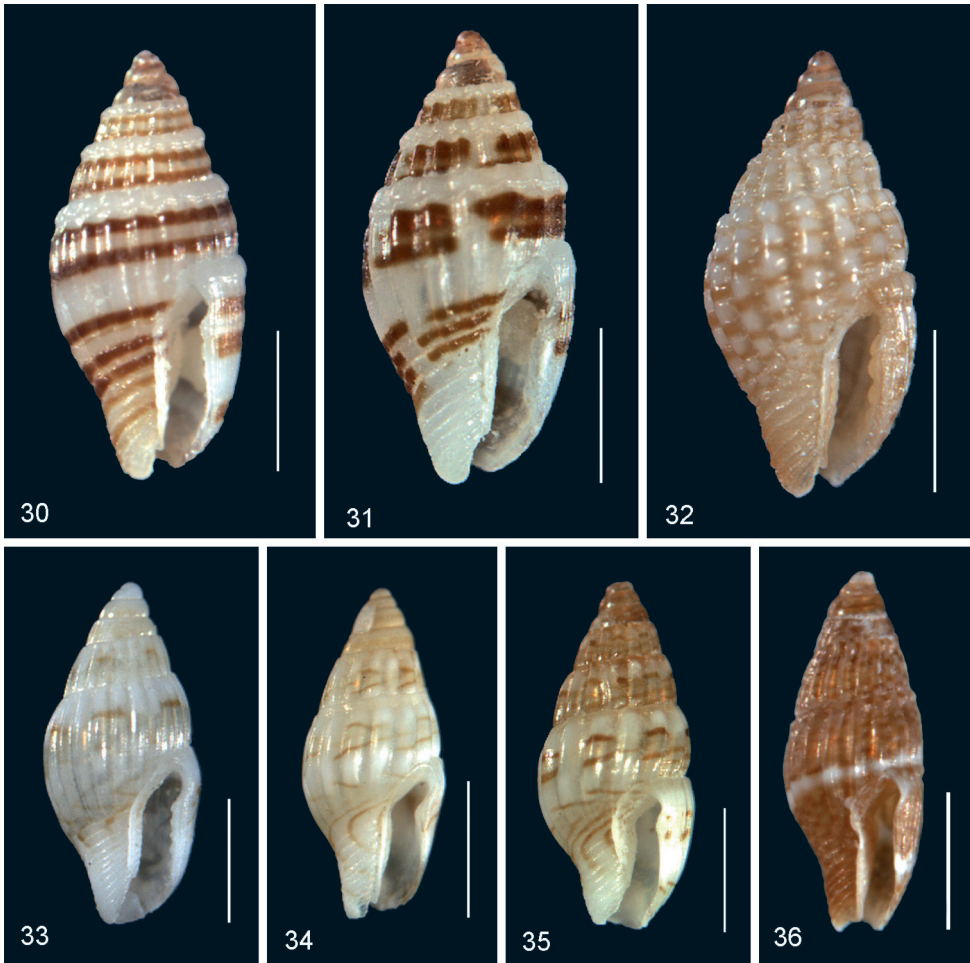
Zafra bilineata spec. nov.

(figs 30-31)

This species is very recognizable for the colour pattern, and appears most similar to *Zafra ulinganensis* Sleurs, 1987. The shell in the adult type specimens ranged from 2.6 to 3.5 mm (average 2.99 mm) long, and 1.3 to 1.5 mm (average 1.40 mm) wide with 3 to 4 teleoconch whorls. The shell has strong axial ribs, 14 to 20 on the body whorl, crossed just below the suture by a spiral groove, creating a row of noticeable beads below the suture. Spiral grooves are also present on the base, as in other columbellid species. The shell is opaque white, with two spiral brown bands, sometimes interrupted, on the posterior portion of the body whorl and continuing on the spire. The base of the shell has two to eight more spiral bands, but unlike in *Z. ulinganensis*, there is no axial striping. The posterior pair of bands or the anterior multiple bands may fuse together in some specimens. The aperture has regular labial denticles and a ridge on the parietal wall, which is divided into denticles in some specimens. The protoconch is translucent purple-brown, darker apically, with a weak midline spiral cord and 2.67 to 3 whorls.

