

Review of the Recent species of *Morula* (*Oppomorus*), *M.* (*Azumamorula*) and *M.* (*Habromorula*) (Gastropoda: Muricidae: Ergalataxinae)

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KEYWORDS. Gastropoda, Muricidae, *Oppomorus*, *Azumamorula*, *Habromorula*, Indo-Pacific, review, new species, new name, lectotype.

ABSTRACT. *Oppomorus* Iredale, 1937, *Azumamorula* Emerson, 1968, and *Habromorula* Houart, 1995 are reviewed and considered as subgenera of *Morula* Schumacher, 1817. *Morula* is transferred from Rapaninae Gray, 1853 to Ergalataxinae Kuroda, Habe & Oyama, 1971, chiefly on basis of differences of shell, operculum and radula morphology. One species of *Oppomorus*, one of *Azumamorula* and fifteen of *Habromorula* are reviewed and illustrated. The spiral cords and the aperture morphology is illustrated for most of the species. *Morula* (*Habromorula*) *whiteheadae* is described from West Australia. A new name is given to *M.* (*Morula*) *striata* (Pease, 1868), not *M.* (*Habromorula*) *striata* (Pease, 1868). A lectotype is designated for *Ricinula pisolina* Lamarck, 1822.

INTRODUCTION

After having reviewed a group of small *Morula* shells and having illustrated all the species of *Morula* s.s. (Houart, 2002a), I now continue and finish the review of that genus in describing and figuring all the species of *Oppomorus* Iredale, 1937, *Azumamorula* Emerson, 1968 and *Habromorula* Houart, 1995. *Morula* was retained in Rapaninae by Houart (2002a) in a conservative way, however it is here reevaluated.

Discussion of the phylogenetic analyses

The phylogenetic analyses of Rapaninae provided by Kool (1993), Vermeij & Carlson (2000), Tan (2003) and the classification of Tan (2000), reveal that the anatomical characters are important but that shell characters complete them very harmoniously (fortunately for the paleontologist). I have analyzed shell, operculum and radula characters of different genera usually classified in Rapaninae and Ergalataxinae, including *Thais* Röding, 1798, *Purpura* Bruguière, 1789, *Reishia* Kuroda & Habe, 1971, *Neothais* Iredale, 1912, *Semiricinula* von Martens, 1903, *Morula* Schumacher, 1817, *Ergalatax* Iredale, 1931, *Lataxiena* Jousseau, 1833, *Orania* Pallary, 1900, *Pascuala* Dall, 1908, *Cytharomorula* Kuroda, 1953, and a few others. My conclusion is closer to that of Kool (1993) whose analyses was based on gross anatomy (female and male reproductive systems, alimentary system, mantle cavity organs), radular, opercular, protoconch morphology and shell ultrastructure, to that of Vermeij and Carlson (2000) based on shell characters only, than to the classification of Tan (2000).

Kool (1993: 233) already showed *Cronia* and *Morula* being grouped together in a consensus cladogram. He suggested then that either these two genera are very highly derived members of his clade C (clade supporting the true Rapaninae), or that their placement in that clade "should be subjected to further examination, which may show that they are better placed in Ergalataxinae Kuroda & Habe, 1971". Wu (1973: 18) recorded a pair of short symmetrical or asymmetrical accessory salivary glands in *Morula granulata* and *Morula uva* (here considered as Ergalataxinae), but noted the absence of accessory salivary glands in *Mancinella tuberosa*, *Drupella cornus* and *Thaisella rugosa* (Rapaninae). Kool (1993: 178) also noted the presence of two short accessory salivary glands in *Cronia amygdala* (Kiener, 1835) (Ergalataxinae).

Morula is also separated from "true" Rapaninae in having a narrow operculum with subapical nucleus (Figs 3-4) vs a broad D-shaped operculum with a lateral nucleus in rapanines (Figs 5-7). The operculum of *Morula* is similar to that of the Ergalataxinae (Fig. 2).

In Rapaninae, the radula consist of a broad rachidian tooth bearing a broad central cusp flanked by large and broad lateral cusps which always bear inner lateral denticles. However, in *Drupa*, *Drupina*, *Ricinella*, *Nassa*, *Drupella*, *Plicopurpura*, *Patellipurpura*, *Mancinella* and *Neorapana*, taxa usually considered as rapanine, the operculum is typically D-shaped with lateral nucleus, but the radula is different of any other Rapaninae or Ergalataxinae. In *Morula* and Ergalataxinae, the central cusp is usually long and slender, flanked by narrow and short lateral denticles, in many cases

completely separate from the narrower and/or shorter lateral cusp.

The subfamily Ergalataxinae is considered to be synonym of Rapaninae by Tan (2000). It is here maintained as separate to clearly group together many species dissimilar from the greatest part of the Rapaninae in having a different shell, radula and operculum structure. *Morula* is here transferred from Rapaninae to Ergalataxinae for the same reasons. However, it is obvious that a complete revision of the higher taxa usually included in this subfamily is highly recommended.

Classification

Many species for which higher taxa have been proposed in the past and which differs primarily by the shell morphology have been included by Tan (2000) in *Thais* Röding, 1798 and in *Morula* Schumacher, 1817, because, following Tan (2000) "they have not been defined rigorously", and because "intraspecific variation that is observed in some species cautions us against using shell shape as a generic character". He is right for a number of species but it is also certain that some of them belong to different genera, tribes, or even subfamilies.

On the other hand, the shell morphology has been proved to be very useful for separating genera or subgenera (Marshall & Burch, 2000, Merle, 1999, 2001, Merle & Houart, 2003). Ipso facto, I don't think either that the fact of having species with similar (or resembling) radula morphology and with more or less variable shell morphology proves they all belong to a same genus.

In the *Morula* list from the South China Sea, Tan (2000) also included following species in *Morula*. I consider them to belong to other genera :

- *Morula cariosa* (Wood, 1828) (not *Murex cariosus* Linnaeus, 1767) [is a synonym of *Muricodrupa fenestrata* (Blainville, 1832)].
- *Morula funicula* (Wood, 1828) [is probably a synonym of *Muricodrupa fiscella* (Gmelin, 1791)].
- *Morula fusca* (Küster, 1862) (is a Rapaninae, probably a *Thais* species). Fujioka (1985: pl. 7, fig. 63) illustrated the radula of a specimen that he identified as *Cronia (Muricodrupa) fusca*. However, the radula illustrated by Fujioka is *Morula*-like. Tan & Chou (2000: 98) illustrated and commented *Morula fusca*, however, the specimen illustrated is *Morula rumphiusi* Houart, 1996. The radula illustrated by Fujioka (1985) is also close to that of *M. rumphiusi* (Houart, 1996a: 392, figs 5-6), and could be also that species instead of the real *Thais fusca*. The radula, the shell, and the operculum of specimens of *Thais fusca* from my collection are here illustrated (Figs 6, 9, 12-13). The specimen here used for the illustration of the radula is figured (Fig. 13) and is identical to the figure of

Küster (1862: pl. 4, fig. 16) here also illustrated (Fig. 11), and by Tsuchiya (2000) (as *Muricodrupa fusca*) and could not has been mixed with any other *Thais* species when SEM was realized, because there was not any other *Thais* in the examined lots. The location of the type of *T. fusca* is unknown (R. Janssen, in litt.)

- *Morula ochrostoma* (Blainville, 1832) (is *Pascula ochrostoma*).

However, Tan reached the same conclusion as me regarding to the differences in radula and operculum structure in *Morula* and *Thais*.

Azumamorula, *Oppomorus* and *Habromorula* are separated from *Morula* on basis of minor, although constant morphological differences of the shell structure only, therefore they are considered as subgenera rather than separate genera. I am of the opinion that constant differences in shell morphology in a group of related species, belonging to a same subfamily, is at least worth the status of subgenus in some cases.

The spiral cords characters, their topological and ontogenetical correspondences, as presented in Merle (1999 and 2001) and used afterwards (Houart, 2000, 2001a, b, 2002a, b, c, 2003; Houart & Dharma, 2001; Merle, 1999, 2001, 2002; Merle et al, 2001; Merle & Pacaud, 2002a, b; Merle & Houart, 2003) have been once again of a primordial help for the identification and the comparison of the species, and for their description.

Radula

The radula is rachiglosse consisting of three rows of teeth with a broad rachidian and sickle shaped, broad, lateral teeth. The rachidian of adult specimens bears a broad, long central cusp; short lateral denticles, usually obviously separated from the central and lateral cusps; long lateral cusps, but almost half the size of the central cusp; 2-4 short marginal denticles between the lateral cusp and a broad, short marginal cusp (Figs 23-31).

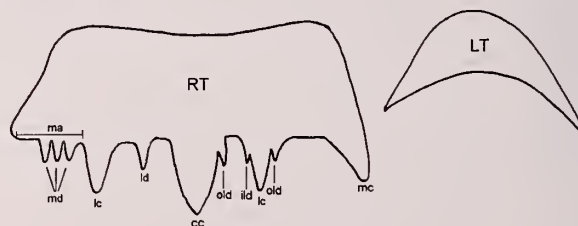


Fig. 1. Schematic drawing of a muricid radula

RT: Rachidian tooth

LT: Lateral tooth

ma: marginal area - md: marginal denticle - lc: lateral cusp - ld: lateral denticle - cc: central cusp - old: outer lateral denticle - ild: inner lateral denticle - mc: marginal cusp.

Operculum

The operculum is ovate-elongate with a lateral nucleus in lower right (Figs 3-4)

Depth and Habitat

The *Morula* species live in the intertidal, eulittoral and sublittoral zones, to approximately 10-15 m depth, among rocks, in crevices, rock pools, on boulders or under dead coral (see also Taylor, 1976). The species of *Habromorula* apparently often live in coral reefs. A few species of *Habromorula* live in deeper water, reaching a depth of 30-80 m.

Distribution

Oppomorus, *Azumamorula*, and *Habromorula* have a planktotrophic larval life with characteristic protoconch morphology (Figs 37-44) (Bouchet, 1987, Kool, 1993, Middelfart, in litt.). All the species occur in the Indo-Pacific, apparently with the exception of the Red Sea and South Africa. However, fossil specimens of *Morula* (*Habromorula*) *bicatenata* (Reeve, 1846) from the Holocene, have been collected at Hurghada, Egypt (B. Landau, in litt.). A few species occur throughout the Indo-Pacific, while some have a narrower geographical range. Others also are known from scattered, widely separated localities, presumably due either to the poor knowledge or scarcity of the species only.

P	Primary cord
s	secondary cord
t	tertiary cord
SP	Subsutural cord (below the suture)
IP	Infrasutural primary cord (primary cord on shoulder)
adis	adapical infrasutural secondary cord (shoulder)
abis :	abapical infrasutural secondary cord (shoulder)
P1	Shoulder cord
P2-P6	Primary cords of the teleoconch whorl
s1-s6	secondary cords of the teleoconch whorl
s1	secondary cord between P1 and P2; s2 : secondary cord between P2 and P3, etc.
ADP	adapertural primary cord on the siphonal canal
MP	median primary cord on the siphonal canal
APERTURE	
ID	Infrasutural denticle
D1 to D5	Abapical denticles
PT	Parietal tooth

Text conventions (after Merle, 1999 and 2001)

Abbreviations

AMS: Australian Museum, Sydney, Australia.
 ANSP: Academy of Natural Sciences of Philadelphia, U.S.A.
 BMNH: The Natural History Museum, London, U.K.
 BPBM: Bishop Museum, Honolulu, Hawaii, U.S.A.
 IRSNB: Institut royal des Sciences naturelles de Belgique.
 MNHN: Muséum national d'Histoire naturelle, Paris, France.
 NM: Natal Museum, Pietermaritzburg, South Africa.
 NMNZ: Museum of New Zealand Te Papa Tongarewa, Wellington, New Zealand.
 RH: Collection of the author.
 RMNH: Nationaal Natuurhistorisch Museum, Leiden, The Netherlands.

lv.: live collected specimen(s).
 dd: empty shell only.

Material examined. For years much material was examined, unfortunately the number of specimens in each lot, or/and the registration number, if any, have not been noted each time. Nevertheless, that material is here also reported because of its usefulness in the geographical distribution.

Following species are reviewed and illustrated:

Morula (*Oppomorus*) *nodulifera* (Menke, 1829)
Morula (*Azumamorula*) *mutica* (Lamarck, 1816)
Morula (*Habromorula*) *aglaos* (Houart, 1995)
Morula (*H.*) *ambrosia* (Houart, 1995)
Morula (*H.*) *andrewsi* (Smith, 1909)
Morula (*H.*) *bicatenata* (Reeve, 1846)
Morula (*H.*) *biconica* (Blainville, 1832)
Morula (*H.*) *coronata* (H. Adams, 1869)
Morula (*H.*) *dichrous* (Tapparone Canefri, 1880)
Morula (*H.*) *euryspira* (Houart, 1995)
Morula (*H.*) *fuscoimbricata* (Sowerby, 1915)
Morula (*H.*) *japonica* (Sowerby, 1903)
Morula (*H.*) *lepida* (Houart, 1995)

Morula (H.) porphyrostoma (Reeve, 1846)
Morula (H.) spinosa (H. & A. Adams, 1853)
Morula (H.) striata (Pease, 1868)
Morula (H.) whiteheadae n.sp.

SYSTEMATICS

Family **MURICIDAE** Rafinesque, 1815
 Subfamily: **ERGalATAXINAE** Kuroda, Habe & Oyama, 1971
 Genus: *Morula* Schumacher, 1817
 Type species by monotypy: *Morula papillosa* Schumacher, 1817 (non Philippi, 1849) = *Morula uva* (Röding, 1798). Indo-West Pacific.
 = *Tenguella* Arakawa, 1965 [type species by original designation: *Morula granulata* (Duclos, 1832)].
 Subgenus: **Oppomorus** Iredale, 1937.
 Type species by original designation: *Morula nodulifera* Menke, 1829.

Remarks: *Oppomorus* differs from *Morula* s.s. in having a more globose, broader shell, a lower spire and a broader aperture. These differences are based on a single species, but are constant, at this time, for all the examined specimens.

Morula (Oppomorus) nodulifera (Menke, 1829)

Figs A, 22, 24, 32, 46-52

Purpura nodulifera Menke, 1829: 33.
Purpura chaidea Duclos, 1832: 106, pl.1, fig.4.
Purpura nassoides Quoy & Gaimard, 1832: 564, pl.38, fig.7-9.
Morula chaidea -Cernohorsky, 1978: 69, pl. 20, fig. 1; Short & Potter, 1987: 60, pl. 29, fig. 7.
Morula nodulifera -Wilson, 1994: 45, pl. 5, fig. 8.

Type material. *Purpura nodulifera*: The whole collection of Menke was sold after his death, in 1861. His collection was acquired by a shell and other natural objects dealer in Frankfurt/Main, and sold as

individual lots. Material from his collection could be in private collections built up after 1862. If one or more of these collections was given or bequeath to a museum, there is a possibility that some lots of Menke's collection could be here and there, somewhere in Europe (possibly in Senckenberg, but also in BMNH, ZMB Berlin, Stuttgart, Stockholm and others) (von Cosel, in litt.). The whereabouts of the type material are unknown.

Purpura chaidea and *P. nassoides*: not located [(not in MNHN, not in BM(NH)].

Other material examined. New Caledonia, 22 lots, 75 lv. & dd, MNHN; 4 lv., RH; Norfolk Id, 3 lv., RH.

Type locality. *Purpura nodulifera* and *P. chaidea*: unknown; *P. nassoides*: Tonga.

Distribution (Fig. A). Australia: Queensland to Central NSW, New Caledonia, Norfolk Id., 0-2 m, on coral flat or sea grass, and Tonga. Wilson (1994: 45) extends its geographical distribution from North West Cape to Central NSW, however, he doubt about the identification of some specimens.

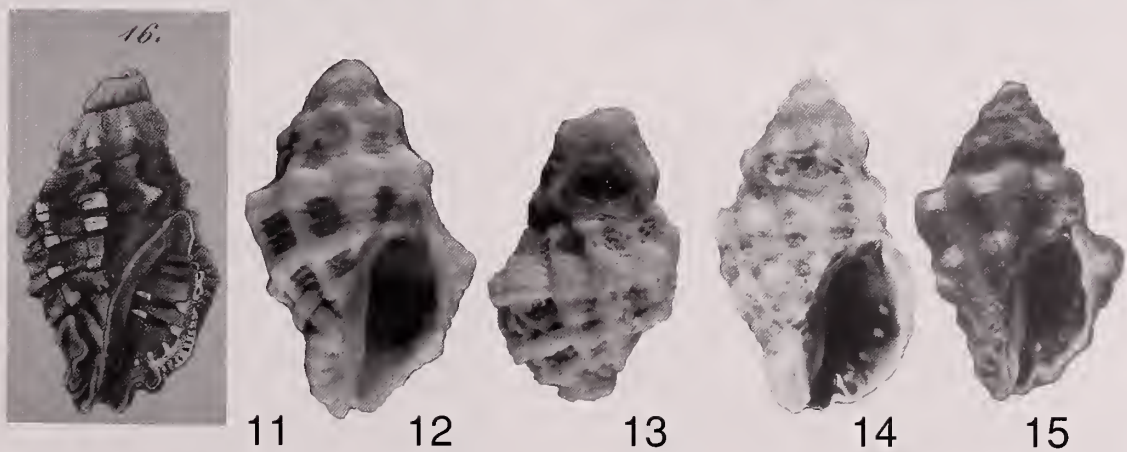
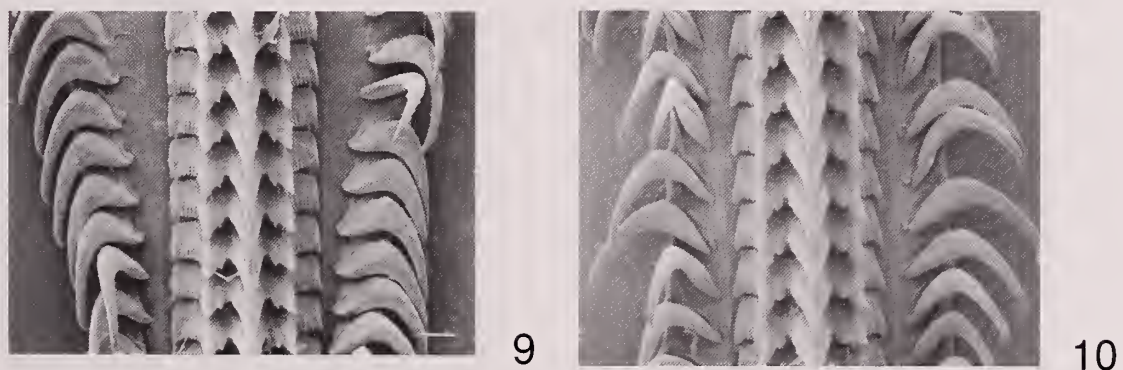
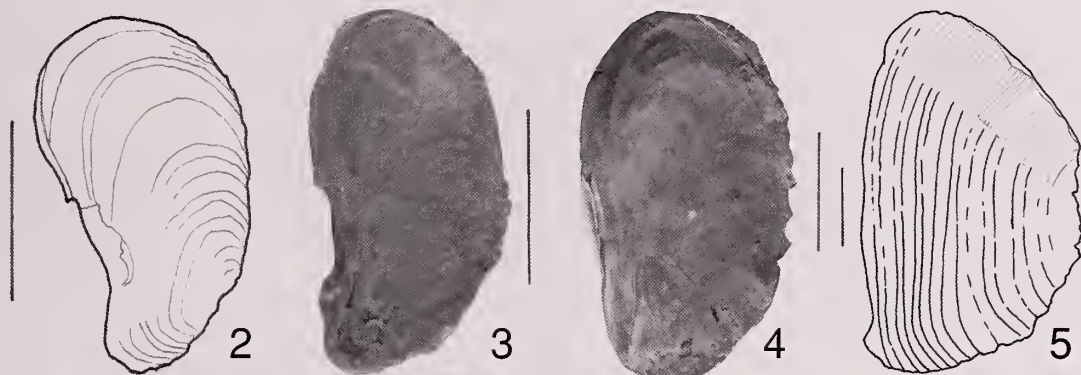
Description. Shell average size of 15-18 mm in length at maturity with 4-4.25 protoconch whorls and 5 or 6 teleoconch whorls. Protoconch conical, smooth, glossy.

