

## AN ILLUSTRATED CHECKLIST OF MURICIDAE (GASTROPODA: PROSOBRANCHIA) FROM THE ANDAMAN SEA, THAILAND

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## ABSTRACT

The Muricidae of the Andaman Sea, Thailand, have been studied from material deposited in the Reference Collection at Phuket Marine Biological Centre. A brief description is given for the studied species together with notes concerning the literature on anatomy, reproduction and habitat. The material comprises 55 species in 4 subfamilies: Muricinae (17 species), Muricopsinae (1 species), Rapaninae (31 species), and Ergalataxinae (6 species). Since the last checklist of prosobranchs from the Andaman Sea, Thailand, was published in 1978, four new species, two rapanines and two muricines have been described from the Malayan Peninsula. 18 of the species included in this paper are new records from the Andaman Sea, Thailand. It is concluded that more collections from the shelf and deeper areas of the Andaman Sea are needed to get a better understanding of the diversity of Muricidae in the Andaman Sea, Thailand.

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## INTRODUCTION

While studying the reproduction of Muricidae from Phuket Island and vicinity (Middelfart 1992; 1993a,c; 1996), I encountered numerous problems in identifying even very common muricid species in the intertidal zone, because many muricids display significant geographical variation in shell characters, and identification from literature from "near by" areas are in many cases impossible. Tantanasiwong (1978) listed shelled gastropods of Prosobranchia, Opisthobranchia (excluding shell-less opisthobranchs), and Pulmonata of Phuket Island, adjacent mainland and offshore islands of the western peninsula Thailand. Revisions by Houart (1992), Ponder & Vokes (1988), and Tan (1995) where the geographical variation of various species is described, have proven to be of great value in species determination.

There has been much debate on what supraspecific taxa should be included in the family Muricidae (see *e.g.*, D'Attilio & Hertz 1988; Kool 1993; Radwin & D'Attilio 1976; Vokes 1964). I have chosen to include the Muricinae (comb shells, murex shells), Ergalataxinae, (oyster drills), Ocenebrinae (whelks) Rapaninae sensu Kool (1993) (rock shells, whelks), Muricopsinae, Typhinae, Trophoninae, and Coralliophilinae (coral shells) in this paper. The only subfamily that is not on record in the Indo-West Pacific region is Ocenebrinae. The coralliophilines have not been studied in this paper.

Muricids inhabit most marine biotopes on the Andaman Sea side of Thailand, with the exception of the intertidal zone of wave swept sandy beaches. The ergalataxines and rapanines are common inhabitants of the intertidal rocky shores and coral reefs. The muricine group generally occur at greater depth. The muricines *Chicoreus* inhabit coral reefs, subtidal rocks or level bottom habitats with hard substrate, while *Murex* and *Haustellum* are found on soft substrates of level bottom, inter- or subtidally.

The muricids are all carnivorous animals and feed on various kinds of invertebrates like polychaetes, sipunculans, molluscs, crustaceans, sponges, corals, holothurians and even fish (Kool 1987; Taylor 1976; 1983; 1982; Thomas & Kohn 1990; Turner 1994). Some genera like *Drupella* have caused considerable damage to certain coral reefs (Turner 1994), and species of the rapanines and ergalataxines have a high potential of destruction in oyster fisheries and aquaculture.

The bauplan of muricid anatomy is best illustrated in Fretter (1941, 1946), Fretter & Graham (1994), Kool (1993), and Middelfart (1993a,c). The radula is one of the most used anatomical character in identification at the species, genera and subfamily levels. The diagnostic anatomical traits of subfamilies were given by Radwin & D'Attilio (1976), Kool (1993), and Vokes (1964).

The sexes of the muricids are separate and all species deposit egg capsules on hard substrates. The egg capsules are as far as we know diagnostic of the various species and genera (see D'Asaro 1991; Middelfart 1996). One exception is the egg capsules of coralliophilines that are non-specific (Bandel 1976), probably due to the lack of a ventral pedal gland used for moulding egg capsules. Furthermore, the egg capsules of these species are held in the mantle cavity during ripening (brooding).

Several modes of development exist. The planktotrophic mode of development involves a free swimming larval phase, usually of a long duration. The lecithotrophic development also involves a free larval phase, but this phase is short and the larvae do not feed. The last mode of development is the intracapsular metamorphosing type, where the whole larval phase is contained in the egg capsules. The lecithotrophic and intracapsular metamorphosing mode of development might involve nurse egg feeding in the embryonic stage.

The modes of development may be inferred

from the shape of the protoconch. A high conical protoconch with many whorls, more than 2-2.5, and a terminal varix (sinusigera larvae) is usually referred to as planktotrophic. A paucispiral, globose protoconch with less than 2.5 whorls and a thick non-sinusigeral terminal varix is usually referred to the intracapsular metamorphosing type. Protoconchs with intermediate characters may be referred to the lecithotrophic type. The inference of mode of development may in some instances be useful in species distinction and in zoogeography (*e.g.*, Shuto 1983; Ponder & Vokes 1988).

This study describes muricids encountered in the period 1992-1995 on various localities on the Andaman Sea side of Thailand. This material has been supplemented with species from the Phuket Marine Biological Centre Reference Collection.

The individual species are described and illustrated. References are given to literature on synonymy, anatomy, reproduction and local habitat of the individual species. At least one specimen of each species described herein is deposited in the Reference Collection.