Nine dead specimens of this species were collected by the expedition at stations 5 and 30, in sediments 1 to 6 m deep. Type locality Hitu, Suli, 29.xi.1990. Seven more specimens on loan from the Santa Barbara Museum of Natural History were collected in Sabah, Malaysia.

Type material.— Holotype, RMNH.MOL.109046, Stn 30, Ambon, Hitu, Suli, 6 m depth, 29.xi.1990, A. Fortuin; five additional paratypes, RMNH.MOL.109047, Stn. 30, Ambon, Hitu, Suli, 6 m depth, 29.xi.1990, A. Fortuin; three paratypes RMNH.MOL.109048, Stn. 5, Ambon, Leitimur, Galghoek, 1 m depth, 8,9.xi.1990, 2.xii.1990, A.F. de Jong; one paratype SBMNH 422870, Malaysia, Sabah, Palau Sepangar, off Kota Kinabalu, 15-20 m depth, 15.i.1993, D. Shasky; seven paratypes SBMNH 422871 – SBMNH 422877, Malaysia, Sabah, Palau Sulug, off Kota Kinabalu, 5-15 m depth, 13.i.1993, D. Shasky.



Figs 30-36, Columbelloidea. Scale bars are 1 mm. 30, *Zafra bilineata* new sp. holotype, RMNH.MOL.109046, Stn. 30. 31, *Zafra bilineata* new sp. Paratype, RMNH.MOL.109047a, Stn. 30. 32, *Zafra brevissima* (Hervier, 1899), Stn. 30. 33, *Zafra hahajimana* (Pilsbry, 1904), Stn. 5. 34-36, *Zafra hervieri* (Pace, 1902), Stn. 30.

Zafra brevissima (Hervier, 1899)
(fig. 32)

Columbella brevissima Hervier, 1899: 372-373, pl. 14 fig. 10.

Zafra brevissima (Hervier, 1900). Sleurs, 1987: 48-50, text figs 9-10, pl. c fig. 5, pl. D fig. 5.

This species of *Zafra* is somewhat unusual in that it has spiral cords in addition to the axial ribs, giving the axial ribs a beaded appearance where the cords cross. The shell has oblique narrow spiral bands of alternating brown and white, and a deep subsutural spiral groove. The labial edge is regularly denticulate. Adults are 2.5 to 3 mm long, with

3 to 3.5 teleoconch whorls. The protoconch is brown, with a strong midline spiral thread and about 3.25 whorls.

This species is also found infrequently. The expedition collected five shells from stations 30 and 44, where they were taken at 3 to 6 m depth.

***Zafra hahajimana* (Pilsbry, 1904)**
(fig. 33)

Columbella hahajimana Pilsbry, 1904: 15-16, pl. 3 fig. 25.

Zafra (Zafra) hahajimana (Pilsbry, 1904). Higo et al., 1999: 249-250; Higo et al., 2001: 84, fig. 2881-1; Okutani, ed., 2000: 435, pl. 217 fig. 65.

This species has a white shell, 2.5 to 3 mm long with about 3 teleoconch whorls. It is noticeable for being shiny white, with more and finer axial ribs than in the other species (this species typically has about 20 or more, other species usually have about 15); there is also a conspicuously smooth area behind the aperture edge over about ¼ whorl. The shell is opaque white below the suture and on the base; the area between is unpigmented, and has a bluish cast in empty shells. It often has inconspicuous white and/or brown wavy axial lines. The protoconch is white with 2.75 to 3 whorls. The aperture edge is regularly denticulate.

Dead shells were found by the expedition at three stations, in sediments from 1 to 6 m depth.

***Zafra hervieri* (Pace, 1902c)**
(figs 34-36)

Columbella hervieri Pace, 1902c: 420, *nomen nov.* for *Columbella peasei* Hervier, 1899 *non* von Martens and Langkavel, 1871.