Axial sculpture of last teleoconch whorl with 7-9 broad, high, rounded, nodose, strong ribs. Spiral sculpture of low, broad, primary, secondary, and tertiary cords of different strength. Last whorl usually with SP + adis (fused), IP, P1 + P2 (usually fused), s2, t, P3, s3, P4, P5, P6.

Aperture narrow, small. Outer lip weakly erect with 6 weak denticles within [ID, D2, D3 (split), D4, D5]. Columellar lip narrow, smooth or with 2 or 3 weak folds abapically (Fig. 32). Siphonal canal short, abaperturally bent at extremity, open. Shell white.

Figures 2-15

2. Operculum of *Lataxiena desserti* Houart, 1985, New Caledonia. Scale bar 4 mm; 3. Operculum of *Morula (Morula) albanigra* Houart, 2002. Guam. Scale bar 0.5 mm; 4. Operculum of *M. (Habromorula) ambrosia* (Houart, 1995). Guam. Scale bar 1 mm; 5. Operculum of *Stramonita haemastoma* (Linnaeus, 1767).
 6. Operculum of *Thais fusca* (Küster, 1862). Scale bar 2.5 mm; 7. Operculum of *T. nodosa* (Linnaeus, 1758). Scale 2.8 mm; 8. Radula of *Morula (Morula) rumphiusi* Houart, 1996, Ambon. Scale bar 100 µm; 9. Radula of *Thais fusca* (Küster, 1862), Japan. Scale bar 50 µm; 10. Radula of *T. nodosa* (Linnaeus, 1758), Congo, Pointe Noire. Enlargement unknown.
 11-13. *T. fusca* (Küster, 1862)
 11. Original drawing from Küster, 1862; 12. Kusui, Nada-Cho, Wakayama Pref. Low tide, Japan, coll. RH, 23 mm; 13. Kusui, Nada-Cho, Wakayama Pref. Low tide, Japan, coll. RH., 17.1 mm.
 14-15. *Morula (Morula) rumphiusi* Houart, 1996
 14. Ambon, holotype RMNH 9443, 21.4 mm; 15. Mozambique, coll. RH, 18.4 mm.



Remarks. *M. nodulifera* was described as follows: "Purpura nodulifera, Mke. testa ovato-conica, longitudinaler costata, costis nodosis transversim seriatis etc.". There was no illustration but the description is valid.

The description could designate a few other *Morula* species, however, as Iredale (1937: 258) retained *Purpura nodulifera* as the type species of his new genus and listed all other names as synonyms, I will follow him and strongly suggest to designate a neotype if further researches for the type material prove to be unsuccessful.

M. nodulifera is not very variable in size and form, and can hardly be confused with any other species of *Morula*.

Subgenus: *Azumamorula* Emerson, 1968 (new name for *Morulina* Dall, 1923, not Börner, 1906)

Type species by original designation: *Ricinula mutica* Lamarck, 1816.

Remarks. *Azumamorula* differs from *Morula* s.s. in having a broader shell with a lower spire, very low, almost indistinct axial ribs, a thick apertural lip with broad and very strong denticles within.

Morula (Azumamorula) mutica (Lamarck, 1816)

Figs B, 16-21, 23

Ricinula mutica Lamarck, 1816: 1, pl. 395, figs. 2a, b; 1822: 233.

Ricinula pisolina Lamarck, 1822: 233.

Azumamorula mutica -Kaicher, 1980: card 2448; Drivas & Jay, 1988: 74, pl. 22, fig. 16.

NOT *Morula mutica* -Wilson, 1994: 44, pl. 5, figs 4A, 45B [= *Morula granulata* (Duclos, 1831)].

NOT *Morula mutica* -Fujioka, 1985: 248, Pl. 4, fig. 37; pl. 8, fig. 83 (= *Morula* sp.).

Type material. *R. mutica*: holotype MHNG 1101/19; *R. pisolina*: holotype missing (Y. Finet in litt.). The specimen figured by Kiener (1835: fig. 8a) is here designated as the lectotype.

Type locality. *R. mutica*: unknown (locality on the label of the lectotype: Mozambique, here designated as type locality. *R. pisolina*: Ile de France (= Mauritius).

Figures 16-26

16-21. *Morula (Azumamorula) mutica* (Lamarck, 1816)

16-17. Original drawing from Lamarck, 1816; 18-19. Holotype MHNG 1101/19; 20-21. Morphology of the denticles and spiral cords: Reunion Island, Harbor, 2-3 m, coll. RH, 18.3 mm.

22. Original drawing of *Purpura chaidea* Duclos, 1832 [= *Morula (Oppomorus) nodulifera* (Menke, 1829)].

23. Radula of *M. (A.) mutica* (Lamarck, 1816), Reunion. Scale bar 50 µm; 24. Radula of *Morula (Oppomorus) nodulifera* (Menke, 1829), New Caledonia. Scale bar 100 µm; 25. Radula of *Morula (Habromorula) ambrosia*

(Houart, 1995), Guam. Scale bar 20 µm; 26. Radula of *M. (H.) dichrous* (Tapparone Canefri, 1880), Guam. Scale bar 20 µm.

Other material examined. Reunion, 8 lv. RH; The Harbour, 2-3 m, 1 lv., RH; Mauritius, Flic et Flac, 1 lv., RH.

Distribution (Fig. B). Western Indian Ocean, Mozambique, Reunion and Mauritius.

Description. Shell average size of 12-18 mm in length at maturity with 5+ teleoconch whorls (early whorls of all examined specimens eroded). Protoconch whorls unknown.

Axial sculpture of last teleoconch whorl with 9-11 broad, low ribs, indistinguishable in most specimens. Spiral sculpture of broad, low cords. Sculpture of first teleoconch whorls unknown; last whorl with 12 or 13 more or less visible cords, probably (adis), IP, abis, P1, s1, P2, s2, P3, s3, P4, s4, P5, s5, (P6). Presence of additional spiral threads on whole surface of shell.

Aperture large, broadly ovate. Outer lip weakly erect, crenulate, with 5 or 6 strong denticles within: (ID), D1-D5. ID usually low or indistinguishable, D1 and D2 high, thick, broadest, occasionally split. Columellar lip broad, smooth abapically, with parietal tooth at adapical end, adherent, weakly erect abapically. Siphonal canal short, broadly open, abaperturally bent at tip.

Dark brown, inside of aperture bluish-white.

Subgenus: *Habromorula* Houart, 1995

Type species by original designation: *Purpura biconica* Blainville, 1832.

Habromorula was described in order to include several species previously classified in *Morula* Schumacher, 1817 or/and in *Spinidrupa* Habe & Kosuge, 1966. It was then considered at genus level (Houart, 1995) but examination of additional specimens, and comparison of different radulae and shells of *Morula* and *Habromorula* proved their close relationship.

The species of *Habromorula* differ from *Morula* in having a more elongate and usually more spiny, rather than nodulose shell; a narrower and more elongate aperture; narrower, more numerous or split, secondary or tertiary spiral cords; numerous, frequently split, spiral cords on the shoulder (SP, adis, IP, abis, and occasionally tertiary cords).

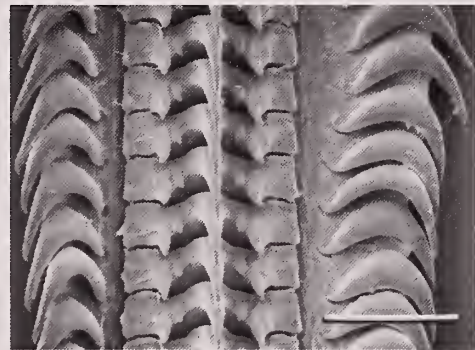
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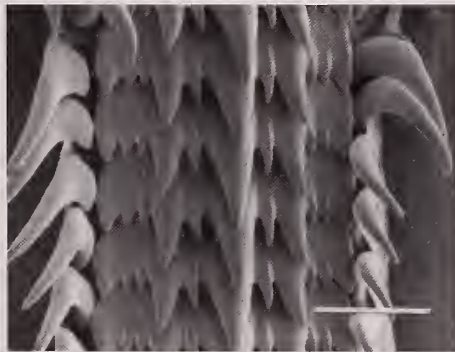
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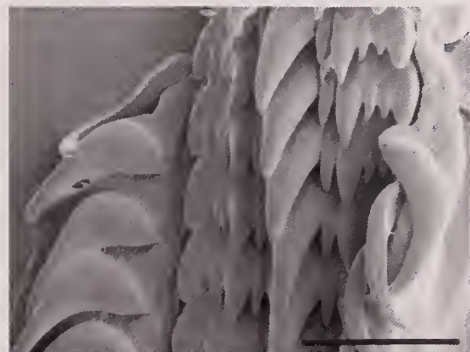
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***Morula (Habromorula) aglaos* (Houart, 1995)**

Figs C, 54-55, 96-100

Habromorula aglaos Houart, 1995: 26, fig. 2, 20, 21; Houart, 1996b: 30, fig. T.50 (holotype).**Type material.** holotype MNHN.**Other material examined.** Marshall Islands, Kwajalein Atoll, 19 m, in coral caves, 3 lv. RH.**Type locality.** Ocean side of west reef, Kwajalein Atoll, Marshall Islands, under dead coral, 15 m.**Distribution** (Fig. C). Kwajalein Atoll, 15-19 m, in coral caves and under coral.**Description.** Shell average size of 23 mm in length with 2.5 - 2.75 protoconch whorls and 6 or 7 teleoconch whorls. Protoconch small, conical. Whorls weakly convex.

Axial sculpture of last teleoconch whorl with 8 broad, low, weakly rounded ribs, each with 6 long, acute, open primary spines. Spiral sculpture of broad primary cords and squamose secondary and tertiary cords. Last whorl with 4 small cords at shoulder, adis, IP, abis, t, followed by P1, t, s1, t, P2, t, s2, t, P3, t, s3, t, P4, t, s4, t, P5, (t), s5, P6. P1-P6 broad, bearing long spines. Spine of P1 longest, P2, P3 and P5 weakly shorter, almost similar in length, P4 and P6 short.

Aperture high, narrow. Outer lip crenulate, with 6 weak denticles within, ID almost obsolete, D1 strongest, D2, D3, D4, D5 decreasing in strength abapically. Columellar lip narrow, smooth, adherent. Siphonal canal short, broadly open.

Ivory-white or creamy-white with darker coloured spines, siphonal canal, and occasionally varices; inside of aperture pink or light mauve.

Remarks. *Morula aglaos* was described from two subadult shells but the discovery of additional specimens from the same area confirms the validity of the species. *M. aglaos* differs from *M. spinosa* in having more obvious P2 and P4, more numerous and longer spines, usually more numerous and crowdedaxial varices, and a pink or light mauve aperture vs dark mauve in *H. spinosa* (see Tables 1 and 2).***Morula (Habromorula) ambrosia* (Houart, 1995)**

Figs D, 4, 25, 56-59, 101-106

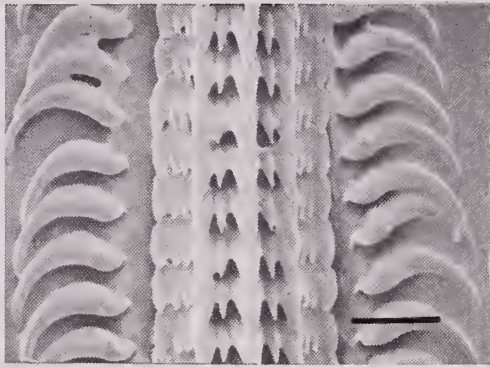
Habromorula ambrosia Houart, 1995: 24, figs 3, 17-19; Houart, 1996b: 30, fig. T.49; Tsuchiya, 2000: 393, pl. 195, fig. 153.**Type material.** Holotype MNHN.**Other material examined.** Philippines, Cebu, Mactan Id, Punta Engano, from Tangle nets, 1 lv., RH; New Caledonia, 13 lots, 18 lv. & dd, MNHN; Marshall Ids, Kwajalein Atoll, oceanside of west reef, 15 m, in cave, 2 lv., RH; Guam, Piti Reef, 8 m, in coral rubble, 1 lv., Schroeder coll.; Off Orote Point, in rock pile, 1 lv., ANSP 399845; Piti Reef, among silty dead coral slabs, 1.5 - 2 m, 1 lv., RH; North of Neve Id, on rock, 19-22 m, 1 lv., RH; Piti Lagoon, on dead coral, 1-1.50 m, 1 lv., RH; S.E. of Orote Point, 22-31 m, 1 lv., RH.**Type locality.** Off Carlson Island, Kwajalein Atoll, Marshall Islands, on coral rock, 9 m.**Distribution** (Fig. D). Central and South Pacific Ocean, Okinawa, the Philippines, Guam, New Caledonia, Marshall Islands, and Rapa (Lozouet et al, 2004) living at 1.5 - 31 m, in coral rubble, in dead coral or rocks.**Description.** Shell average size of 18-21 mm in length, with 3.5 - 3.75 protoconch whorls, and 6 or 7 teleoconch whorls. Protoconch small, conical, glossy. Axial sculpture of last teleoconch whorl with 7 or 8 broad, low, weak ribs, each with long or short, acute, open spines, corresponding to the primary, secondary and tertiary spiral cords. Largest spine corresponding to a secondary cord on shoulder (abis). Other axial sculpture of numerous growth lamellae.

Spiral sculpture of high, narrow, primary, secondary and tertiary cords: last whorl with SP, adis, IP, abis, P1, (s1), P2, (t), s2, (t), P3, (t), s3, t, P4, s4, P5, s5, P6. P2, P4, P5 weakly broader, bearing long, open spines; P1 small, abis broadest, bearing longest spine.

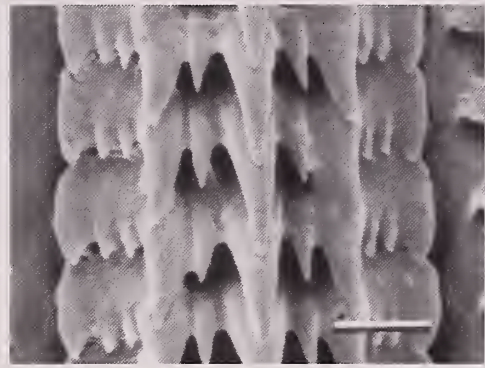
Figures 27-36**27-28.** Radula of *Morula (Habromorula) bicatenata* (Reeve, 1846), Tahiti.

Scale bars: 27: 20 µm; 28: 10 µm.

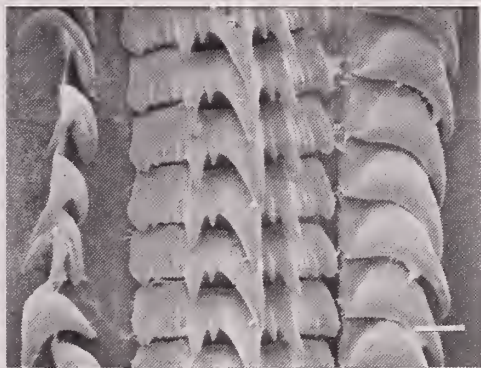
29. Radula of *M. (H.) lepida* Houart, 1995, New Caledonia. Scale bar 20 µm; **30-31.** Radula of *M. (H.) spinosa* (H. & A. Adams, 1853)30. New Caledonia. Scale bar 50 µm; 31. Japan. Scale bar 20 µm [illustrated as *Habromorula andrewsi* (Smith, 1909) by Houart (1995)].**32.** Denticles morphology of *Morula (Oppomorus) nodulifera* (Menke, 1829). Scale bar 5 mm; **33.** Original drawing of *Engina striata* (Pease, 1868); **34.** Original drawing of *Sistrum striatum* (Pease, 1868); **35.** *Morula (Morula) zebrina* nom. nov. Lectotype of *Sistrum striatum* (Pease, 1868) designated by Johnson (1894), ANSP 36735, 16.5 mm; **36.** *M. (M.) zebrina* nom. nov. Tahiti, coll. RH, 14.7 mm.



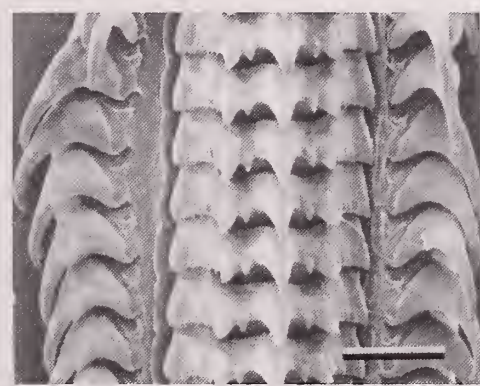
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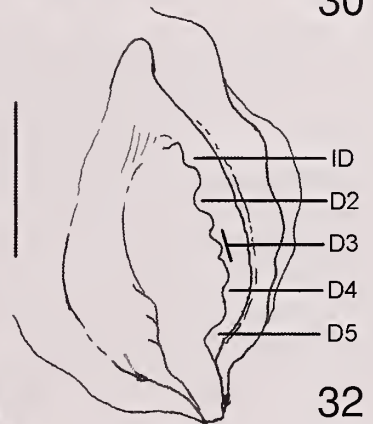
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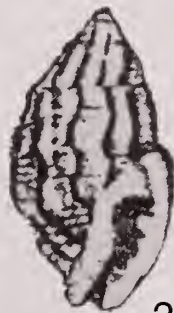


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35



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Aperture narrow, high. Outer lip crenulate, with weak denticles within: ID, D1-D5, usually very low or indistinguishable, occasionally split. Columellar lip narrow, smooth, weakly erect, adherent abapically. Siphonal canal short, broadly open, abaperturally recurved at tip. Creamy-white or pinkish-white with darker coloured protoconch whorls.

Remarks. *Morula ambrosia* was originally compared with *M. andrewsi* (Smith, 1909), a larger shell with different spiral sculpture (see further). *M. ambrosia* resembles *M. coronata* (H. Adams, 1869) which also has the particularity to have a broad "abis" with longest spine on the last teleoconch whorl, and an unusual narrow P1. However, *H. coronata* has a much smoother shell with more numerous and lower, secondary spiral cords, a comparatively broader and longer spine in the continuation of abis, a narrower P2 with almost obsolete spine, and broader P3 and P4. *H. coronata* also has a comparatively higher spire.

It is obvious that the three species have similar abis, and P1. P1 being strong on first teleoconch whorls, becoming weaker, to almost totally disappear on the last whorl, while "abis" is weak on first whorls, but becomes broad and strong on last whorls, to finally bear the longest spine of the shell. It is also obvious that "abis" becomes the most prominent cord and spine from penultimate or even antepenultimate teleoconch whorl in *M. ambrosia*, and only on the last whorl in *M. coronata*.

These differences are stable in all examined specimens of *M. ambrosia* and *M. coronata* (see Table 1).

***Morula (Habromorula) andrewsi* (Smith, 1909)**

Figs E, 60-61, 129-130

Sistrum andrewsi Smith, 1909: 369.

Morula andrewsi -Kaicher, 1980: card 2417 (holotype).

Morula coronata -Wells et al, 1990: 42, pl. 20, fig. 137 [not *M. coronata* (H. Adams, 1869)].

NOT *Habromorula andrewsi* -Houart, 1996: 30, figs T.38-39 [= *Morula spinosa* (H. & A. Adams, 1853)].

Type material. 3 syntypes BM(NH) 1909.5.8.62-4.

Figures 37-44

Protoconchs (scale bars: 37 & 40: 200 µm; 38 & 41: 100 µm; 39: 20 µm; 42: 50 µm)

37-39. *Morula (Habromorula) lepida* (Houart, 1995); **40-42.** *M. (H.) striata* (Pease, 1868); **43.** *M. (H.) biconica* (Blainville, 1832); **44.** *M. (H.) spinosa* (H. & A. Adams, 1853).

Other material examined. Christmas Island, 10°30' S, 105°40' E, 1 lv., AMS C.152414 (figured in Wells et al, 1994 as *Morula coronata*).

Type locality. Christmas Id (Indian Ocean).

Distribution (Fig. E). Only known from Christmas Island, Indian Ocean, depth and habitat unknown.