Zafra hervieri (Pace, 1902). Cotton, 1957: 2; Sleurs, 1987: 34-37, figs 1-3, pl. A figs 3, 4, 6, pl. C figs 1-3, pl. D fig. 3.

Zafra (Zafra) hervieri (Pace, 1902). Okutani (ed.), 2000: 435, pl. 216 fig. 63.

This is one of the smaller *Zafra* species, with only 2 to 3 teleoconch whorls and an adult shell length of 2 to 3 mm. The protoconch in contrast appears quite large, having 3.75 to 4.25 whorls and a moderately developed midline spiral thread; it comprises about one-fifth of the shell length. Shell colour is variable and has two main patterns (Sleurs (1987) differentiates three): an unpigmented or white shell, with 2 or 3 spiral interrupted brown bands or oblique dashes and a white protoconch (figs 34-35), or brown with white spots in a mesh-like pattern (fig. 36), and often a white spiral band just above the suture and a brown protoconch. The labial edge has one or two large denticles close to the posterior end, setting off the posterior canal. Drivas & Jay (1990) synonymized this with *Zafra cinnamomea* (Hervier 1899), apparently based on the fact that as an original variety of *Columbella peasei* Hervier, 1899, the name *cinnamomea* Hervier, 1899 has seniority over the name *C. hervieri* Pace, 1902c. But according to Monsecour (pers. comm.) the identity of *Z. cinnamomea* appears to be unstable as the type has not been found.

This was the most common species of *Zafra* collected by the expedition, with over 100 specimens from seven stations. Almost all were in the dry lots, and were collected between 1 and 20 m depth, typically by sieving.

***Zafra obesula* (Hervier, 1899)**
(fig. 37)

Columbella obesula Hervier, 1899: 376-377, pl. 14 fig. 6.

Zafra obesula (Hervier, 1899). Cotton, 1957: 2; Drivas & Jay, 1997b: 35, fig. 29.

This is tentatively identified here, because the specimens do not completely match photos of the type lots. This is one of several *Zafra* species that has a very wide shell, and thus looks rather globular. The shell in these specimens is glossy, and mostly or often completely white, sometimes with wavy brown axial lines on the base and two vague unpigmented to straw-coloured or tan spiral bands. The shell is 3 to 3.5 mm long, with 3 to 3.5 teleoconch whorls. There is a relatively weak subsutural groove, and the aperture edge is regularly denticulate, with a ridge of denticles on the parietal wall. The protoconch is white, with 3 whorls and a weak midline cord.

The expedition collected dead specimens of this species from four stations, mostly from sediments about 6 m deep.

***Zafra ocellatula* (Hervier, 1899)**
(fig. 38)

Columbella ocellatula Hervier, 1899: 367, pl. 13 fig. 11.

Pyrene ocellatula (Hervier, 1899). Higo et al., 1999: 247.

Zafra (*Zafra*) *ocellata* Hervier, 1899 (an apparent misspelling of *ocellatula*). Okutani (ed.), 2000: 435, pl. 216 fig. 60.

Zafra ocellatula (Hervier, 1899). Drivas & Jay, 1990: 188, fig. 42, 1997b: 35, fig. 30.

This is one of the larger species of *Zafra*, with shells 3.8 to 4.6 mm long and having up to 5 teleoconch whorls. The shell is biconic, but has a taller spire than other *Zafra* species. It is white, overlain by tan or brown over the middle of each whorl, and covered by round white spots in a mesh-like pattern. The columella has a distinct raised ridge internally, and the labial edge is denticulate. As in most species, there is a spiral subsutural groove intersecting the axial ribs, producing a beaded ridge below the suture. The protoconch is white or brown, with a midline spiral thread on the last whorl and 2.75 to 3.25 whorls.

This species of *Zafra* is found infrequently; the expedition collected a total of eight, from 4 stations. All were found in sediments at 3 to 20 m depth.

***Zafra pumila* (Dunker, 1860)**
(fig. 39)

Columbella pumila Dunker, 1860: 224-225 (not figured).

Zafra minuscula (Gould, 1860). Sleurs, 1987: 37-40, fig. 4, pl. B fig. 2, pl. D fig. 1; Drivas & Jay, 1997a: 29; 1997b: 35, fig. 31; Okutani (ed.), 2000: 435, pl. 216 fig. 59.

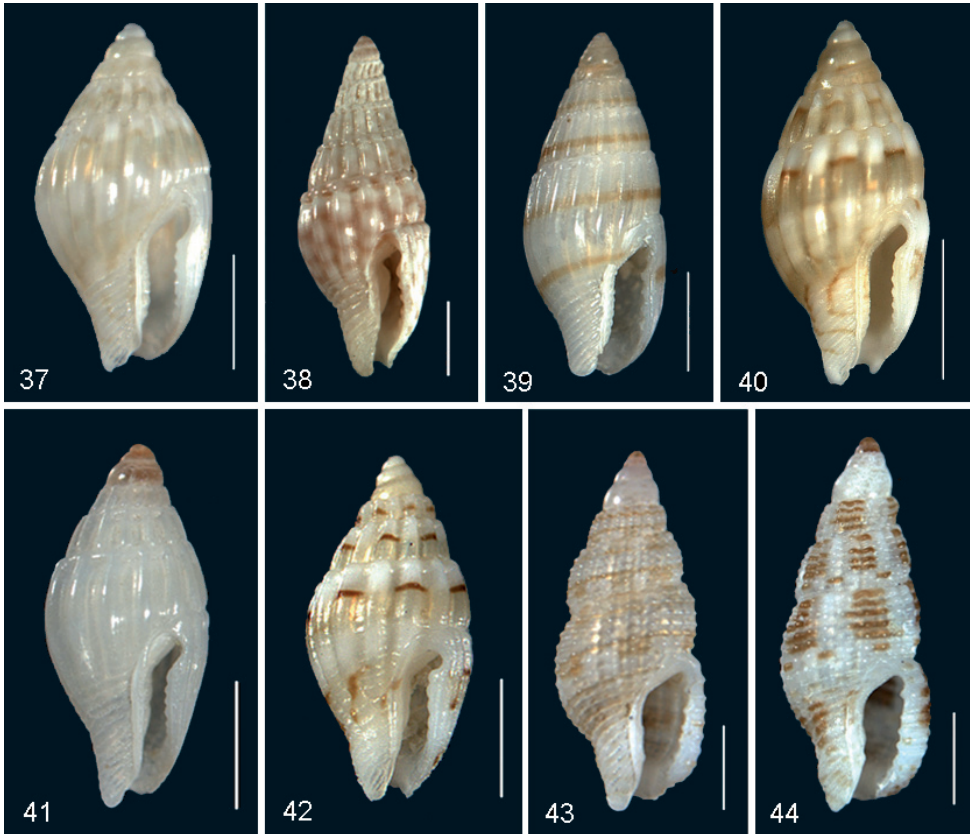
Zafra goollandi (Brazier, 1874). Cotton, 1957: 2; Wilson, 1994: 109.

Zafra regulus (Souverbie in Souverbie & Montrouzier, 1864). Cotton, 1957: 2; Cernohorsky, 1972: 138, pl. 47 fig. 1; Drivas & Jay, 1990: 188, figs 44a-b; Wilson, 1994: 109.

Zafra (*Zafra*) *pumila* (Dunker, 1860). Higo et al., 1999: 249; Okutani (ed.), 2000: 435, pl. 216 fig. 58; Monseour & Kohler, 2006: 297-298, fig. 49.

This is a well known species of *Zafra*, found throughout the Indo-West Pacific. The synonymy is discussed in depth by Monsecour & Kohler (2006). The shell is 2.5 to 3.5 mm long with 3.5 to 4 teleoconch whorls, and has one of two colour patterns: brown overall, or white with two spiral brown lines on the body whorl (fig. 38), one of which continues on the spire whorls. The aperture edge is regularly denticulate. The axial ribs on this species are typically slightly finer and denser than in other *Zafra* species, and there is a strong subsutural spiral groove. The protoconch is brown, with about 3.5 whorls and a midline spiral thread on the final whorl; Sleurs (1987) reports two spiral threads, but only one was seen here using light microscopy; scanning electron microscopy might reveal another.