Description. Shell up to 25 mm in length (syntype), with 6 or 7 teleoconch whorls. Protoconch unknown. Axial sculpture of last whorl with 7-9 broad, high, rounded, spinose ribs, each with short or long, blunt, narrowly open primary spines. Spiral sculpture of high, rounded, broad and narrow primary cords. Last whorl with SP, adis, IP, abis, P1-P6, and additional low, narrow, secondary and tertiary cords. IP medium sized or broad, abis broad, giving rise to longest spine, P1 very small, spine short, narrow, P2 short or medium sized, P3 and P5 long spines of approximately same strength and length, P4 narrow, spine very short, P6 medium sized, spine short.

Aperture narrowly ovate, high. Outer lip crenulate with high or low denticles within, decreasing in strength abapically, probably ID, D1, D2 split, D3, D4 and D5. D4 very low, D5 indistinguishable. Columellar lip narrow, smooth or with small denticles abapically. Siphonal canal short, narrowly open.

Creamy-white with pink aperture.

Remarks. *Morula (Habromorula) andrewsi* is close to *M. coronata* (H. Adams, 1869), but the shell is obviously broader, more spiny, and has a different spiral sculpture morphology (see Table 1). As an answer to a few questions about the muricids to figure in Wells et al (1990), I answered to F. Wells (1987, in litt.) that the shell illustrated in fig. 137 (here figured in Figs 129-130) was close to *H. coronata* although being obviously more spiny. At that time however, very few was known about the spiral sculpture morphology. Moreover, both species are rare in collections, thus not easy to compare with each other.

M. andrewsi differs from *M. ambrosia* in having a broader, lower aperture, more numerous secondary and tertiary cords on a broader shoulder, broader and less split apertural denticles, and different size of spiral cords and spines (see also Table 1).



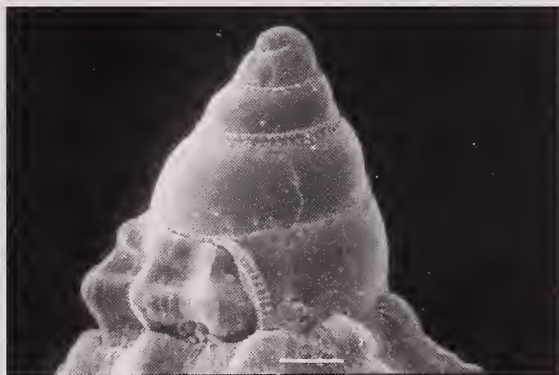
37



38



39



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42



43



44

***Morula (Habromorula) bicatenata* (Reeve, 1846)**

Figs F, 27-28, 62-63, 108-109

Ricinula bicatenata Reeve, 1846: pl. 6, sp. 48.*Morula rosea* (Reeve, 1846) -Drivas & Jay, 1988: 72, pl. 21, fig. 13.*Morula (Spinidrupa) bicatenata* -Tröndle & Houart, 1992: 105, fig. 87 (only).*Habromorula bicatenata* -Houart, 1996: 31, fig. T.51.NOT *Morula (Spinidrupa) bicatenata* -Tröndle & Houart, 1992: 105 (in part), fig. 88 (only) [= *M. dichrous* (Tapparone Canefri, 1880)].**Type material.** Not located [not BM(NH)].**Other material examined.** **Mozambique**, Ferão Veloso Bay, 1-2 m, dead coral; **Madagascar**, Tulear, MNHN; **Japan**, Okinawa, Ishigaki Ids, Kabira Bay, under dead coral, 1 m, 5 lv., RH; **Papua New Guinea**, Manokwari, 1 dd, RH; **Guam**, Piti Lagoon, among dead coral, 4-8 m, 1 lv., RH; **New Caledonia**, 8 lv. & dd, MNHN; **Society Archipelago**, Moorea, EPHE; Tahiti, Huanine, under coral blocks, 3 lv., RH; Tahiti, Moorea, 1 lv., RH; Tahiti, Afaahiti, under coral blocks, 0.50 m, 3 lv., RH; Tahiti, Toahotu, 1 lv., RH.**Type locality.** Unknown.**Distribution** (Fig. F). Western Indian Ocean, Okinawa, Papua New Guinea, Guam, New Caledonia, and the Society Archipelago, living at the shore to 8 m depth, on and under coral blocks.**Description.** Shell average size of 9-10 mm in length with 3.25 - 3.75 protoconch whorls and 5 teleoconch whorls. Protoconch small, conical, acute, glossy. Axial sculpture of last whorl with 6 or 7 broad, high, strong ribs, each with numerous short, open spinelets. Other axial sculpture of numerous, squamose growth lamellae. Spiral sculpture of high, narrow, squamose primary and secondary cords: adis, IP, abis, P1 split in three, s1, P2, s2, P3 split, s3, P4, P5, P6. Aperture narrow, small. Outer lip weakly crenulate, with 6 or 7 small, heavy denticles within: ID, D1 split, D2, D3, D4, (D5). Columellar lip narrow, smooth abapically or with 2-4 small nodes, with parietal tooth at adapical end, weakly erect**Figures 46-55****46-52.** *Morula (Oppomorus) nodulifera* (Menke, 1829)

46. New Caledonia, coll. RH, 19.4 mm; 47-48. Norfolk Id, coll. RH, 17.5 mm; 49. Spiral cords morphology 50-51. New Caledonia, coll. RH, 8.1 mm; 52. Protoconch.

53. Type figure of *Purpura dumosa* Pease, 1837 (from Cernohorsky, 1982); **54-55.** Spiral cords morphology of *Morula (Habromorula) aglaos* (Houart, 1995).

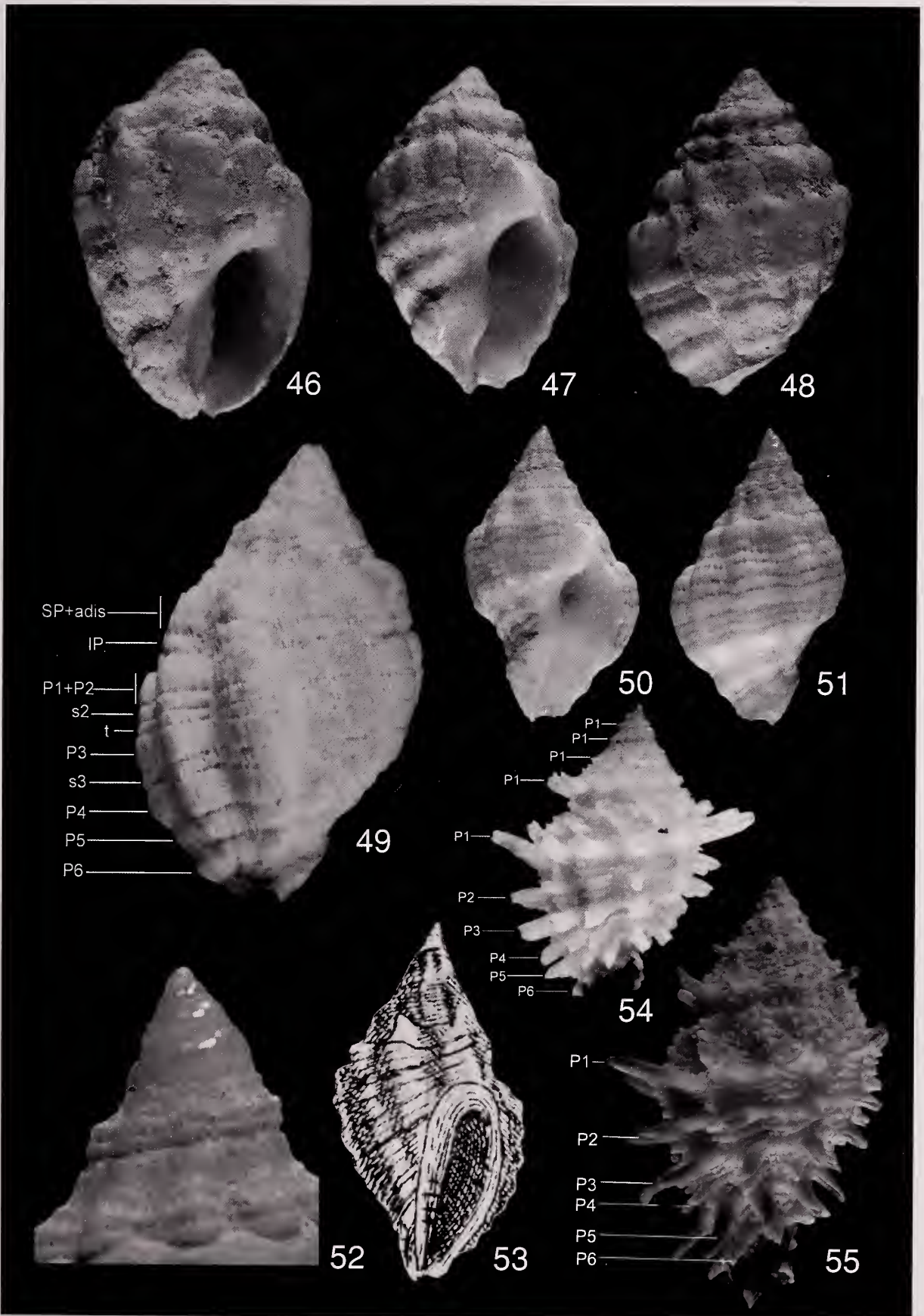
abapically, adherent adapically. Siphonal canal moderately short, broadly open, weakly recurved at tip.

Blackish brown shell with P1 and P3 and spines of P4-P6 white, erratically white on the other spiral cords; aperture white with brown spiral bands; columellar lip grey or light brown.

Remarks. *Morula bicatenata* and *M. dichrous* (Tapparone Canefri, 1880) have the particularity to have P1 split in three and P3 split. Otherwise both species have a different shell morphology (see under *M. dichrous* for further comparison) (see Tables 1 and 2).***Morula (Habromorula) biconica* (Blainville, 1832)**

Figs G, 43, 45, 64, 110-111

Purpura biconica Blainville, 1832: 203, pl.9, fig.1*Engina slootsi* De Jong & Coomans, 1988: 83, pl.4, fig.450a**Fig. 45.** *Morula (Habromorula) biconica* (Blainville, 1832). Holotype MNHN, 18.9 mm.*Morula* sp. -Hinton, 1978: 38, fig. 220.*Morula (Spinidrupa) biconica* -Fujioka, 1985: 249, pl. 5, figs 51, 52, pl. 8, fig. 88.*Morula biconica* -Subba Rao & Surya Rao, 1993: 95, pl. 11, fig. 5; Subba Rao, 2003: 239, pl. 57, fig. 6.*Morula dumosa* -Wilson, 1994 [not *Purpura dumosa* Conrad, 1837 (*nomen dubium*)].*Habromorula biconica* -Houart, 1994: 23, fig. 1 (holotype); 1996: 31, fig. T.40; Tsuchiya, 2000: 393, pl. 195, fig. 149.



NOT *Morula biconica* -Cernohorsky, 1969: 308, pl. 48, fig. 13 (only) [= *Morula lepida* (Houart, 1995)].
 NOT *Morula biconica* -Cernohorsky, 1969: 308, pl. 48, fig. 18 (only); 1972: 127, pl. 35, fig. 11; Matsumoto, 1979: 42, pl. 9, fig. 1; Wells & Bryce, 1985: 92, pl. 28, fig. 319; Short & Potter, 1987: 60, pl. 29, fig. 12; Wilson, 1994: 45, pl. 6, fig. 26; Jarrett, 2000: 60, fig. 246 [= *Morula striata* (Pease, 1868)].
 NOT *Cronia biconica* -Abbott & Dance, 1982: 145 [= *Morula spinosa* (H. & A. Adams, 1853)].

Type material. *P. biconica*: holotype MNHN; *E. slootsi*: holotype ZMA 3.87.083.

Other material examined. Madagascar, Tulear, MNHN; Seychelles (no other data), 1 dd, RH; Reunion, 20-40 m, coll. J.C. Martin; Maldives, Ari Atoll, 96 km S from Male, 2 lv., RH; Vietnam, Ninh Thuan, 1-15 m, 1 dd, RH; Java, Sundak, beach, 1 dd, RH; Papua New Guinea, 19 lots, 45 lv. & dd, IRSNB; Hansa Bay, Madang, Laing Id, 10 lv. & dd, RH; Guam, Piti, West of Camel Rock, among dead coral, 14-17 m, 2 lv., RH; Australia, North Queensland, Blue Low Isles, 2 lv., RH; Queensland, Fitzroy Id, off Cairns, AMS & RH; Queensland, Reef, 12°20' S, 143°51' E, 10-12 m, AMS; Coral Sea, Osprey Reef, 13°59' S, 146°40' E, 8-15 m, AMS; Coral Sea, Rapid Horn, Osprey Reef, 14°0' S, 146°38' E, 6 m, AMS; Queensland, Tryon Id, Capricorn Group, low tide, on coral slabs, AMS; Queensland, Hook Reef, SE of Bowen, GBR, 19°52' S, 149°10' E, AMS; New Caledonia, 14 lots, 39 lv. & dd, MNHN;

Type locality. *P. biconica*: unknown; *E. slootsi*: Aruba, north coast (erroneous).

Distribution (Fig. G). From Madagascar to the Maldives, Java, Vietnam, south of Japan, Guam, Papua New Guinea, Queensland (Australia), and New Caledonia, living at 1-7 m, among dead coral. Surprisingly there is no mention of *M. biconica* in the Philippine Islands, or if so it was misidentified (see under *M. striata*).

Description. Shell average size of 18-21 mm in length with 3.5 protoconch whorls and 6 teleoconch whorls. Protoconch small, conical, acute, glossy.

Figures 56-67

56-59. *Morula (Habromorula) ambrosia* (Houart, 1995)

56. Spiral cords morphology; 57-58. Marshall Ids. Kwajalein Atoll, holotype MNHN, 16.6 mm; 59. N Cook Ids, SW Aitutaki, NW of Maina Id, ANSP 278326, 23.7 mm.

60-61. *M. (H.) andrewsi* (Smith, 1909), Christmas Id, syntype BM(NH) 1909.8.62.64, 25 mm.

62-63. *M. (H.) bicatenata* (Reeve, 1846)

62. Spiral cords morphology; 63. Denticles morphology.

64. Spiral cords morphology of *M. (H.) biconica* (Blainville, 1832); **65-67.** *M. (H.) coronata* (H. Adams, 1869)

65. Spiral cords morphology; 66. Denticles morphology; 67. Mauritius, holotype BM(NH) 1902.11.26.73, 19.2 mm.

Axial sculpture of last teleoconch whorl with 7 broad, low ribs, each with 2 short, open primary spines (P1 and P3). Other axial sculpture of numerous, low, serrate growth lamellae. Spiral sculpture of high, flattened, weakly squamose primary, secondary and tertiary cords, probably in following order: SP, adis, IP, abis, t, P1, t, s1, P2, s2, t, P3 split, s3, P4, s4, P5, P6. P1 and P3 ending as broad, short, open spines on varices.

Aperture narrow, high. Outer lip weakly crenulate with 6 denticles within: ID weak or obsolete, D1 and D2 fused, D3, D4 split, D5. Columellar lip narrow, with 1 or 2 weak nodes abapically; adapically with small, shallow, parietal tooth. Siphonal canal short, broad, broadly open.

Dark brown or blackish-brown with white blotches on P1 and tertiary cords, P3, P5 and P6.

Remarks. *Morula biconica* has been often confused with *M. striata* (Pease, 1868). Both species are compared under *M. striata*. The spiral cord morphology of *M. biconica* is particularly intricate, but young, subadult and adult specimens have been examined. The presented combination is the most probable one (see Tables 1 and 2).

Morula (Habromorula) coronata (H. Adams, 1869)

Figs H, 65-67, 89, 114-116

Coralliophila coronata H. Adams, 1869: 272, pl. 19, fig. 4.

"*Coralliophila*" *coronata* -Kaicher, 1985: card 4032.

Habromorula coronata -Houart, 1996b: 31, fig. T.41.

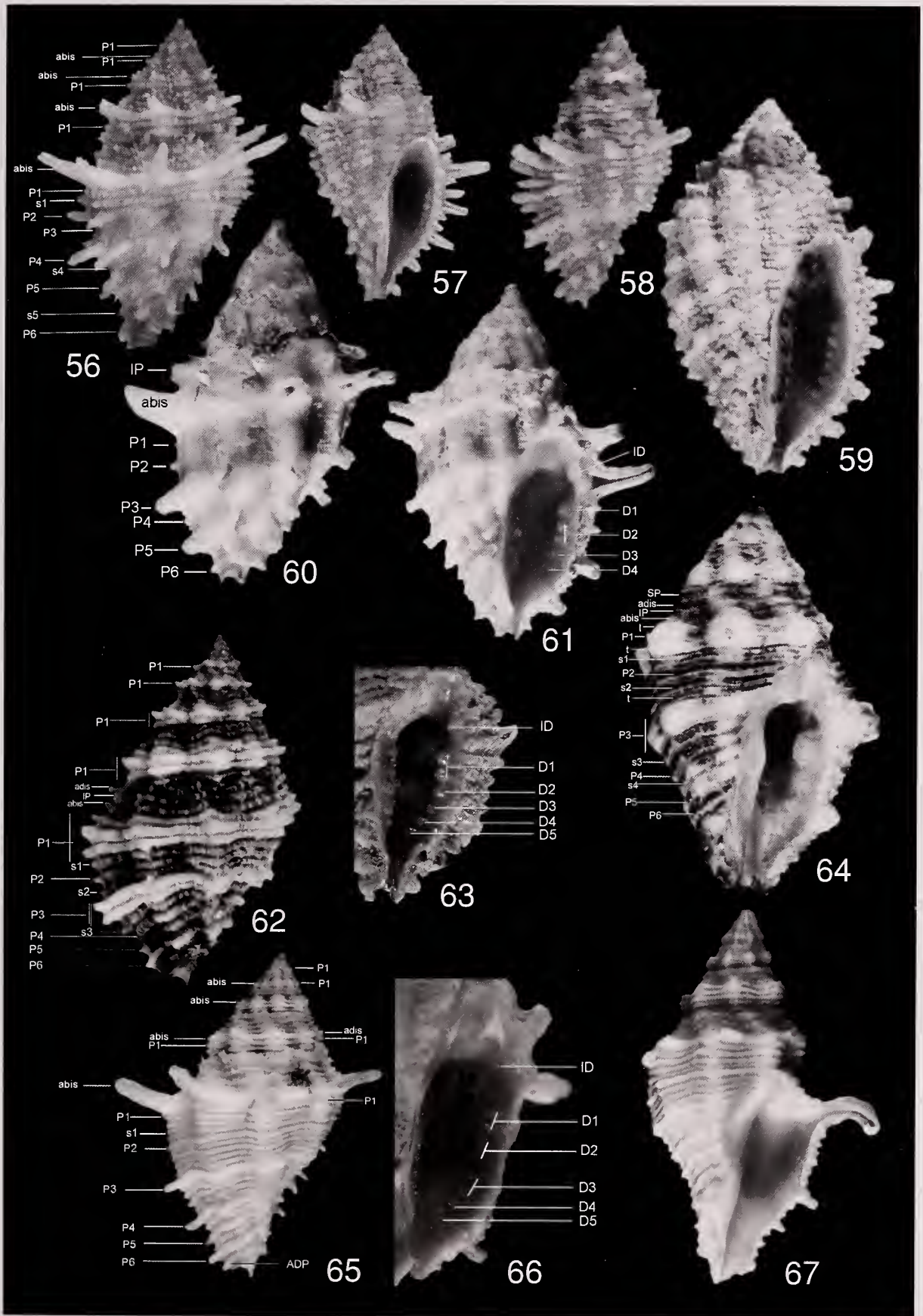
Morula spinosa Jarrett, 2000: 59, fig. 243 [not *Morula spinosa* (H. & A. Adams, 1853)].

NOT *Morula coronata* -Wells et al, 1990: 42, pl. 20, fig. 137. [= *M. andrewsi* (Smith, 1909)].

NOT *Cronia coronata* -Drivas & Jay, 1988: 76, fig. 8 [(= *M. lepida* (Houart, 1995)].

Type material. Holotype BM(NH) 1902.11.26.73.

Other material examined. Seychelles (no other data), 3 lv., RH; Reunion, 1 dd, RH; under basalt blocks, 2 dd, RH.



Type locality. Barclay Id, Mauritius.

Distribution (Fig. H). Reunion, Mauritius and Seychelles, under rocks, depth unknown.

Description. Shell of an average size of 19-21 mm in length with 2+ protoconch whorls (partially broken) and 6 teleoconch whorls. Protoconch small, conical.

Axial sculpture of last teleoconch whorl with 7 or 8 broad, low varices with 2 long, open spines (adis and P3) and additional spinelets abapically. Spiral sculpture of high, rounded, narrow primary, secondary and tertiary cords: abis and P3 strongest on last teleoconch whorl. Nomenclatur of secondary and tertiary cords unknown, but probably as follows: SP split, t, adis, IP, t, abis, P1, t, s1, t, P2, t, s2, t, t, P3, t, s3, t, P4, s4, P5, s5, P6, ADP; abis, P3 and P4 ending as long, blunt open spines at varices, abis longest.

Aperture narrow, high. Outer lip weakly crenulate with 6-8 weak denticles within: ID small, D1 (or D1 split), D2 (or D2 split), D3 (or D3 split), D4, D5. Columellar lip narrow, smooth, weakly erect

abapically, adherent adapically. Siphonal canal moderately short, straight, broadly open. Light pink with darker pink coloured aperture.

Remarks. *Morula coronata* resembles *M. ambrosia* Houart, 1995 but differs in spiral structure morphology (see under *M. ambrosia*) (see Tables 1 and 2).

Morula (Habromorula) dichrous
(Tapparone Canefri, 1880)
Figs I, 26, 68-70, 71-72, 107

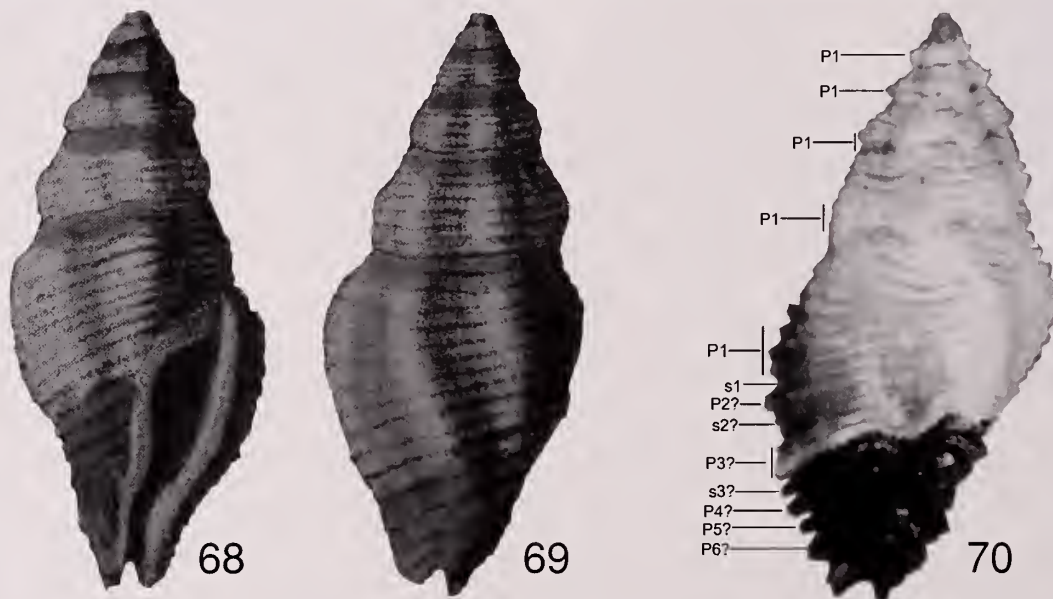
Murex dichrous Tapparone-Canefri, 1880: 21, pl.2, fig. 5, 6.

Engina xantholeuca Sowerby, 1882: 119, pl.5, fig.9.

Morula (Spinidrupa) bicatenata -Tröndle & Houart, 1992: 105 (in part), fig. 88 (only).

Habromorula dichrous -Houart, 1996b: 31, fig. T.42.

Type material. *M. dichrous*: Not located; *E. xantholeuca*: holotype BM(NH) 1982130.



68-69. Original drawing of *Morula (Habromorula) dichrous* (Tapparone Canefri, 1880); 70. Spiral cords morphology of *M. (H.) dichrous* (Tapparone Canefri, 1880)

Other material examined. Philippines, Cebu, 1 lv., RH; Coral Sea, Osprey Reef, 13°59' QS, 146°40' E, 8-15 m, 1 dd, AMS C.170061; New Caledonia, 3 lv. & dd, MNHN; Guam, Piti Reef, in rubble, 1 lv., coll. Schroeder; Society Archipelago, Tahiti, Toahotu, 1 lv; RH; Tahiti, Tautira, in coral's holes, 1 dd, RH.

Type locality. *M. dichrous*: Mauritius; *E. xantholeuca*: Mauritius.

Distribution (Fig. I). Mauritius, Philippine Islands, Guam, North Queensland (Australia), New

Caledonia, and Society Archipelago, living at 8-15 m, in rubble, or in coral's holes.

Description. Shell of an average size of 10-12 mm in length, with 3.5 protoconch whorls and 5 or 6 teleoconch whorls. Protoconch small, conical, glossy. Axial sculpture of last teleoconch whorl with 6-8 broad, low, nodose varices. Other axial sculpture of numerous growth lamellae. Spiral sculpture of low, weakly flattened, nodose primary, secondary, and tertiary cords, probably as follows (young specimens

not observed): adis, IP, abis, P1 split in three, s1, P2, s2, P3 split, P4, P5, P6.

Aperture narrow, high. Outer lip crenulate, with 7 weak denticles within: ID, D1 split, D2, D3, D4, D5. Columellar lip narrow, with 2 weak knobs abapically and a shallow parietal tooth at adapical end. rim weakly erect abapically, adherent adapically. Siphonal canal short, straight, broadly open.

Light yellow adapically, brown or blackish-brown abapical of P3; occasionally brown tinged spinelets of apertural varix.

Remarks. *Morula dichrous* resembles *M. bicatenata* which has an identical spiral sculpture morphology. However, I maintain it separate because of the broader, weakly flattened, more serrate spiral cords, the broader siphonal canal, the more elongate, convex shell outline, and the broader axial ribs (see Tables 1 and 2).

***Morula (Habromorula) euryspira* (Houart, 1995)**

Figs J, 73-74, 123-124

Habromorula euryspira Houart, 1995: 26, fig. 22; Houart, 1996b: 32, fig. T.48 (holotype).

Type material. Holotype MNHN.

Other material examined. Only known from the holotype.

Type locality. Off New Caledonia, north lagoon, 19°05' S, 163°38' E, 39 m.

Distribution (Fig. J). New Caledonia, north lagoon, living at 39 m.

Description. Shell 15.5 mm in length (holotype), with 5 teleoconch whorls. Protoconch unknown.

Axial sculpture of last teleoconch whorl with 8 broad, high, nodose, strong ribs, weakly higher at intersection of ribs and spiral cords. Spiral sculpture of high, strong, nodose, primary, secondary and tertiary cords. Last teleoconch whorl with adis, IP, abis, P1 split, P2, s2, P3, s3, t, P4, s4, t, P5, s5, t, P6, s6.

Aperture narrow, high. Outer lip weakly crenulate, with 9 weak denticles within: ID small, D1 small, D2 split, D3 split, D4 split, D5. D2-D5 decreasing in strength abapically. Columellar lip narrow, with 3 weak knobs abapically, partially erect abapically, adherent adapically. Siphonal canal short, weakly abaperturally bent, open.

Creamy-white, aperture light pink.

Remarks. *Habromorula euryspira* most closely resembles *H. porphyrostoma* and *H. lepida*, but differs from both in having a quite different aperture and spiral cords morphology (see Tables 1 and 2).

***Morula (Habromorula) fuscoimbricata*
(Sowerby, 1915)**

Figs K, 75-79, 131-136

Pentadactylus (Sistrum) fuscoimbricata Sowerby, 1915: 166, pl.10.

Drupa walkerae Pilsbry & Bryan, 1918: 99, pl.9, fig.4.

Morula fuscoimbricata -Cernohorsky, 1978: 69, pl. 20, fig. 3 (holotype); Kaicher, 1980: card 2418.

Habromorula fuscoimbricata -Houart, 1996b: 32, text fig.

Type material. *P. fuscoimbricata*: holotype BM(NH) 1919.12.31.32; *D. walkerae*: holotype ANSP 9382.

Other material examined. Hawaii: Oahu, Honolulu Harbor, 1 dd, BPBM 198166; Edge of Pearl Harbor Channel, 9 m, 1 lv., coll. B. Cook; Sand Island, South Oahu, 3 dd, coll. B. Cook; South Oahu, 13 m, 3 dd, coll. B. Cook; South Oahu, 22 m, 1 dd, coll. B. Cook; South Oahu, edge of Pearl Harbor Channel, 3 dd, coll. B. Cook; Fort Kamehameha Reef, South Oahu, low tide, 2 dd, coll. B. Cook; Kahe South Oahu, 15 m, 1 lv., 1 dd, coll. B. Cook; Kauai Id, reef, low tide, tide pool, 1 lv., coll. B. Cook;

Type locality. *P. fuscoimbricata*: Hawaii; *D. walkerae*: Honolulu Harbor, Hawaii.

Distribution (Fig. K). Hawaii, living at reef to 15 m depth.

Description. Shell of an average size of 22-24 mm in length with 2+ protoconch whorls (partially eroded) and 6 teleoconch whorls. Protoconch small, conical.

Axial sculpture of 8 or 9 broad, low, nodose varices, each with 5 short, open primary spines and several spinelets corresponding to primary and secondary spiral cords. Spiral sculpture of low, strong, squamose, primary, secondary and tertiary cords: SP, IP, abis, P1, s1 (t), P2, s2, P3, s3, (t), P4, s4, (t), P5, s5.

Aperture large, narrow. Outer lip crenulate, with 7 or 8 strong denticles within: ID, D1 (or D1 split), D2 split, D3 split, D4. Columellar lip narrow, smooth or with 2 or 3 weak knobs abapically, and a shallow parietal tooth at adapical extremity. Siphonal canal short, straight, broadly open.

Usually creamy-white or tan with brown spinelets, occasionally entirely brown.

Remarks. Kay (1979: 248) considered *M. fuscoimbricata* to be a synonym of *M. spinosa* (H. & A. Adams, 1853), however, *M. spinosa* differs in many ways, especially in the spiral cords morphology. *M. spinosa* has small, narrow P2 and P4 on the last teleoconch whorl, and brown P1, P3 and P5, ending as long open spines on the varices. *M.*

spinosa also has a purple aperture with fewer (not split) denticles (see Tables 1 and 2).

***Morula (Habromorula) japonica* (Sowerby, 1903)**

Figs L, 80-81, 125

Pentadactylus japonica Sowerby, 1903: 496.

Sistrum (Ricinula) morus var. *borealis* Pilsbry, 1904: 18, pl.3, fig.31.

Drupa (Morula) borealis -Matsumoto, 1979: 42, pl. 9, fig. 2.

Morula borealis -Higo et al, 1999: 211; 2001: fig. 2331 (syntype).

Habromorula borealis -Tsuchiya, 2000: 393, pl. 195, fig. 152.

Morula (Spinidrupa) borealis -Fujioka, 1985: 249, pl. 6, fig. 53; pl. 8, fig. 89.

Morula japonica -Cernohorsky, 1983: 189, figs 10 (holotype), 11-12 (syntype of *Sistrum morus borealis* Pilsbry, 1904).

Habromorula japonica -Houart, 1996b: 32, fig. T.43; Tsuchiya, 2000: 393, pl. 195, fig. 151.

NOT *Morula (Spinidrupa) japonica* -Fujioka, 1985: 249, pl. 6, fig. 55, pl. 8, fig. 85 [= *Morula striata* (Pease, 1868)?].

Type material. *P. japonica*: holotype BM(NH) 1903.12.7.12; *S. borealis*: syntypes ANSP 85982.

Other material examined. Minabe, Wakayama Prefecture, 1 lv., RH.

Type locality. *P. japonica*: Tanabe, Kii, Japan; *S. borealis*: Hachijojima, Izu, Japan.

Distribution (Fig. L). Central Japan to Okinawa. It lives on dead coral rocks or rubble, on reef moat and reef pass, in littoral and sublittoral zone, to 10 m depth in Okinawa (H. Kubo, in litt).

Description. Shell of an average size of 20-25 mm in length, with 6 broad teleoconch whorls. Protoconch unknown.

Axial sculpture of last teleoconch whorl with 7 broad, low, nodose varices, each with 4 long, open, primary spines and numerous spinelets corresponding to the primary, and secondary spiral cords. Spiral sculpture of high, nodose, smooth primary and secondary cords: SP, IP, abis, P1 broad, s1, P2

narrow, s2, P3 broad, s3, P4 narrow, s4, P5 broad, s5, P6 narrow, giving rise to long and short spines on the varices.

Aperture large, high. Outer lip crenulate, with 6 denticles within: ID, D1-D5, decreasing in strength abapically. Columellar lip narrow, with 2 or 3 weak knobs abapically and a small parietal tooth at adapical extremity. Siphonal canal short, broadly open.

Creamy-white with light mauve aperture.

Remarks. *Morula japonica* is a large species, probably the largest and most robust of all known *Habromorula* species. It is easily distinguishable from the other species thanks to its relatively basic spiral sculpture. Cernohorsky (1983: 189) illustrated the holotype of *M. japonica* and of *M. borealis*, a synonym (see Tables 1 and 2).

***Morula (Habromorula) lepida* (Houart, 1995)**

Figs M, 29, 37-39, 82-83, 120-122

Habromorula lepida Houart, 1995: 29, fig. 3.

Morula biconica -Cernohorsky, 1969: 308, pl. 48, fig. 13 (only), not *M. biconica* (Blainville, 1832).

Morula (Spinidrupa) dumosa -Fujioka, 1985: 249, pl. 6, fig. 54; pl. 8, fig. 90 [not *Purpura dumosa* Conrad, 1837 (*nomen dubium*)].

Cronia coronata -Drivas & Jay, 1988: 76, fig. 8 [not *Morula coronata* (H. Adams, 1869)].

Habromorula lepida -Houart, 1996b: 32, fig. T.47; Tsuchiya, 2000: 393, pl. 195, fig. 148.

Type material. Holotype MNHN.

Other material examined. **Australia**, West Australia, Bernier Id, Shark Bay, AMS; west Australia, Turtle Beach, W side of Northwest Cape, 21°48' S, 114°10' E, AMS; West Australia, Gun Id, Houtman Abrolhos, 28°53' S, 113°52' E, AMS; Queensland, Tryon Id, Capricorn group, low tide, on coral slabs, AMS; Queensland, Broadhurts Reef, E of Townsville, GBR, AMS; Coral Sea, Osprey Reef, 13°53' S, 146°31' E, 13-17 m, AMS; Queensland, No Name Reef, GBR, 14°40' S, 145°39' E, 15-19 m, AMS; **Papua New Guinea**, Hansa Bay, Madang Province, Laing Id, 1 lv., RH, 1 dd, IRSNB IG.25955; **New Caledonia**, 70 lots, 279 specimens, lv. and dd, MNHN.

Figures 71-79

71-72. *Morula (Habromorula) dichrous* (Tapparone Canefri, 1880)

71. Holotype of *Engina xantholeuca* Sowerby, 1882, Mauritius, BM(NH) 1982.130, 13 mm.

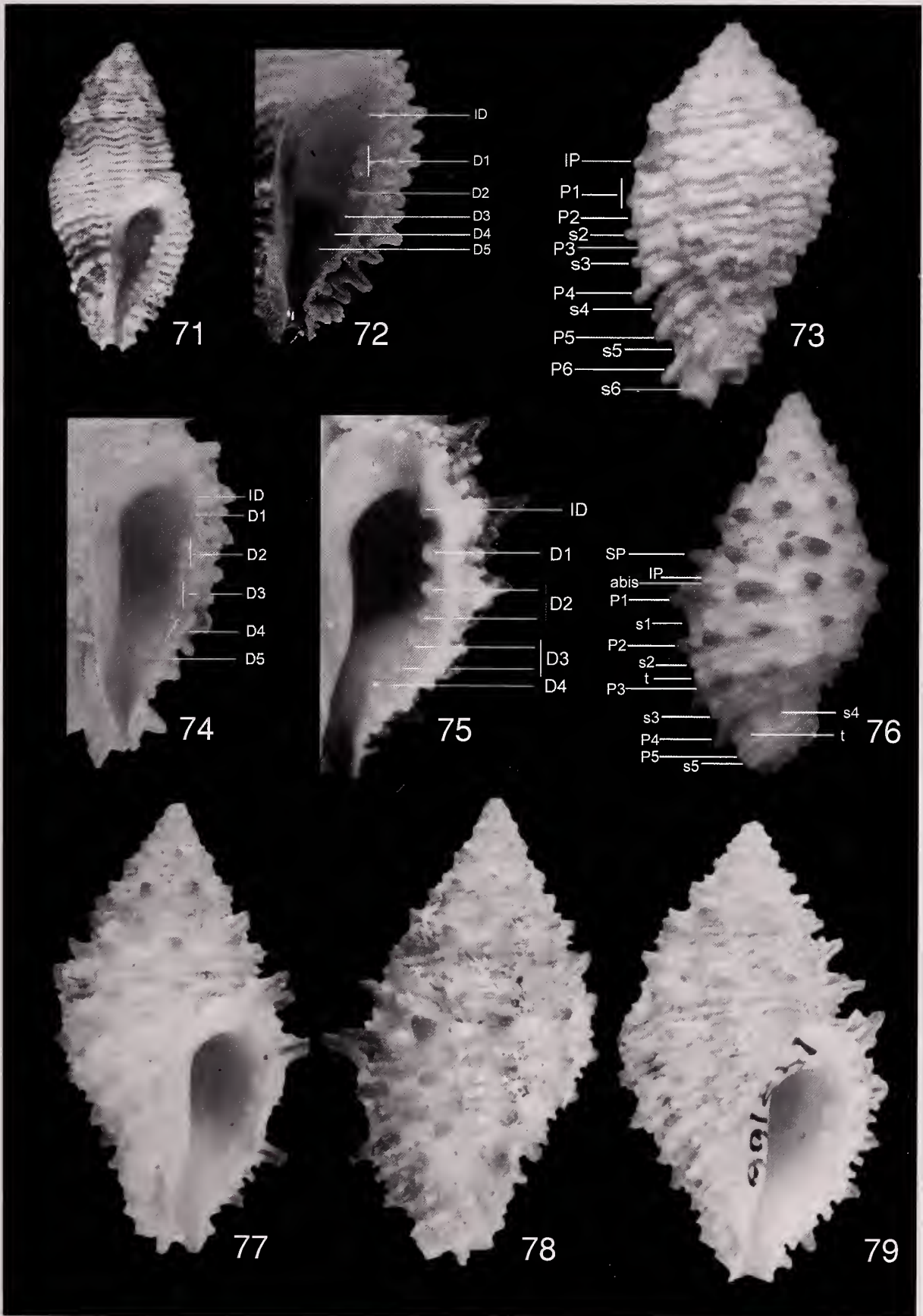
72. Denticles morphology.

73-74. *M. (H.) euryspira* (Houart, 1995)

73. Off New Caledonia, holotype MNHN, 15.5 mm, spiral cords morphology; 74. Denticles morphology.

75-79. *M. (H.) fuscoimbricata* (Sowerby, 1915)

75. Denticles morphology; 76. Spiral cords morphology; 77-78. Hawaii, holotype BM(NH) 1919.12.31.32, 19.9 mm; 79. Hawaii, Oahu, Honolulu Harbor, BPBM 198166, 18.5 mm.



Type locality. Off New Caledonia, secteur de Canala, 21°15' S, 165°46' E, 44 m.

Distribution (Fig. M). Okinawa, Western Australia, Queensland, Papua New Guinea, and New Caledonia, living at 13-26 m, on rocks and corals.