The expedition collected a number of living individuals of this species, typically in the mid to low intertidal zone under coral, rocks and oysters. A total of 75 individuals were sampled from 11 stations.



Figs 37-44, Columbelloidea. Scale bars are 1 mm. 37, *Zafra obesula* (Hervier, 1899), Stn. 30. 38, *Zafra ocellatula* (Hervier, 1899), Stn. 23. 39, *Zafra pumila* (Dunker, 1860), Stn. 44. 40, *Zafra selasphora* (Melvill & Standen, 1901), Stn. 30. 41, *Zafra succinea* (Hervier, 1899), Stn. 44. 42, *Zafra troglodytes* (Souverbie, 1866), Stn. 30. 43-44, *Zafra isomella* (Duclos, 1840), Stn. 44.

***Zafra selasphora* (Melvill and Standen, 1901)**
(fig. 40)

Columbella selasphora Melvill & Standen, 1901: 406, pl. 23 fig. 7.

This species has a glossy, unpigmented shell, 2.5 to 3 mm long with 2.5 to 3 teleoconch whorls. The shell has opaque white bands below the suture, at the level of the suture on the body whorl, and at the base, and straw coloured bands between. The hindmost straw coloured band is rimmed posteriorly with a single interrupted brown spiral line. The anterior white bands have wavy axial brown lines that extend to the anterior tip of the shell. There is a weak subsutural groove. The aperture edge is regularly denticulate. The protoconch is off-white, with 3.5 to 3.75 whorls, and a brown suture at the apex. Sleurs (1987) considers this a synonym of *Zafra troglodytes*, but they differ in several aspects; most noticeably, this species is glossier and only has spiral grooves at the base of the shell, whereas those on *Z. troglodytes* cover the bottom half of the body whorl.

Dead shells of this species were collected at four stations by the expedition, mostly at 6 m depth in sand.

***Zafra succinea* (Hervier, 1899)**
(fig. 41)

Columbella succinea Hervier, 1899: 375-376, pl. 14 fig. 5.

Zafra succinea (Hervier, 1899). Drivas & Jay, 1990: 188, 190, fig. 45; 1997a: 29; 1997b: 35, fig. 32; Higo et al., 1999: 249 (as a synonym of *troglodytes* Souverbie, 1866).

Zafra (*Seminella*) *succinea* (Hervier, 1899). Okutani (ed.), 2000: 437, pl. 217, fig. 68.

The shell in this species is 2.75 to 3.5 mm long, white to off-white, usually rather obese, with 3 to 3.5 teleoconch whorls. The body whorl is straw-coloured in some, and in this case there is a narrow white band below the suture, which is somewhat channeled; in many specimens the shell is entirely white. The aperture is narrow and sinuous, with a raised parietal edge and many fine labial teeth. The protoconch is the one strongly coloured part of the shell, and is generally reddish-brown at the apex with a moderate mid-whorl carina. It has 2.75 to 3 whorls.

This species was collected only at Station 5, in sediments at 3 m depth.

***Zafra troglodytes* (Souverbie, 1866)**
(fig. 42)

Columbella troglodytes Souverbie in Souverbie & Montrouzier, 1866: 145-147, pl. 6 fig. 4.

Columbella troglodytes Souverbie, 1866. Hervier, 1899: 374.

Anachis troglodytes (Souverbie, 1866). Wilson, 1994: 100; Higo et al., 1999: 249.

Zafra troglodytes (Souverbie, 1866). Cotton, 1957: 2; Cernohorsky, 1972: 138, pl. 41 fig. 8; Sleurs, 1987: 40-43, figs 5-6, pl. C fig. 4, pl. D fig. 7; Drivas & Jay, 1997a: 29; 1997b: 35, not fig. 33.

Zafra (*Zafra*) *troglodytes* (Souverbie, 1866). Okutani (ed.), 2000: 435, pl. 216, fig. 62.

This species has a white shell, 2.75 to 3.25 mm long with 3.25 to 3.5 teleoconch whorls. The unusual characteristic of this species is the prominent spiral grooves that

cross the shell over the lower half of body whorl (up to the top of the aperture). Similar to *Z. selasphora*, the body whorl has two straw-coloured spiral bands, the upper one rimmed posteriorly by an interrupted brown spiral line on alternating axial ribs. The basal straw band is crossed by oblique axial wavy brown lines. The aperture edge is regularly denticulate. The protoconch is straw-coloured with a moderate mid-whorl carina, and has 3.25 to 3.5 whorls.

This is a common Indo Pacific species; dead shells were found by the expedition at four stations, in sediments from 3 to 20 m depth.

Zafrona Iredale, 1916

Iredale introduced this name in 1916 with the type *Colombella isomella* Duclos, 1840, but did not actually describe the genus. Currently *Zafrona* consists of a combination of a few Indo-Pacific and tropical American species. Shells in this group are small (less than 10 mm long) and fusiform, with well rounded whorls and axial and often spiral sculpture. Members of the genus, especially those in the American tropics, are very similar in shell characteristics to members of the genus *Metanachis* Thiele, 1924, and Wilson (1994) has *Metanachis* as a synonym of *Zafrona*. A conclusion on this awaits further study, however on the basis of strictly conchological characteristics, the tropical American *Zafrona* species are more similar to Indo-Pacific *Metanachis* than they are to Indo-Pacific *Zafrona*. Type species by original designation: *Zafrona isomella* (Duclos, 1840).

Zafrona isomella (Duclos, 1840) (figs 43-44)

Colombella isomella Duclos, 1840: pl. 9, figs 7-8.

Columbella isomella Duclos in Chenu, 1858. Hervier, 1899: 360-362.

Zafrona nebulosa (Gould, 1860). Sleurs, 1987: 63-65, figs 18, 19, pl. B fig. 5, pl. D fig. 8.

Zafrona neburossa (Gould, 1860). Okutani (ed.), 2000: 437, pl. 217 fig. 73.

Zafrona isomella (Duclos, 1840). Drivas & Jay, 1990: 193-194, figs 50a-d; 1997a: 29; 1997b: 36-37, fig. 39; Higo et al., 1999: 250; Okutani (ed.), 2000: 437, pl. 217 fig. 72.

This species is typically very small, about 3.5 to 5.5 mm long with 3 to 5 teleoconch whorls. The protoconch is conical and often slightly tilted, with 4.25 to 4.5 smooth whorls and a deep velar sinus. The shell itself is fusiform and glossy, with slightly separated spiral ribs crossing barely discernible low axial ribs, giving the shell a beaded appearance. The labial edge is denticulate internally. Colour and pattern vary in this species; the base colour of the shell is typically white; brown markings, if present, may be light or dark, and are in the form of vague or distinct blotches, or occasionally spiral lines.

This species is generally quite common in the southwest Pacific, and may be collected in large numbers in some locations. It is sometimes confused with a similar species, *Zafrona striatula* (Dunker, 1871), but the latter is larger, typically 7 to 8.5 mm in length. The expedition collected 34 dry shells from 3 stations, between 1 and 20 m deep.

Table 1. Diversity and abundance by station of columbellid species collected by the 1990 expedition.