Description. Shell of an average size of 15-16 mm in length, with 3.5 - 4.25 protoconch whorls and 6 teleoconch whorls. Protoconch small, conical, glossy. Protoconch I with numerous, small pustules (Figs 37-39)

Axial sculpture of last teleoconch whorl with 8-10 narrow, low, rounded ribs. Spiral sculpture of numerous, narrow, low, primary, secondary and tertiary cords: First teleoconch whorl with visible SP, IP, P1, second whorl of a juvenile shell with SP (or SP split), 1P, adis, P1, s1, P2, s2, P3, s3, P4, P5, and P6. Last teleoconch whorl of adult specimens with additional secondary, tertiary and/or split cords.

Aperture narrow, high. outer lip crenulate, with 6 or 7 denticles within, 1D, D1 (or D1 split), D2, D3, D4, D5, decreasing in strength abapically. Columellar lip narrow, smooth, or with 2 or 3 knobs abapically, adherent. Siphonal canal short, broadly open, straight.

Creamy-white, tan, or light brown, occasionally with white blotches on broadest spiral cords.

Remarks. *Morula lepida* differs from *M. porphyrostoma* (Reeve, 1846), in having a relatively narrower shell, a narrower, more elongate aperture, narrower and more numerous spiral cords with a different development; narrower axial ribs, and flatter sides. *M. lepida*, *M. porphyrostoma*, and *M. coronata* have an intricate spiral cord morphology on the last teleoconch whorl, but are easily distinguishable from each other thanks to the different size, strength, and development of these cords (see Tables 1 and 2).

***Morula (Habromorula) porphyrostoma* (Reeve, 1846)**

Figs N86-87, 93-94, 117-119

Ricinula porphyrostoma Reeve, 1846: pl.2, fig.7.

Figures 82-89

80-81. *Morula (Habromorula) japonica* (Sowerby, 1903)

80. Denticles morphology; 81. Japan, holotype BM(NH) 1903.12.7.12, 13 mm.

82-83. *M. (H.) lepida* (Houart, 1995)

82. Spiral cords and denticles morphology; 83. New Caledonia, holotype MNHN, 15 mm.

84-85. *M. (H.) spinosa* (H. & A. Adams, 1853)

84. Spiral cords morphology (juvenile); 85. NW Madagascar, of Nossi Bé, ANSP 257521, 25.9 mm.

86-87. *M. (H.) porphyrostoma* (Reeve, 1846)

86. Denticles morphology; 87. Spiral cords morphology.

88. Denticles morphology of *M. (H.) striata* (Pease, 1868); 89. Denticles morphology of *M. (H.) coronata* (H. Adams, 1869).

Morula dumosa - Kay, 1979: 247, fig. 87C [not *Purpura dumosa* Conrad, 1837 (*nomen dubium*)]; Kaicher, 1980: card 2456; Cernohorsky, 1982: 126, figs 5-9 [not *Purpura dumosa* Conrad, 1837 (*nomen dubium*)].

Morula (Spinidrupa) porphyrostoma -Tröndle & Houart, 1992: 106, fig. 89.

Habromorula porphyrostoma -Houart, 1996b: 33, Fig. T.44.

Type material. Lectotype BM(NH) 1980128, designated by Cernohorsky (1982: 126).

Other material examined. Marquesas, Nuku Hiva, on rocks, 3-30 m, 3 lv., RH; Nuku Hiva, Pointe Kapu, 20 m, 6 lv, RH; Marquesas (no other data), 1 lv., RH; Tuamotu, Kaukura, coll. J. Tröndlé; Hawaii, South Oahu; Kam Reef, edge of Pearl Harbor channel, 1.5 - 2 m, 1 lv., RH; South Oahu, 9-11 m, 4 lv., RH; Midway Ids, Sand Id, 2-3 m, under coral, 3 lv., coll. D. Shasky.

Type locality. Marquesas Ids.

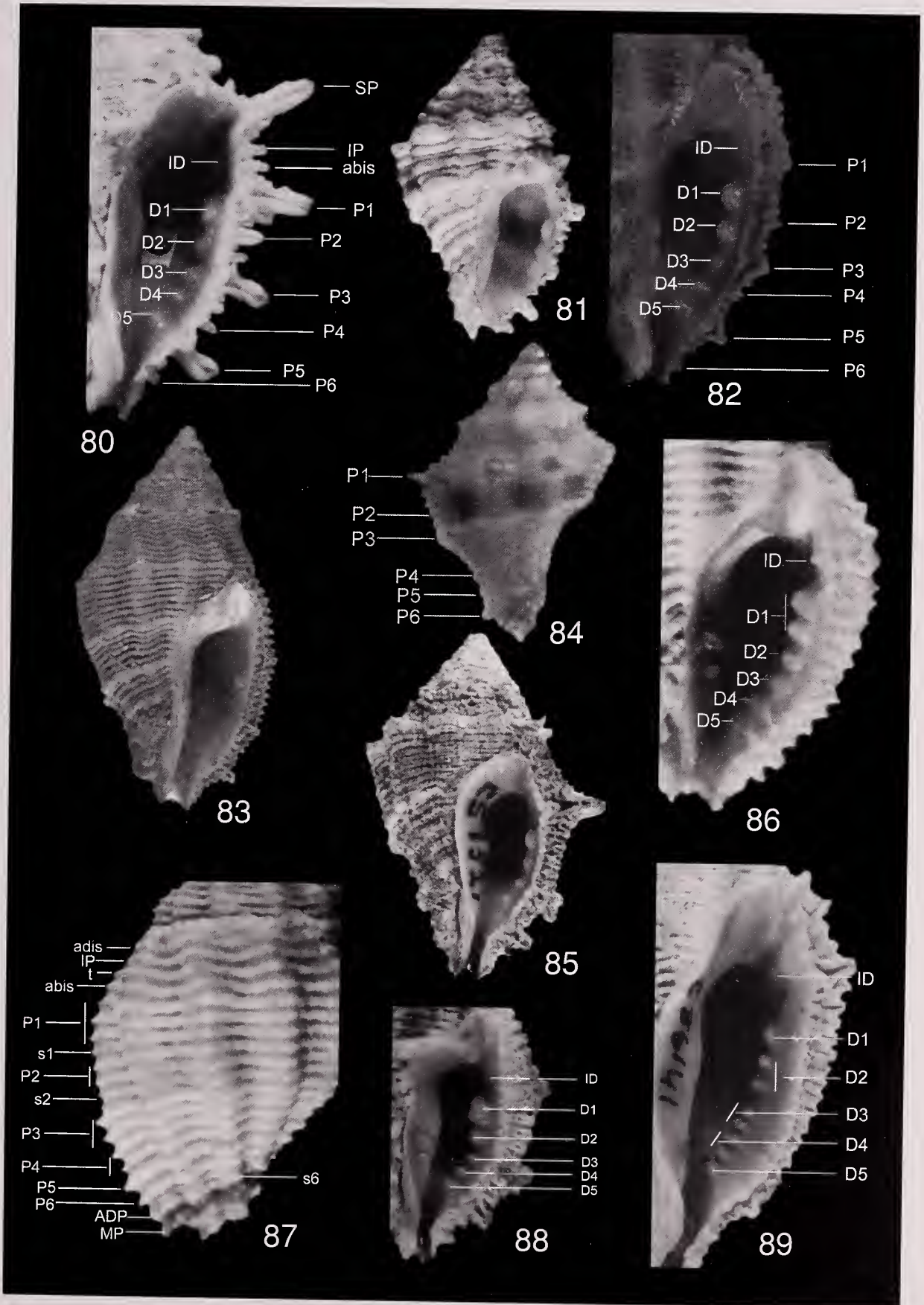
Distribution (Fig. N). Midway Ids, Hawaii, Marquesas, under coral or on rocks, living at 1.5 - 30 m.

Description. Shell with an average size of 15-20 mm in length, with 3.5 - 3.75 protoconch whorls and 6 or 7 teleoconch whorls. Protoconch small, conical, acute, glossy.

Axial sculpture of last teleoconch whorl with 7-9 broad, low ribs. Other axial sculpture of numerous growth lamellae. Spiral sculpture of narrow, high, squamose, primary, secondary and tertiary cords: SP, adis, IP, abis, P1 split in three, s1, P2 split, s2, P3 split, P4 split, P5, P6, s6, ADP, MP.

Aperture narrow, high. Outer lip crenulate, with 6 or 7 weak denticles within: ID weak, D1 split, D2, D3, D4, D5. Columellar lip narrow with 2 weak or strong knobs abapically. Weakly erect abapically, adherent adapically. Siphonal canal short, broadly open, straight.

Light tan or light orange with pink aperture.



Remarks. *Morula (Habromorula) porphyrostoma* was identified as *Purpura dumosa* Conrad, 1837 by Kay (1979) and Kaicher (1980). The type specimen of *Purpura dumosa* can no longer be located at the Academy of Natural Sciences, Philadelphia (Cernohorsky, 1982), and, as already stated by Tröndle & Houart (1992: 106), Conrad's original illustration (1837: pl. 20, fig. 20) could represent any species of the genus *Habromorula*, without or with few, short spines, and a narrow aperture (Fig. 53). For this reason Tröndle & Houart (1992) interpreted *P. dumosa* as a *nomen dubium*.

The Hawaiian specimens of *M. porphyrostoma* are larger, slightly broader, and have weakly broader spiral cords, otherwise they have a similar spiral sculpture development than the Marquesas form (see also Tables 1 and 2).

***Morula (Habromorula) spinosa*
(H. & A. Adams, 1853)**

Figs O, 30-31, 44, 84-85, 90, 126-128

Pentadactylus (Sistrum) spinosus H. & A. Adams, 1853: 130 (n.n. for *chrysostoma* "Deshayes" Reeve).

Morula ambusta Dall, 1924: 304 (n.n. for *chrysostoma* Reeve, not Deshayes).

Morula ambusta -Habe, 1964: 51, pl. 26, fig. 5.

Morula spinosa -Cernohorsky, 1969: 309, pl. 49, figs 22, 22a; Wilson & Gillett, 1971: 92, pl. 61, figs 6-6a; Hinton, 1977: 30, fig. 12; Hinton, 1978: 38, fig. 16; Kaicher, 1980: card 2440; Wells & Bryce, 1985: 92, pl. 27, fig. 306; Short & Potter, 1987: 60, pl. 29, fig. 11; Lai, 1987: 72, fig. 15; Wilson, 1994: 45, pl. 6, figs 30A, 30B.

Cronia biconica -Abbott & Dance, 1982: 145 [not *Morula biconica* (Blainville, 1832)].

Spinidrupa spinosa -Springsteen & Leobrera, 1986:

7, pl. 39, fig. 7.

Cronia spinosa -Drivas & Jay, 1988: 74, pl. 22, fig. 14.

Morula (Spinidrupa) spinosa -Fujioka, 1985: 249, pl. 5, fig. 49; pl. 8, fig. 87; Tröndle & Houart, 1992: 106, fig. 91.

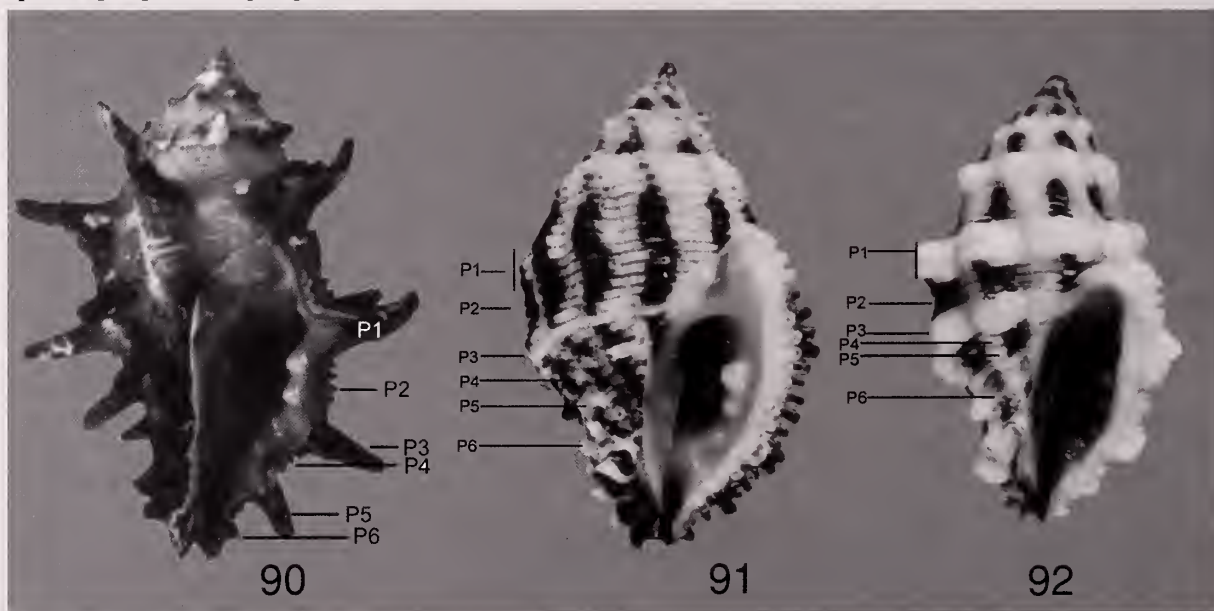
Habromorula andrewsi -Houart, 1996b: 30, figs T.38-39 (not *Sistrum andrewsi* Smith, 1909).

Habromorula spinosa -Houart, 1996b: 33, fig. T.45; Middelfart, 1997: 376, fig. 8; Tsuchiya, 2000: 393, pl. 195, fig. 150.

NOT *Morula spinosa* -Jarrett, 2000: 59, fig. 243 [(= *M. coronata* (H. Adams, 1869)].

Type material. *P. spinosus*: specimen of fig. 12b of Reeve (1846), designated as lectotype by Tröndle & Houart (1992: 107); *M. ambusta*: unknown.

Other material examined Madagascar. Tulear, 1 lv., MNHN; **Australia**, North Queensland, 2 lv., RH; off Central Queensland, Swain Reefs, 1 lv., RH; Queensland, attached to rock on reef near pipeline, Casnaru Beach, 4 lv., RH; **Japan**, Nada-Cho, Wakayama Prefecture, 3 - 9 m, 1 lv., RH; Cape Shiono, Wakayama Prefecture, 10-20 m, 1 lv., RH; **Philippines**, Sulu Sea, 2 lv., RH; Mactan Id, Cebu, in shell rubble, 10 lv. & dd, RH; Philippines (no other data), 13 lv. & dd, juveniles, RH; Mactan Id, Punta Engano, 9 dd, RH; **Guam**, east of Gabgab Beach, Apra Harbor, 1-12 m, 2 lv., RH; **Thailand**, Pattayan Id, under rocks, 4 m, RH; **Moluccas**, Aru, Dobo, 2 lv., RH; **Enewetak**, 1 lv. BPBM 251689; **New Caledonia**, 102 lots, 192 lv. and dd, MNHN; **Fiji**, 18°28' S, 177°59' E, 31-32 m, 1 lv (juv.), MNHN; **Society Archipelago**, Moorea, EPHE: **Marshall Islands**, Enewetak, lagoon side, under dead coral, 5 m, 1 lv., BPBM 251689..



Spiral cords morphology

90. *M. (H.) spinosa* (H. & A. Adams, 1853); 91-92. *M. (H.) striata* (Pease, 1868)

Type locality. Unknown.

Distribution (Fig. O). Southwestern Madagascar, Reunion, Mauritius, Melanesia, West Australia, Japan, Taiwan, Philippine Islands, Mollucas, Queensland, Marshall Islands, New Caledonia and French Polynesia, on and under coral and rocks, in shell rubble, living at 1-37 m.

Description. Shell of an average size of 20-25 mm in length, with 3.5 protoconch whorls and 6 or 7 teleoconch whorls. Protoconch conical, glossy.

Axial sculpture of last teleoconch whorl with 7 or 8 broad, low ribs, each with 3 long, acute, narrowly open, primary spines. Other axial sculpture of numerous growth lamellae. Spiral sculpture of primary, secondary and tertiary cords. Three high, spiny, primary cords (P1, P3, P5), a relatively lower cord (P6), and two low cords (P2 and P4). P2 and P4 similar in height and strength to secondary and tertiary cords. Shoulder of first teleoconch whorl with SP and IP, continuously with additional secondary and tertiary cords, until last whorl with SP, and 7 or 8 additional cords of same magnitude.

Aperture large, ovate. Outer lip crenulate, with 6 weak or strong denticles within: ID weak, D1 and D2 strong, D3, D4 and D5, decreasing in strength abapically. Columellar lip narrow, smooth or with small denticles abapically, partially erect abapically, adherent adapically. Siphonal canal short, broadly open, weakly abaperturally bent.

Colour creamy-white, tan, yellow-tan or brown, usually with blackish-brown spines and tip of siphonal canal.

Remarks. H. & A. Adams introduced the name *Pentadactylus spinosus* to designate the species that Reeve (1846: pl. 2, figs 12a-b) wrongly illustrated as *Ricinula chrysostoma* (Deshayes). In fact, Reeve illustrated two different species, his fig. 12b represents effectively *M. spinosa*, but the fig. 12a is a good illustration of *Morula biconica* (Blainville, 1832). Therefore the shell figured in 12b was designated as the lectotype of *M. spinosa* by Tröndle & Houart (1992: 107). Dall (1924: 304) probably ignoring H. & A. Adams gave again a new name for *Morula chrysostoma* Reeve, not Deshayes. Dall's name is thus to be considered as a junior synonym of *Pentadactylus spinosus* H. & A. Adams, 1853.

M. spinosa is probably the commonest and best known species of *Habromorula*. For the differences of shell morphology with *M. aglaos*, see under that species. Other species are easily distinguishable from *M. spinosa* (see Tables 1 and 2).

***Morula (Habromorula) striata* (Pease, 1868)**

Figs P, 33, 40-42, 88, 91-92, 112-113

Engina striata Pease, 1868: 275, pl. 23, fig. 18 (fig. 10 in error).

Habromorula striata -Houart, 1996b: 33, fig. T.46.

Drupa aspera -Mc Pherson & Gabriel, 1962: 176, fig. 212 [not *Morula aspera* (Lamarck, 1816)].

Morula biconica -Cernohorsky, 1969: 308, pl. 48, fig. 18 (only); 1972: 127, pl. 35, fig. 11; Wells & Bryce, 1985: 92, pl. 28, fig. 319; Short & Potter, 1987: 60, pl. 29, fig. 12; Dharma, 1988: 84, pl. 28, fig. 17; Wilson, 1994: 45, pl. 6, fig. 26; Jarrett, 2000: 60, fig. 246 [not *Morula biconica* (Blainville, 1832)].

Drupa (Morula) biconia (sic) -Matsumoto, 1979: 42, pl. 9, fig. 1 [not *Morula biconica* (Blainville, 1832)].

Morula (Spinidrupa) japonica -Fujioka, 1985: 249, pl. 6, fig. 55, pl. 8, fig. 85 [not *Morula japonica* (Sowerby, 1903)].

Morula striata (Pease, 1869) -Lozouet et al, 2004: 29, fig. 15-16 (not *Morula striata* -see remarks-).

Type material. Not located in ANSP (Johnson, 1994); not in BM(NH).

Other material examined. Madagascar, Tulcar, 4 lv., RH; Australia, Queensland, Wheeler Reef, NE of Townsville, GBR, intertidal, AMS; New Caledonia, 29 lots, 105 lv. & dd, MNHN; Vietnam, Ninh Thuan, along rocky shores, 1-5 m, 2 dd, RH; Java, Sundak, beach, 10 dd, RH; Papua New Guinea, Manokwari, 1 dd, RH; Madang, Laing Id, 3 lv. & dd, IRSNB; Samoa, Tutuila Id, Pago-Pago Harbour, under dead coral, 1-2 m, 3 lv., RH.

Type locality. Paumotus (= Tuamotu Archipelago).

Distribution (Fig. P). Throughout de Indo-West Pacific, on and under rocks, under dead coral, living at 1-20 m. The species was recently recorded in Rapa (Lozouet et al, 2004).

Description. Shell of an average size of 15-18 mm in length, with 4-4.5 protoconch whorls and 6 teleoconch whorls. Protoconch small, conical, acute, glossy; protoconch I of one whorl with numerous, small pustules; protoconch II almost smooth (Figs 40-42).

Axial sculpture of last teleoconch whorl with 7-9 broad, low, nodose ribs. Other axial sculpture of numerous growth lamellae. Spiral sculpture of high, narrow, rounded, squamose, primary, secondary and tertiary cords: juvenile with one teleoconch whorl: SP, IP, P1 - P6; juvenile with 2 whorls: SP, IP, adis, P1 split in three, P2, s2, P3, s3, P4, P5, s5, P6; juvenile with 3 whorls: SP, IP, adis, P1 split in three, s1, P2, s2, P3, s3, t, P4, P5, s5, P6; last whorl of adult shell: SP, t, adis, IP, abis, P1 split in three, t, s1, t, P2, s2, P3 split, t, s3, t, P4, P5, s5, P6. P5 occasionally broader.

Aperture narrow, high. Outer lip crenulate, with 6 denticles within, decreasing in strength abapically: ID small, shallow, D1 strong, D2 moderate, D3-D5 small. Columellar lip with 2 knobs abapically, partially erect abapically, adherent adapically.

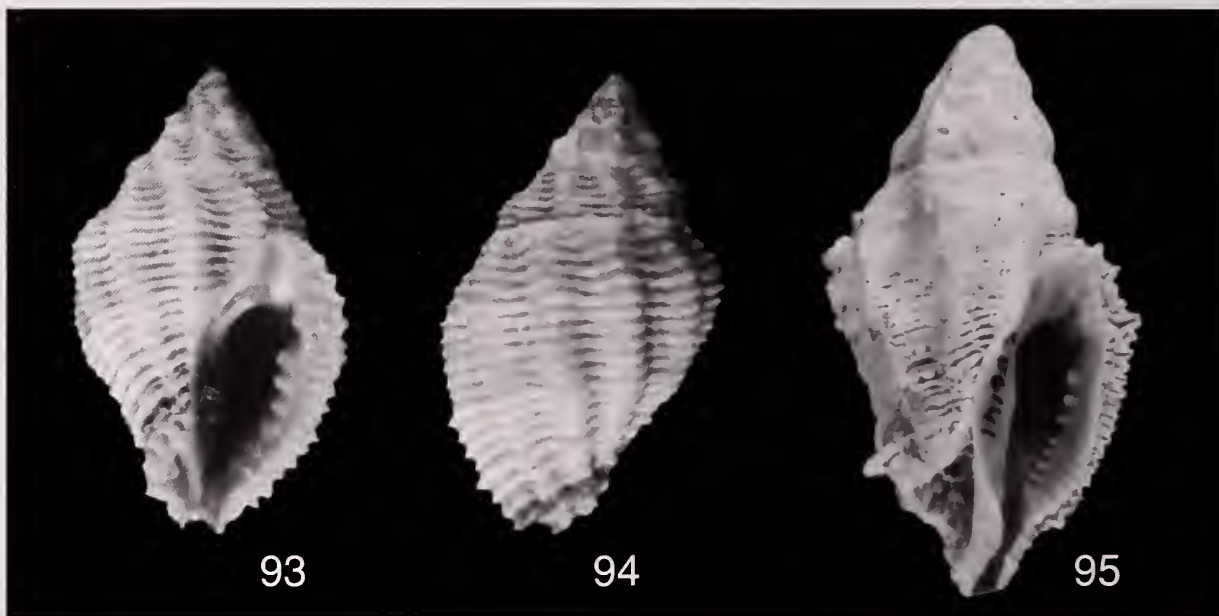
Siphonal canal short, weakly abaperturally bent, open.

Creamy-white with blackish-brown axial ribs, P1, P3 and occasionally P5, s5, P6 occasionally white, aperture light mauve.

Remarks. *Morula striata* is often confused with *M. biconica* due to the fact that both species have more or less the same colour pattern. However, both species have different spiral sculpture morphology and *M. biconica* has a comparatively narrower shell

with broader and flatter spiral cords, more numerous, lower axial growth striae, a broad, fused D1 and D2, and a parietal tooth not yet observed in *M. striata* (see Tables 1 and 2).

Morula (Morula) striata (Pease, 1868) (Pease, 1868: 276, pl. 23, fig. 2; Tröndlé & Houart, 1992: 103, figs 79, 110; Houart, 2002a: 98, fig. 62), described from French Polynesia, is a secondary junior homonym of *Morula (Habromorula) striata* (Pease, 1868). It is here renamed as *Morula (Morula) zebrina* nom. nov. (Figs 34-36).



93-94. *Morula (Habromorula) porphyrostoma* (Reeve, 1846). Lectotype, designated by Cernohorsky (1982), BM(NH) 1980.28.1, Marquesasa, 17.2 mm; 95. *M. (H.) whiteheadae* n.sp. West Australia: Turtle Beach, W side of North West Cape. 21°48' S, 114°10', paratype AMS C.086141, 44.3 mm.

***Morula (Habromorula) whiteheadae* n.sp.**

Figs Q, 95, 137-138

Type material. Holotype AMS C.323003, 34.6 x 19.3 mm, West Australia, Houtman Abrolhos, Gun Id, 28°53' S, 113°52' E, in coral rubble, 5 m; paratype AMS C.009084, 25.12 x 15.6 mm, West Australia, Shark Bay, Bernier Id, 24°52' S, 113°8' E; 1 paratype AMS C.086141, 44.30 x 24.5 mm and 1 paratype WAM S13493, 35.85 x 17.75 mm (ex AMS C.086141), West Australia, W side of North West Cape, Turtle Beach, 21°48' S, 114°10' E; 2 paratypes

MNHN (young specimens), 24.85 x 14.35 mm and 20.50 x 12.40 mm, West Australia, Pelsart Id; 1 paratype RH, 34.07 x 18.00 mm, North West Australia (no other data).

Type locality. West Australia, Houtman Abrolhos, Gun Id, 28°53' S, 113°52' E, in coral rubble, 5 m.

Distribution (Fig. Q). West Australia, from 28.57' S, 113°58' E (Pelsart Id) to 21°48' S, 114°10' E (North West Cape).

Figures 96-107

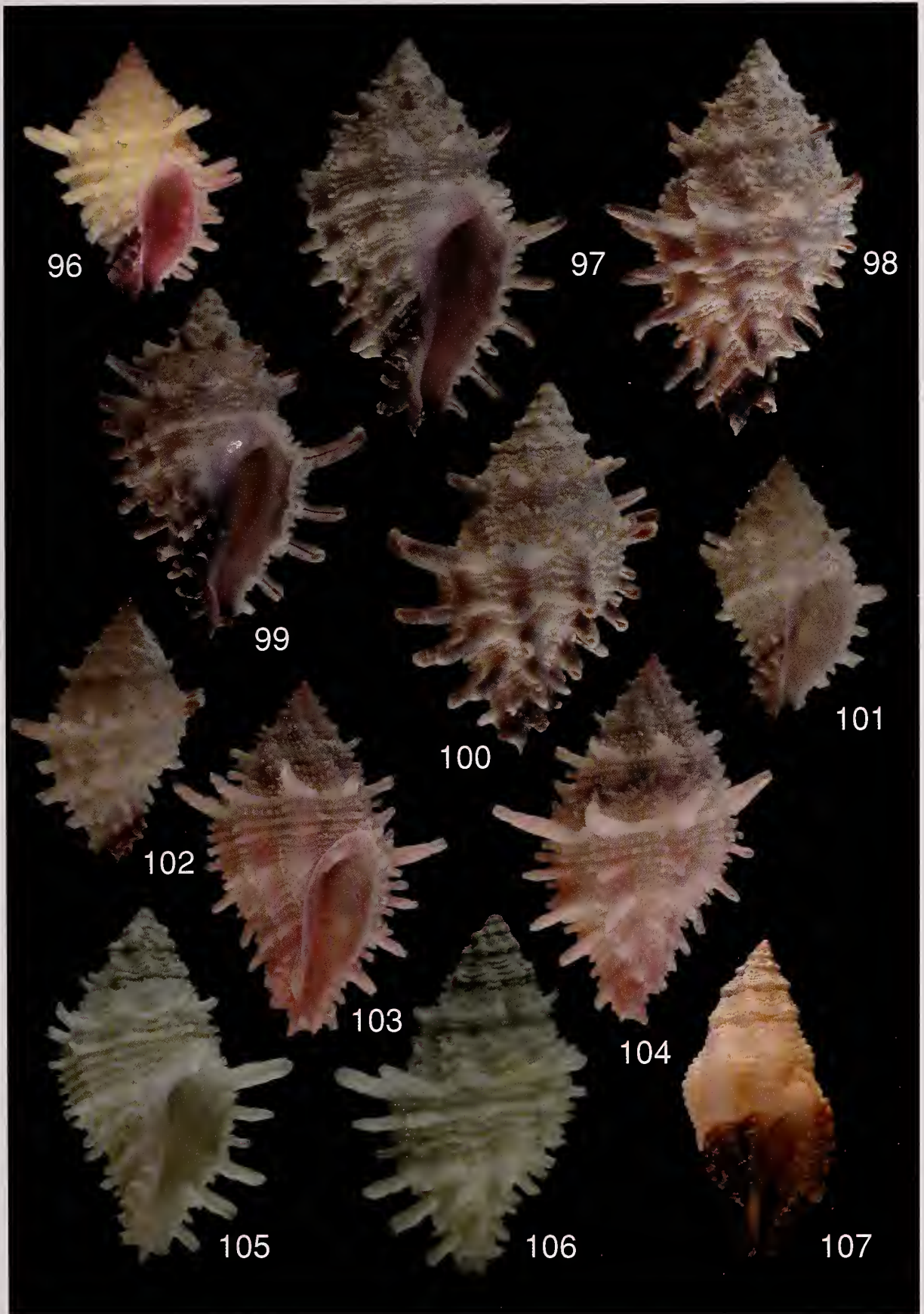
96-100. *Morula (Habromorula) aglaos* (Houart, 1995)

96. Marshall Ids, holotype MNHN, 14.2 mm; 97-100. Marshall Islands, off Kwajalein Atoll, coral caves, 18 m, coll. RH (97-98: 22.7 mm; 99-100: 19.6 mm).

101-106. *M. (H.) ambrosia* (Houart, 1995)

101-102. Marshall Islands, Kwajalein Atoll, off Carlson Island, on coral rock, 9 m, paratype coll. RH, 14.2 mm; 103-104. Philippines, Cebu, Mactan Id, 80 m, coll. RH, 20.9 mm; 105-106. Guam, coll. RH, 16.7 mm.

107. *M. (H.) dichrous* (Tapparone Canefri, 1880), Philippines, Cebu, coll. RH, 10.8 mm.



Description. Shell large sized for the subgenus, up to 44.3 mm in length at maturity, biconical, heavy, squamose. Spire high, up to 6-6.5 broad, weakly shouldered, teleoconch whorls. Suture impressed. Protoconch unknown (broken).

Axial sculpture of teleoconch whorls consisting of high, broad, frondose ribs; sculpture of first and second whorl eroded on all examined specimens, third to penultimate whorl with 8 or 9 ribs, last whorl with 7 or 8 ribs. Apertural varix fringed. Spiral sculpture of high, strong, narrow, crowded cords. Ontogeny unknown. Last whorl with 25-34 cords of approximately same magnitude. P1 not split.

Aperture large, narrow, high. Columellar lip broad, smooth, rim partially erect abapically, adherent at adapical extremity. Anal notch broad, moderately deep. Outer lip erect, crenulate, with strong denticles within: ID, D1-D5 or ID, D1 split, D2-D5, or ID, D1 split, D2, D3 split, D4 split, D5. Siphonal canal short, broad, straight, broadly open.

Greyish-white, aperture light mauve.

Operculum and radula unknown.

Remarks. *Morula whiteheadae* n.sp. resembles *M. lepida* and *M. porphyrostoma*. It differs from *M. lepida* in being larger for a same number of teleoconch whorls, in having comparatively higher, more obvious and more crowded spiral cords which are more obviously prominent on axial ribs, and in having a broader, smooth, columellar lip with erect rim. *M. whiteheadae* differs from *M. porphyrostoma* in being also comparatively larger, in having more numerous spiral cords, 25-34 cords vs 16-24 on last teleoconch whorl, with P1 not split, in having a light mauve aperture with broader and smooth columellar lip, while pink with small knobs abapically in *M. porphyrostoma*.

Etymology. This new species is named for Mrs Thora Whitehead, Capell Hill, Queensland, in

recognition for her friendship and kindness. She was also the first to bring that shell to my attention.

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Many people helped in many ways and such a work would have been impossible without their assistance and collaboration. I am most thankful to Paul Callomon and Mark Kitson, Academy of natural Sciences, Philadelphia, USA, for the loan of specimens and digital images; Julien Cillis, Institut royal des Sciences naturelles de Belgique, for SEM work of the protoconchs; Bunnie Cook, Honolulu, Hawaii for the loan of specimens; Yves Finet and G. Ratton, Muséum d'Histoire Naturelle, Genève, for photographs and information about Lamarck's types; Virginie Héros (Muséum national d'Histoire naturelle, Paris), for searching (and finding) related literature; Regina Kawamoto, Bishop Museum, Honolulu, Hawaii, for the loan of specimens; Silvard Kool for suggestions; H. Kubo, Okinawa Prefectural Fisheries Experimental Station, for information about *Habromorula japonica* in Okinawa; D. Merle, Muséum national d'Histoire naturelle, Laboratoire de Paléontologie for helpful comments on the spiral morphology; Winston Ponder and Ian Loch, Australian Museum, Sydney, for the loan of material; M. Rocroi (MNHN) for checking Menke's Description of *Purpura nodulifera*; Rudo von Cosel, Muséum national d'Histoire naturelle, Paris, for information about Menke's collection; Anders Warén, Natural History Museum, Stockholm, for preparation and SEM work of the radulae.

I also would like to record my thanks to Jackie Van Goethem, to Diana Oortmans, to Claudine Claes, to Philippe Bouchet, to Virginie Héros, and to Kathie Way and the staff of the malacology department of the Institut royal des Sciences naturelles de Belgique, the Muséum national d'Histoire naturelle, Paris and the Natural History Museum, London, who regularly kindly collaborate in many ways.

Figures 108-120

108-109. *Morula (Habromorula) bicatenata* (Reeve, 1846), Society Archipelago, Tahiti, Toahotu, coll. RH, 10.3 mm.

110-111. *M. (H.) biconica* (Blainville, 1832), Papua New Guinea, Hansa Bay, Laing Island, coll. RH, 22.3 mm.

112-113. *M. (H.) striata* (Pease, 1868)

112. Tulear, Madagascar, coll. RH, 16.1 mm; 113. Samoa, coll. RH, 13.8 mm.

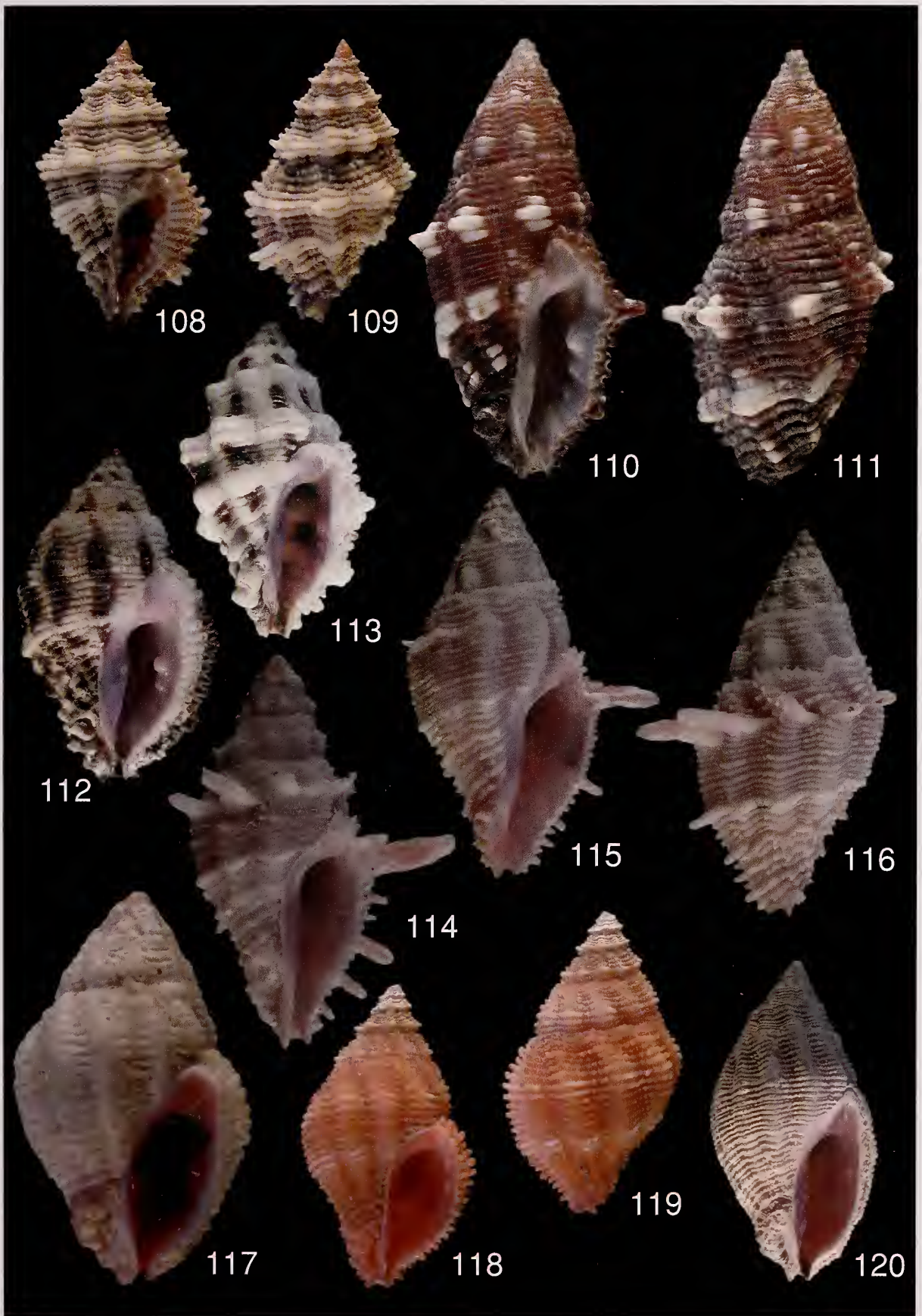
114-116. *M. (H.) coronata* (H. Adams, 1869), Reunion

114: 24 mm; 115-116: 21.5 mm.

117-119. *M. (H.) porphyrostoma* (Reeve, 1846)

117. Hawaii, South Oahu, coll. RH, 18.1 mm; 118-119. Marquesas, Nuku Hiva, coll. RH, 14.2 mm.

120. *M. (H.) lepida* (Houart, 1995), New Caledonia, coll. RH, 15.5 mm.