Species	1	3	4	5	9	11	14	16	17	18	19	20	21	23	26	27	29	30	34	35	37	39	41	44	Sum	Number of stations
<i>Ascalista polita</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
<i>Euplicia bidentata</i>	-	17	2	1	-	-	-	2	-	5	-	1	5	7	2	7	-	-	23	6	8	-	-	-	-	86
<i>E. brumidentata</i>	-	-	-	4	-	-	-	-	-	1	-	-	4	-	-	-	-	2	-	-	-	-	-	-	-	11
<i>Euplicia ionida</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	52	-	10	-	-	-	5	1	-	-	33
<i>Euplicia turturina</i>	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	1	-	-	-	4
<i>Euplicia varians</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4	-	6	-	-	-	-	-	-	-	-	2
<i>G. albina</i>	-	-	1	-	2	-	-	-	-	-	-	-	2	-	-	-	1	-	1	-	1	-	-	-	-	7
<i>G. ligula</i>	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	2	1	-	-	-	-	-	-	-	5
<i>I. conspersa</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	1
<i>I. cf. schepmani</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
<i>Indomitrella puella</i>	2	-	-	-	-	-	1	-	-	-	-	-	-	-	-	1	-	-	-	2	-	-	1	-	-	7
<i>Lavesopus cumingii</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	1
<i>Metanachis jaspidea</i>	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>M. laingensis</i>	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
<i>Mitrella moleculina</i>	-	-	3	-	1	-	-	6	-	6	-	-	3	-	23	-	12	-	7	1	1	1	-	-	-	68
<i>Mitrella nympha</i>	-	-	1	1	-	-	-	-	-	-	-	-	-	-	4	1	-	-	-	-	-	-	-	-	-	14
<i>Mitrella rorida</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
<i>Mitrella tenuolata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	2	-	-	-	-	-	-	3
<i>Pard. testudinaria</i>	-	14	-	5	-	1	1	10	6	5	2	9	7	13	-	-	-	-	-	-	13	1	-	-	-	87
? <i>Pard. marmorata</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-	-	-	1	-	-	7
<i>Picto. ocellata</i>	-	33	-	15	6	-	6	28	-	2	-	-	-	2	-	2	-	-	-	-	-	35	-	-	-	125
<i>Pyrene punctata</i>	-	-	1	-	-	-	-	9	-	1	-	2	-	-	-	-	-	-	-	-	1	-	-	-	-	14
<i>Pyreneola delineata</i>	-	-	-	1	-	-	-	-	-	-	-	-	-	2	-	1	-	-	-	-	-	-	-	-	-	4
<i>Seminella peasei</i>	-	-	-	5	-	-	-	-	-	-	-	-	-	3	37	11	-	11	-	-	1	-	-	-	-	25
<i>Zafra ambonensis</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	23	-	10	-	-	-	-	-	-	-	-	15
<i>Zafra bilineata</i>	-	-	-	3	-	-	-	-	-	-	-	-	-	-	-	-	6	-	-	-	-	-	-	-	-	9
<i>Zafra brevissima</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-	-	-	-	2
<i>Zafra hahajinana</i>	-	1	-	6	-	-	-	-	-	-	-	-	-	-	-	21	-	21	-	-	-	-	-	-	-	28
<i>Zafra herveri</i>	-	2	-	19	-	-	-	1	-	-	-	-	-	-	77	-	46	3	-	-	-	-	-	-	-	22
<i>Zafra obesula</i>	-	1	-	6	-	-	-	-	-	-	-	-	-	-	-	-	36	1	-	-	-	-	-	-	-	44
<i>Zafra ocellatula</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	3	-	1	-	-	-	-	-	-	-	8
<i>Zafra pumila</i>	-	5	-	1	-	1	25	-	-	4	-	4	-	2	7	18	6	-	-	-	-	3	-	3	-	75
<i>Zafra selasphora</i>	-	1	-	14	-	-	-	-	-	-	-	-	-	-	16	-	3	2	-	-	-	-	-	-	-	36
<i>Zafra succinea</i>	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22
<i>Zafra troglodytes</i>	-	2	-	-	-	-	-	-	-	-	-	-	-	-	4	-	21	-	-	-	-	-	-	-	-	36
<i>Zafra isomella</i>	-	-	3	1	-	1	-	-	-	-	-	-	-	-	15	-	-	-	-	-	-	-	-	-	-	20
Number of species	1	9	3	16	1	7	1	4	7	3	1	4	6	11	5	18	1	20	7	3	7	7	1	14	1	14

Table 2. Depth distributions of columbellid species collected by the 1990 expedition.

Species	intertidal	subtidal to 3m	3-6m	6-12 m	12-25m	Total
<i>Ascalista polita</i>	-	-	-	1	-	1
<i>Euplica bidentata</i>	63	19	-	-	-	82
<i>Euplica deshayesi</i>	-	4	-	-	-	4
<i>Euplica brunnidentata</i>	3	2	2	-	-	7
<i>Euplica ionida</i>	-	34	16	1	52	103
<i>Euplica turturina</i>	-	2	-	2	1	5
<i>Euplica varians</i>	-	7	6	1	-	14
<i>Graphicomassa albina</i>	-	1	2	2	-	5
<i>Graphicomassa ligula</i>	1	1	3	-	-	5
<i>Indomitrella conspersa</i>	-	-	1	-	-	1
<i>Indomitrella cf. schepmani</i>	-	-	-	1	-	1
<i>Indomitrella puella</i>	-	-	-	2	2	4
<i>Lavesopus cumingii</i>	-	1	-	-	-	1
<i>Metanachis jaspidea</i>	1	-	-	-	-	1
<i>Metanachis laingensis</i>	-	1	-	-	-	1
<i>Mitrella moleculina</i>	10	23	15	1	21	70
<i>Mitrella nympha</i>	8	1	-	-	-	9
<i>Mitrella rorida</i>	-	1	-	-	-	1
<i>Mitrella venulata</i>	2	-	1	-	-	3
<i>Pardalinops testudinaria</i>	62	5	-	-	-	67
? <i>Pardalinops marmorata</i>	-	2	2	-	2	6
<i>Pictocolumbella ocellata</i>	131	20	-	-	-	151
<i>Pyrene punctata</i>	11	1	-	-	-	12
<i>Pyreneola delineata</i>	-	1	-	2	1	4
<i>Pyreneola melvilli</i>	-	1	-	-	-	1
<i>Seminella peasei</i>	-	31	12	3	37	83
<i>Zafra ambonensis</i>	-	15	10	-	23	48
<i>Zafra bilineata</i>	-	3	6	-	-	9
<i>Zafra brevissima</i>	-	2	3	-	-	5
<i>Zafra hahajimana</i>	-	6	21	-	-	27
<i>Zafra hervieri</i>	1	44	54	-	76	175
<i>Zafra obesula</i>	-	6	37	-	-	43
<i>Zafra ocellatula</i>	-	2	1	2	3	8
<i>Zafra pumila</i>	24	29	6	-	-	59
<i>Zafra selasphora</i>	-	8	11	-	16	35
<i>Zafra succinea</i>	-	22	-	-	-	22
<i>Zafra troglodytes</i>	-	36	21	-	4	61
<i>Zafra isomella</i>	-	1	20	-	15	36

Diversity among sites

A total of 36 columbellid species was found by the Rumphius expedition of 1990, and two more were found on nearby Ceram by Hermann Strack in 1997 (*Euplica deshayesi* and *Pyreneola melvilli*). Of these, several species were notably abundant (tables 1 and 2); *Zafra hervieri*, one of the smallest of the *Zafra* species, was most abundant and found at all depths, and a second *Zafra* species, *Z. pumila*, was also found in large numbers, especially in the intertidal and high subtidal zones. Most *Zafra* species tend to occur below the intertidal zone. *Pictocolumbella ocellata* and *Pardalinops testudinaria* were both common in the intertidal zone; these two species were not found alive at depths greater than 2 m. *Euplica ionida* and *Euplica bidentata* were also abundant, *E. ionida* at all subtidal depths and *E. bidentata* intertidally to 2 m.

Some stations had greater columbellid diversity than others. Most columbellid

species are epibenthic on hard substrates, where they feed on algae or a variety of animal foods or carrion. The sites where the most columbellid species were found include stations 5, 27, 30 and 44. Station 30 had the highest number of species, 20, and high abundance. Most of this material was collected dead at 5 to 7m, in sand near corals. Station 27 had 18 species, most of which were sieved at 20m depth. A few species were collected live on the reef flat. Most of the material for the 16 species collected at station 5 was collected dead at 1 m depth or sieved from sand at 6m depth, and all of the material for the 14 species collected at station 44 was collected dead at 3m depth. It is likely that much of the material from these stations was not found in its living habitat, however reef and rubble zones tend to have a number of columbellid species.

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