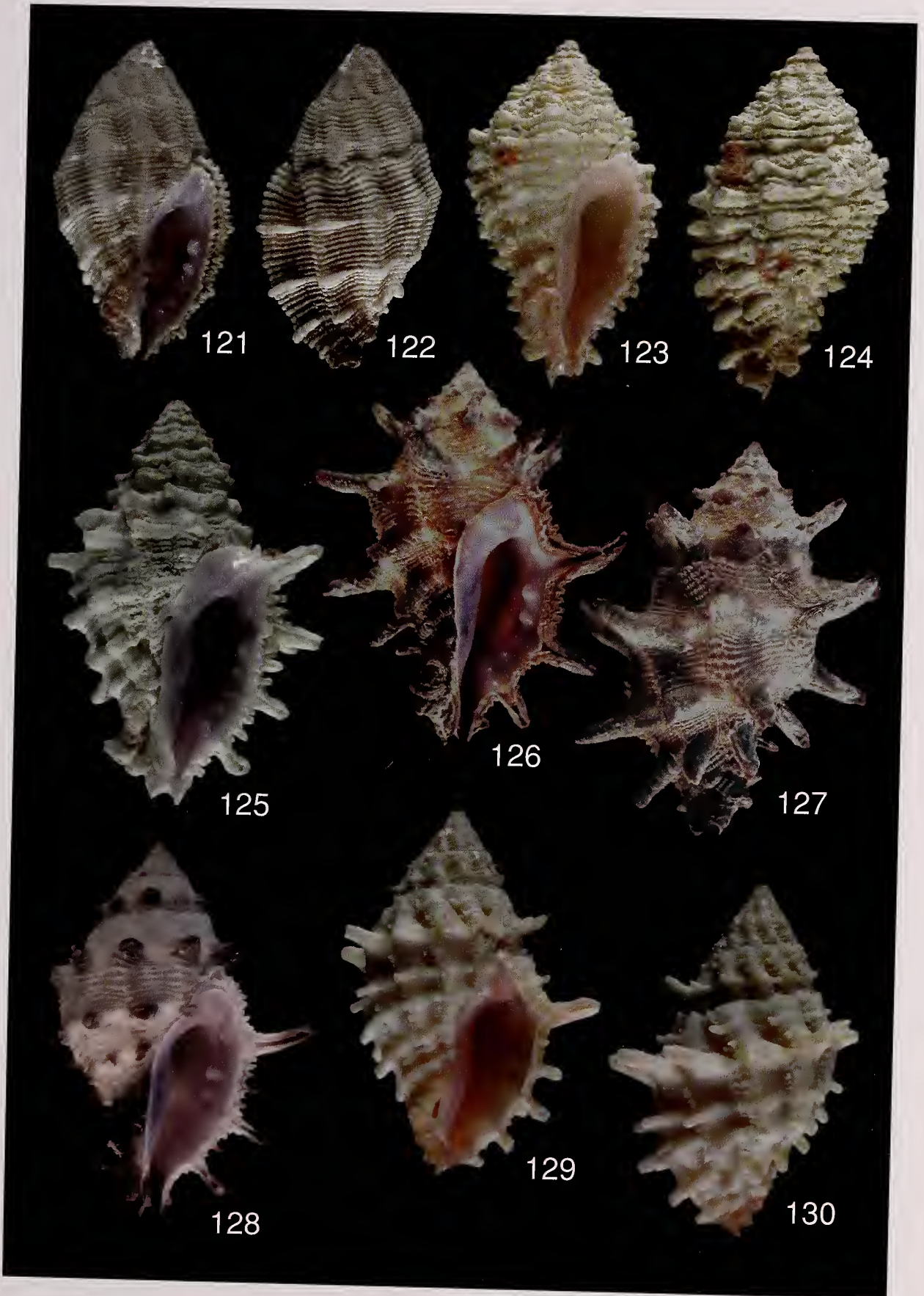


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Figures 121-130

- 121-122.** *Morula (Habromorula) lepida* (Houart, 1995), Papua New Guinea, Hansa Bay, Laing Id, coll. RH, 13.3 mm; **123-124.** *M. (H.) euryspira* (Houart, 1995), New Caledonia, holotype MNHN, 15.5 mm.
- 125.** *M. (H.) japonica* (Sowerby, 1903), Japan, Wakayama Pref., Minabe, coll. RH, 30.8 mm.
- 126-128.** *M. (H.) spinosa* (H. & A. Adams, 1853)
126-127. Moluccas, Aru, coll. RH, 24.1 mm; 128. Australia, Queensland, Swain Reefs, coll. RH, 25.5 mm.
- 129-130.** *M. (H.) andrewsi* (Smith, 1909), Christmas Id, 10°30' S, 105°40' E, AMS C.152414, 22.1 mm. Specimen illustrated as *M. coronata* by Wells et al (1990).



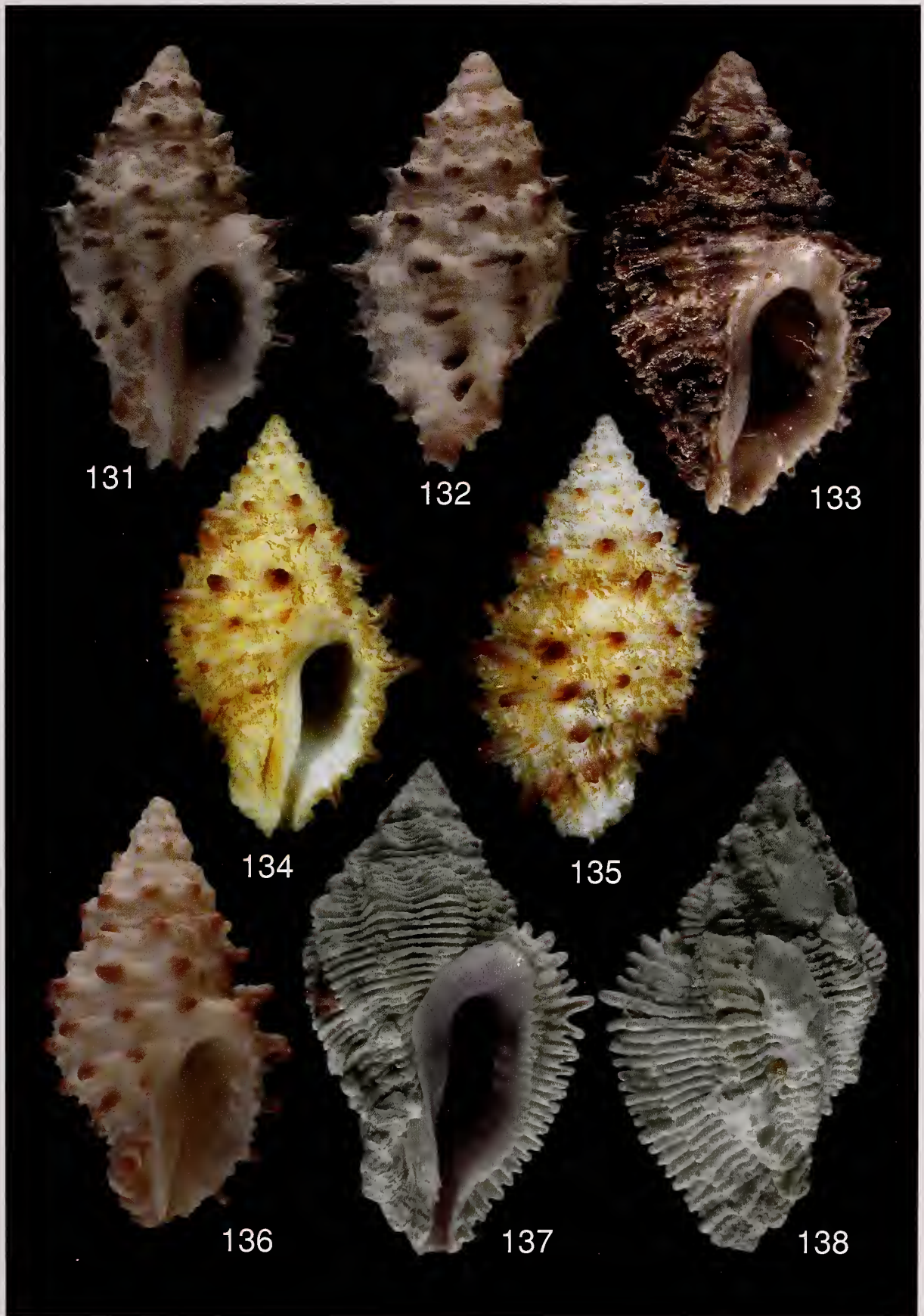
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Figures 131-138

131-136. *Morula (Habromorula) fuscoimbricata* (Sowerby, 1915)

131-132. Hawaii, Kahe South Oahu, coll. B. Cook, 20.4 mm; 133. Hawaii, South Oahu, Fort Kamehameha Reef, coll. B. Cook, 24.7 mm; 134-135. Holotype of *Drupa walkerae* Pilsbry & Bryan, 1918, ANSP 9382, 25 mm, photo courtesy P. Callomon; 136. Hawaii, South Oahu, Sand Island, near reef edge, coll. B. Cook, 24.9 mm.

137-138. *M. (H.) whiteheadae* n.sp. West Australia, Gun Island, Houtman Abrolhos, 28°53' S, 113°52' E, in coral rubble, 5 m, holotype AMS C.323003, 34.6 mm.



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	<i>M. aglaos</i>	<i>M. ambrosia</i>	<i>M. andrewsi</i>	<i>M. bicatenata</i>	<i>M. biconica</i>	<i>M. coronata</i>	<i>M. dichrous</i>	<i>M. euryspira</i>
Spiral cords of last whorl								
SP	absent	present	present	absent	present	split	present	absent
adis	small	small	small	broad	broad	broad	broad	narrow
IP	small	small	broad	broad	broad	broad	broad	broad
abis	small	broadest cord, giving rise to the longest spine	broadest cord, giving rise to the longest spine	broad	broad	broadest cord, giving rise to the longest spine	broad	narrow
P1	broad, spine longest	small, narrow	small, narrow	split in three	weakly broader	small, narrow	split	split
P2	broad, medium spine	medium, spine long	narrow, short spine	narrow	medium	small, narrow	broad	broad
P3	broad, medium spine	medium, spine long	broad, long spine	split	medium, occasionally split	broad	split	broad
P4	broad, short spine	medium, spine long	narrow, short spine	narrow	of same magnitude	broad	broad	broad
P5	broad, medium spine	medium, spine long	broad, long spine	narrow		broad	broad	broad
P6	broad, short spine	medium, spine long	medium, spine short	narrow		broad	broad	broad
s	s1-s5	s1-s5	s1-s5 (probably)	s1-s3	s1-s4	s1-s5	s1-s3	s2-s6
t	regular	irregular	irregular	absent	irregular	regular	absent	present
ADP	absent	absent	absent	absent	absent	present	absent	absent
MP	absent	absent	absent	absent	absent	absent	absent	absent
Aperture								
ID	almost obsolete	almost obsolete	broad	small	weak or obsolete	small	small	small
D1	strongest	very low or indistinguishable occasionally	broad	broad, occasionally split	D1 and D2 fused	occasionally split	split	small
D2	decreasing in length	split	split	medium sized, approximately same magnitude		occasionally split	small	split
D3	abapically		broad, low	same	medium	small	small	split
D4			low	magnitude	split	small	small	split
D5			?		medium or small	small	small	small
PT	absent	absent	absent	present	present	absent	present	absent

TABLE 1. Comparison of *Habromorula* species

	<i>M. fuscoimbricata</i>	<i>M. japonica</i>	<i>M. lepida</i>	<i>M. porphyrostoma</i>	<i>M. spinosa</i>	<i>M. striata</i>	<i>M. whiteheadae</i>
Spiral cords of last whorl							
SP	present	present, broad	present	present	present	present	
adis	absent	absent	small	small	7 or 8 cords of same magnitude	adis, IP, abis and secondary cords of same magnitude	Ontogeny unknown. 25-34 cords of approximately same magnitude.
IP	broad	small	small	small			P1 not split
abis	small	small	small	small			
P1	broad	broad	weakly broader than secondary cords	approximately same magnitude.	broad	split in three, broad	
P2	broad	medium	split	P1 split in 3	narrow	narrow	
P3	broad	broad	broad	P2 split	broad	broad	
P4	broad	broad	narrow	P3 split	narrow	narrow	
P5	broad, medium spine	broad	broad	P4 split	broad	broad	
P6	absent	narrow	narrow	P5 P6	medium	narrow	
s	s1-s5	s1-s5	s1-s5	s1-s5	s1-s5	s1-s5	
t	irregular	absent	present	absent	present	present	
ADP	absent	absent	?	present	absent	absent	
MP	absent	absent	?	present	absent	absent	
Aperture							
ID	broad	small	small	weak	small	small	small
D1	strongest or split	broad	broad, occasionally split	split	occasionally split	broad	broad, occasionally split
D2	split	decreasing in strength abapically	decreasing in strength abapically	decreasing in strength abapically	occasionally split	decreasing in strength abapically	broad
D3	split				small		small, occasionally split
D4	small				small		small, occasionally split
D5	absent				small		small
PT	present	present	absent	absent	absent	absent	absent

TABLE 2. Comparison of *Habromorula* species

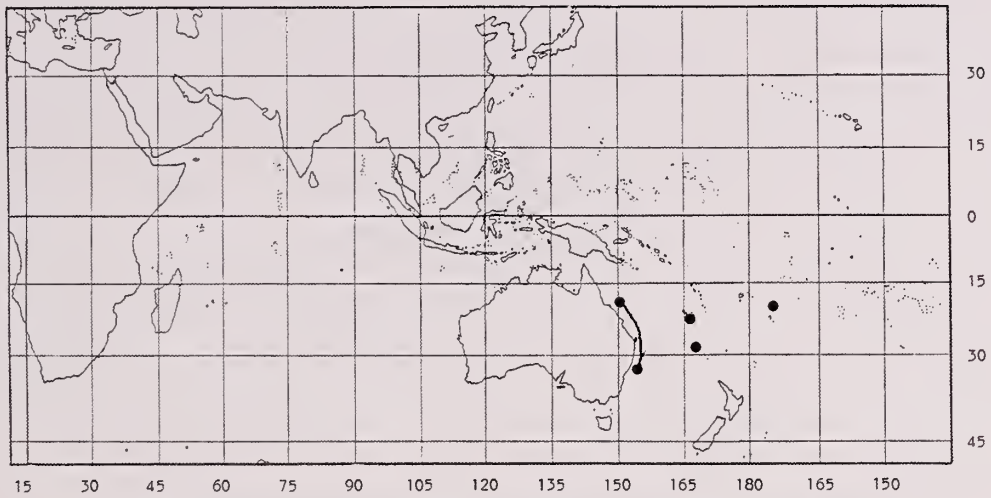


Fig. A. Distribution of *Morula (Oppomorus) noodulifera* (Menke, 1829)

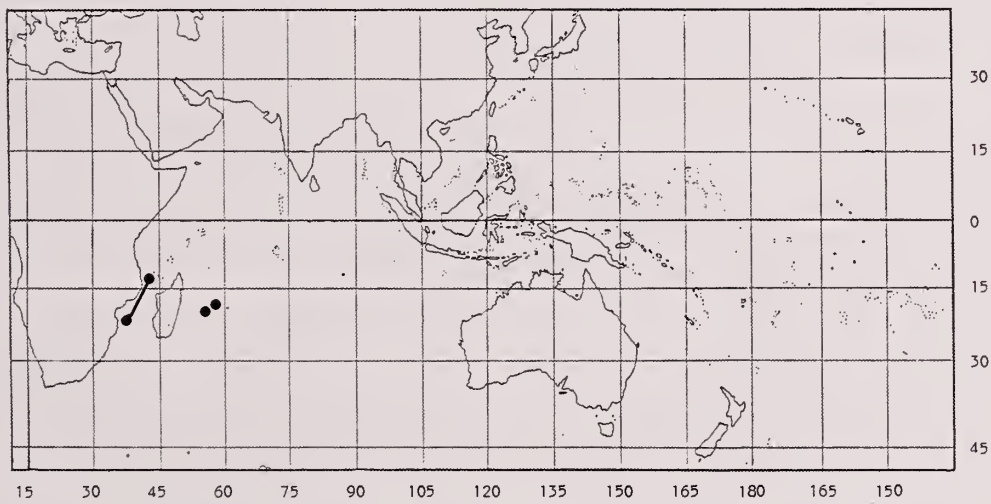


Fig.B. Distribution of *Morula (Azumamorula) mutica* (Lamarck, 1816)

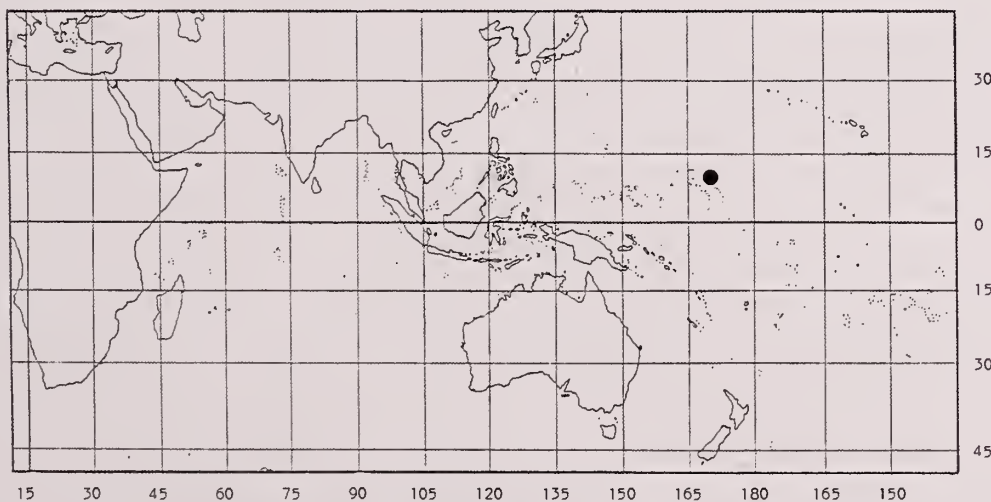


Fig.C. Distribution of *Morula (Habromorula) mutica* (Lamarck, 1816)

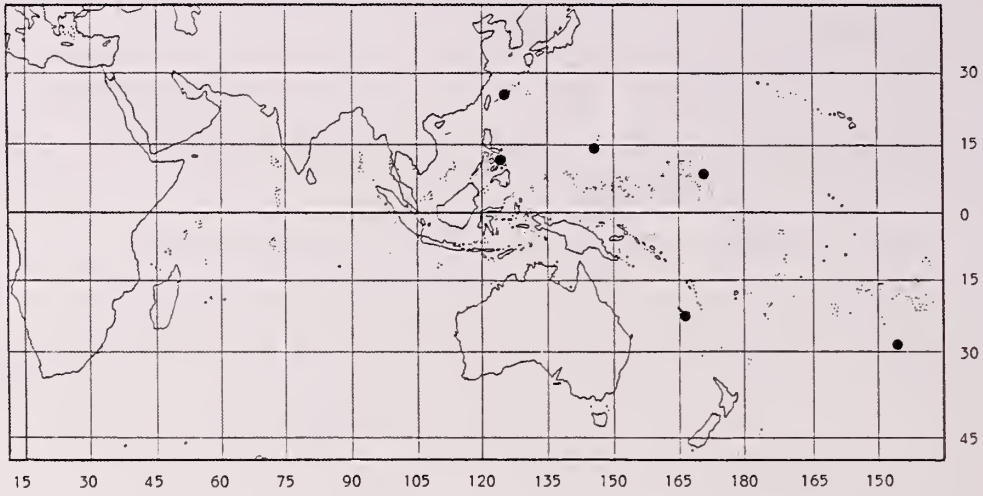


Fig. D. Distribution of *Morula (Habromorula) ambrosia* (Houart, 1995)

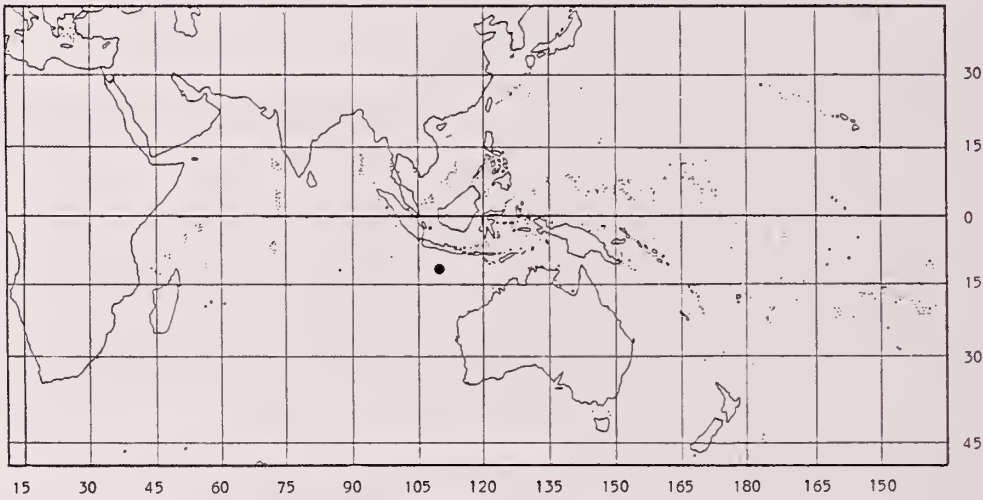


Fig. E. Distribution of *Morula (Habromorula) andrewsi* (Smith, 1909)

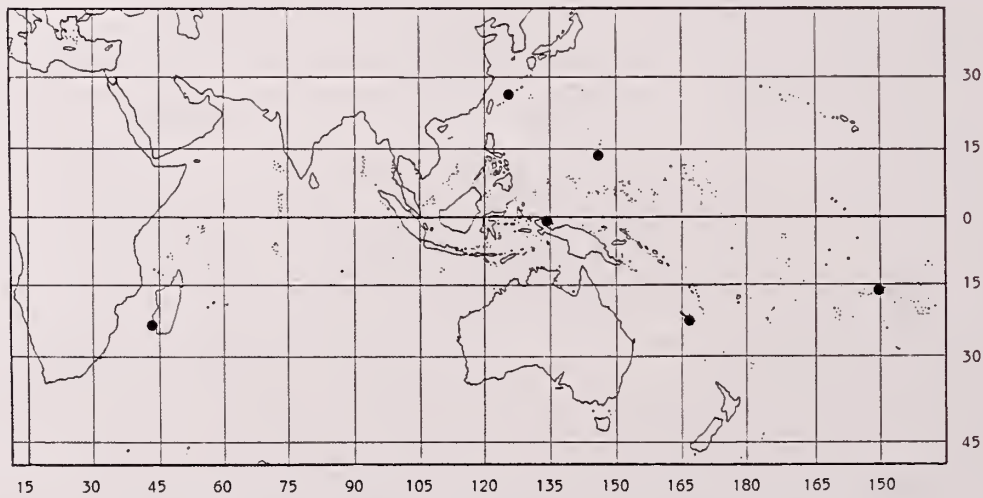


Fig. F. Distribution of *Morula (Habromorula) bicatenata* (Reeve, 1846)

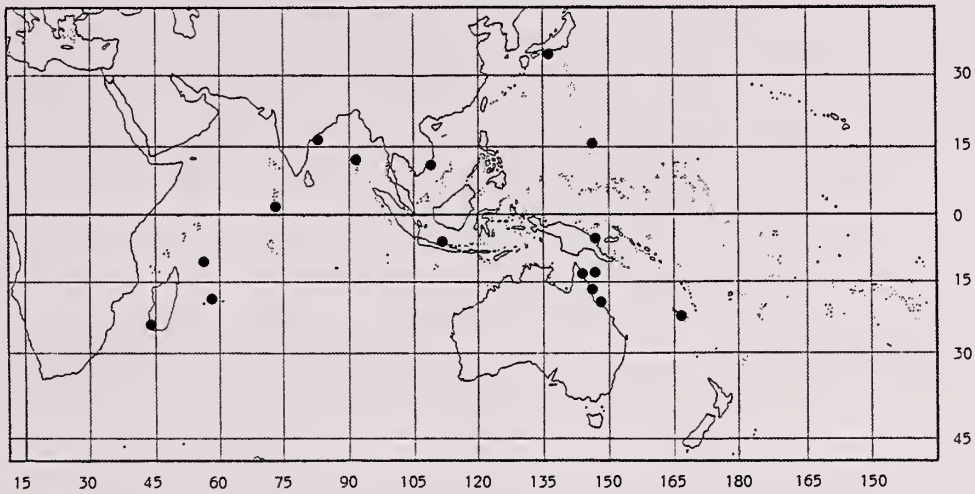


Fig. G. Distribution of *Morula (Habromorula) biconica* (Blainville, 1832)

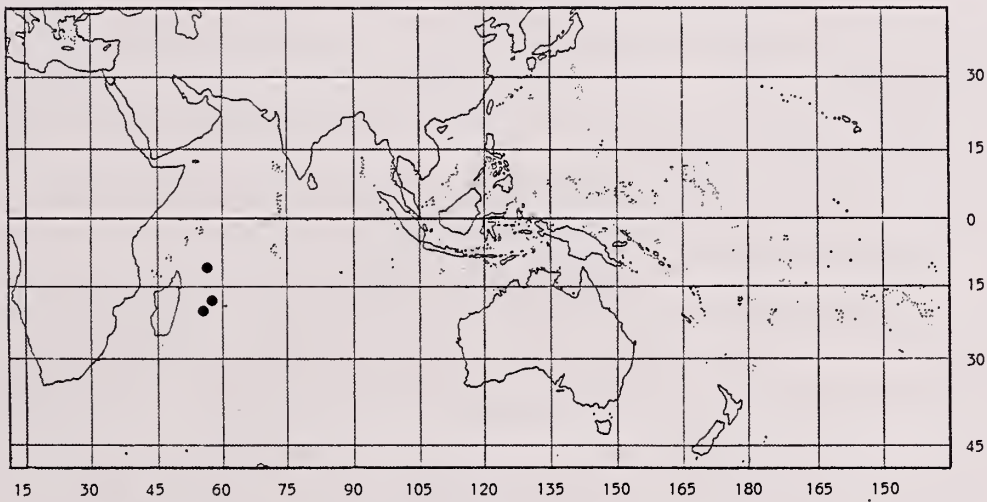


Fig. H. Distribution of *Morula (Habromorula) coronata* (H. Adams, 1869)

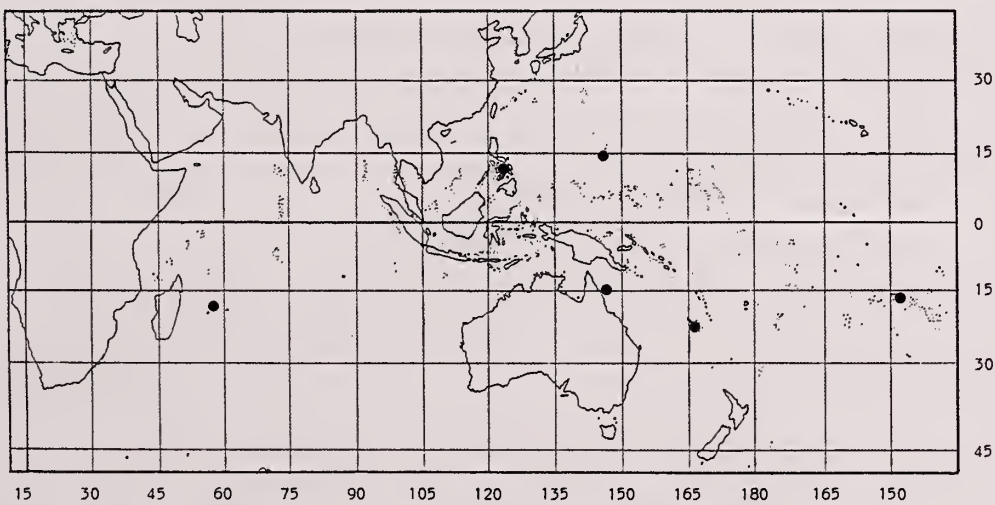


Fig. I. Distribution of *Morula (Habromorula) dichrous* (Tapparone Canefri, 1880)

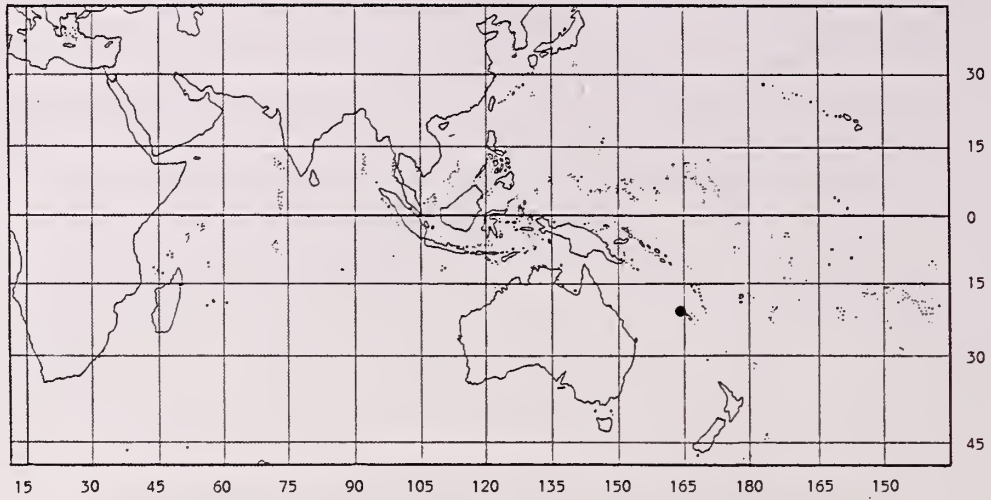


Fig. J. Distribution of *Morula (Habromorula) euryspira* (Houart, 1995)

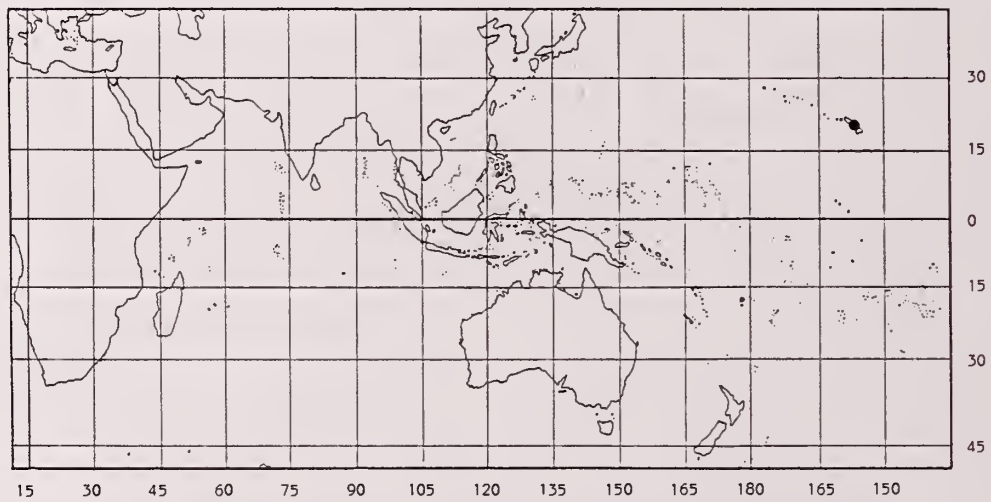


Fig. K. Distribution of *Morula (Habromorula) fuscoimbricata* (Sowerby, 1915)

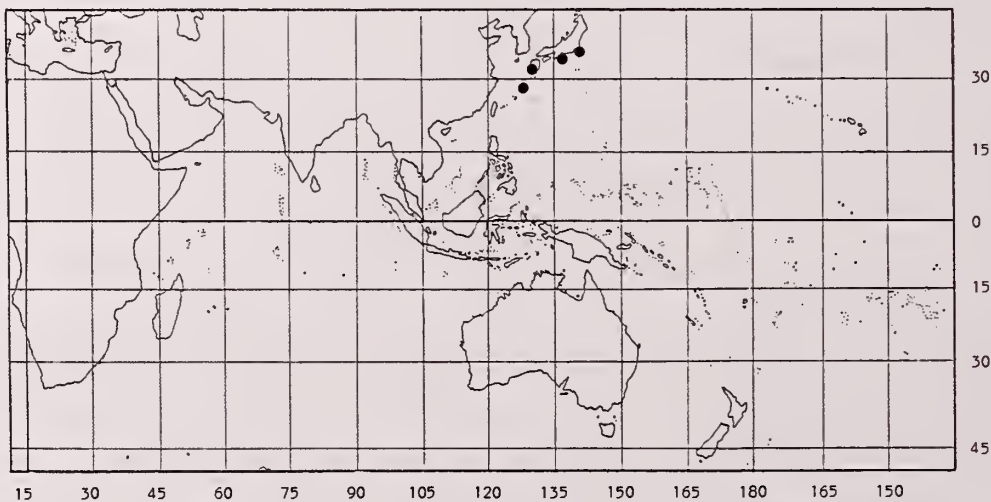


Fig. L. Distribution of *Morula (Habromorula) japonica* (Sowerby, 1903)

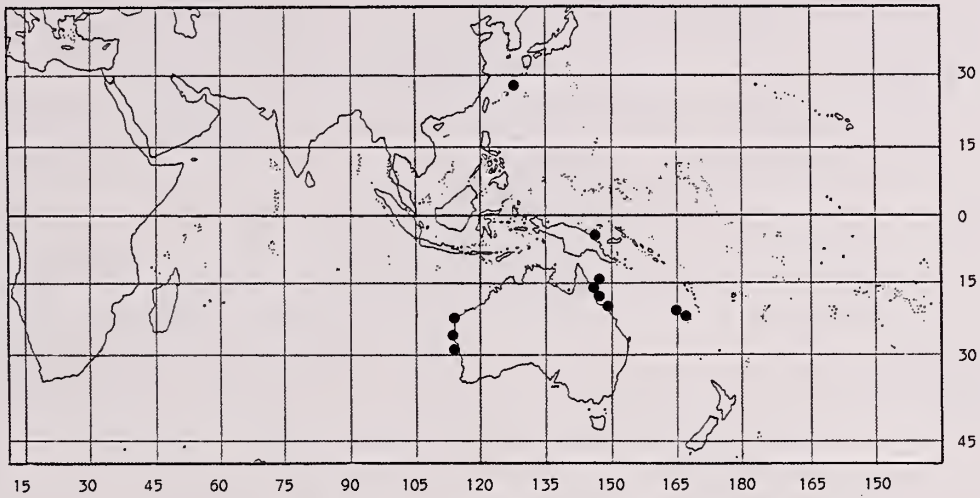


Fig. M. Distribution of *Morula (Habromorula) lepida* (Houart, 1995)

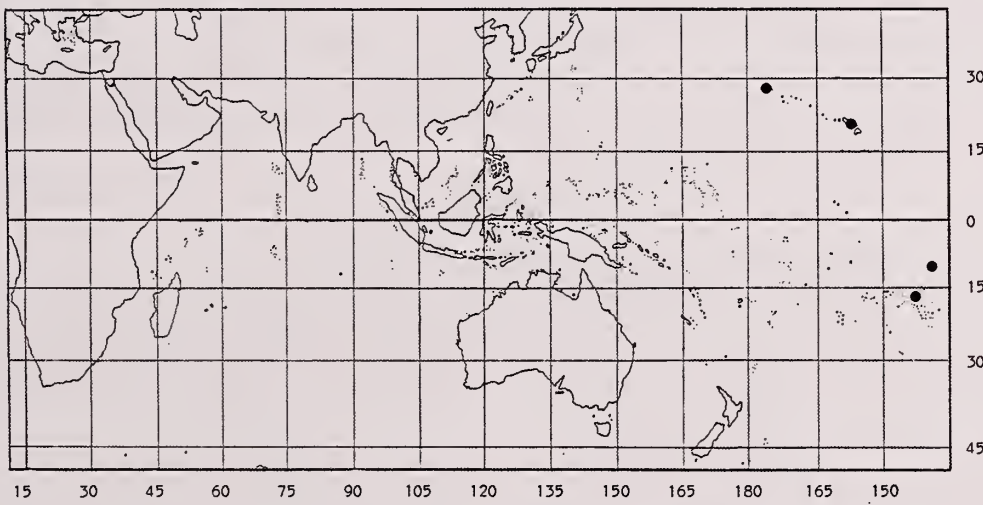


Fig. N. Distribution of *Morula (Habromorula) porphyrostoma* (Reeve, 1846)

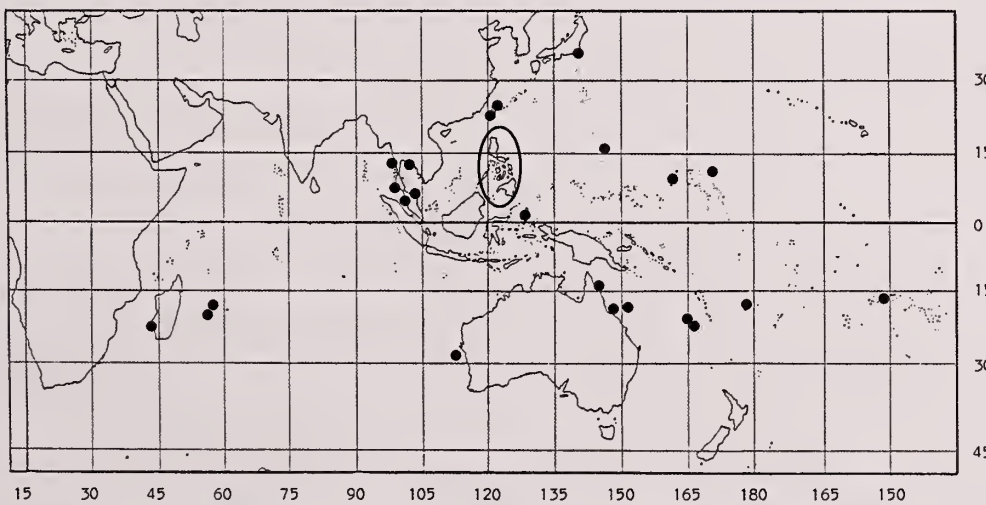


Fig. O. Distribution of *Morula (Habromorula) spinosa* (H. & A. Adams, 1853)

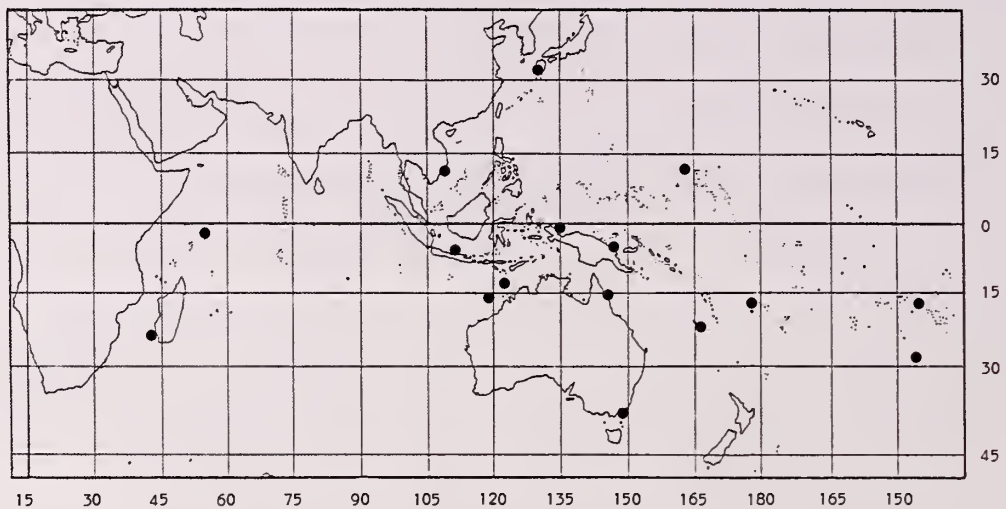


Fig. P. Distribution of *Morula (Habromorula) striata* (Pease, 1868)

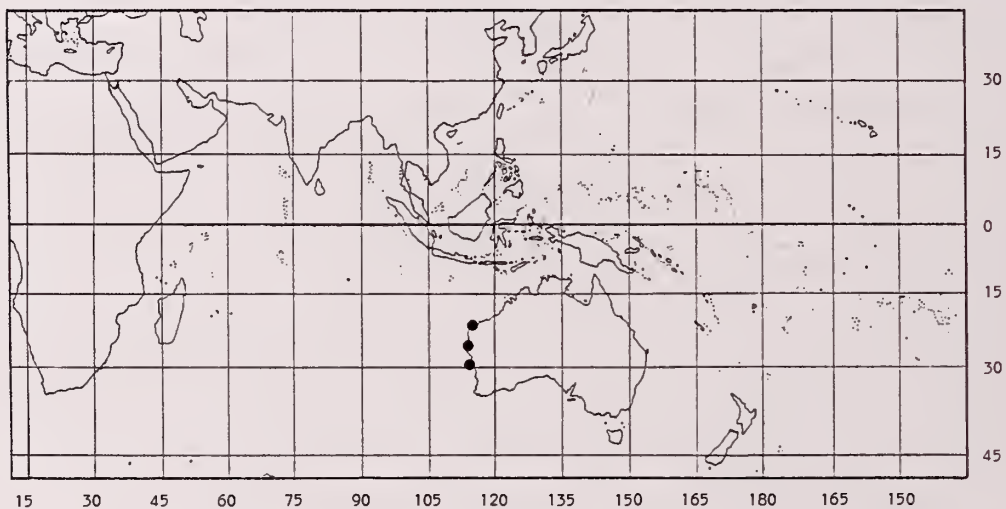


Fig. Q. Distribution of *Morula (Habromorula) whiteheadae* n.sp.