#### MATERIALS AND METHODS

Muricid gastropods were collected from various localities on Koh Phuket, Koh Racha Yai, Koh Racha Noi, Koh Maiton, Koh Phi Phi, Koh Lipé (Koh Tarotao Marine Park) and artificial reefs near Koh Lanta. The localities were sampled by means of SCUBA-diving (down to 30 m), snorkelling, and field collection at low water spring tide.

On shores with clear water (west coast of Phuket Island, and all the mentioned islands) the collection sites covered rocky areas and coral reefs from high intertidal to 30 m, as well as gravel level bottoms at a few metres to 20 m. Areas with very turbid water like the eastern and northern side of Phuket Island was only covered in the tidal zone.

Some specimens were obtained from Mr. S. Patamakarthin and Mr. H. Russey, who employ local Sea Gypsies to collect molluscs in the local area (down to 60 m). These specimens were only used in this study if specimens were handed over to me alive. Several lots of muricids from the Reference Collection at Phuket Marine Biological Centre (PMBC) were included as well.

If I did not have specimens sampled alive or dead of a particular species, I used the Reference Collection specimens. However, quite a few specimens in the Reference Collection are gifts from shell dealers/shops with the label "Thailand" or "Phuket" and these have been disregarded altogether in this work.

A basic description is given for each species, except in situations where material had disappeared from the Reference Collection or where the species were in such a bad condition that description was impossible.

A synonymy has been given based on present revisions and faunal works. References are given to anatomical data, including radula characters, and reproductive data if available. Researchers interested in information on the radulae, anatomy or reproduction of the individual species will have to study the works referred to. Notes on habitats are given, where data allows.

Of each species one specimen is illustrated and catalogued in the Reference Collection with a PMBC number. The various species can be obtained on request to The Reference Collection, Phuket Marine Biological Centre, PO Box 60, Phuket 83000, Thailand.

My identifications have been verified or corrected by Mr. R. Houart, Belgium and Dr. K. S. Tan, Singapore, and have been compared with material in the Australian Museum Sydney.

Recommendation on subfamilial and generic assignment, as well as synonymy has generously been provided by Mr. R. Houart.

## TAXONOMIC ACCOUNT

## Muricinae

*Murex* Linné, 1758*Murex trapa* Röding, 1798  
Pl. 1 (1) (PMBC 11828)

## Synonyms from Ponder &amp; Vokes (1988):

- Purpura hystrix* Martini, 1777: 363 (in part), pl. 113, fig. 1056 (not binominal)
- Murex trapa* Röding, 1798: 145 (refers to Martini, 1777, pl. 113, figs 1055, 1056).
- Murex rarispina* Lamarck, 1822: 158 (for further explanation see Ponder & Vokes (1988))
- Murex unidentatus* Sowerby, 1834: pl. 66, fig. 52.
- Murex duplicatus* Pusch, 1837: 135, pl. 12, fig. 1a (refers to Martini, 1777: pl. 113, figs 1055, 1056. fig. 1056 is designated as a lectotype in Ponder & Vokes (1988))
- Murex martinianus* Reeve, 1845: pl. 18, fig. 72 (refers to Martini, 1777: pl. 113, fig. 1056).

**MATERIAL EXAMINED:** There is only one specimen of this species in the reference collection. North Phuket Island on beach (PMBC 11828).

**DESCRIPTION:** The examined specimen measured 62 mm (max. 115 mm, Ponder & Vokes 1988). The examined specimen had 6 teleoconch whorls. The protoconch had 2 and one half protoconch whorl, but parts of the tip was broken (three whorls in Ponder & Vokes (1988)). Two weak spiral cords on the first two whorls, and nine varices on the first whorls. Succeeding teleoconch whorls with three varices and increasing number of intervarical nodes. The suture is impressed with numerous lamellae. The body whorl has three varices with four intervarical axial nodes. The outer lip with a pronounced labial tooth. Three major spines on body whorls, and three spinelets. The two most anterior spinelets larger than the most posterior spinelet. Three spiral cords on the subsutural ramp. Three major spiral cords running into the two major spines on body whorl. Smaller spiral cords run into

spinelets. And yet smaller spiral cords in a variable number between these larger spiral cords. Inner lip, smooth and detached more than halfway. Siphonal canal with five spines and two spinelets. Colour cream.

**ANATOMY:** The alimentary canal and radula have been described by Ponder & Vokes (1988).

**REPRODUCTION:** Egg capsules and mode of development is described in D'Asaro (1991). Egg capsules with live embryos have been observed washed ashore in September.

**RECORDS:** Locally: Gulf of Thailand and Andaman Sea (Ponder & Vokes (1988)). Regionally: Madagascar to Ambon Indonesia (Ponder & Vokes 1988).

*Murex occa* Sowerby, 1834  
Pl. 1 (2) (PMBC 11826)

*Murex occa* G. B. Sowerby II, 1834: pl. 64, fig. 45 (in Ponder & Vokes 1988).

**MATERIAL EXAMINED:** Several specimens from Ao Nam Bor sand flat (East Phuket Island), nine of these are deposited in the PMBC reference collection together with the illustrated specimen (PMBC 11827).

**DESCRIPTION:** The largest shell measured 78 mm (max. 95 mm, Ponder & Vokes 1988), consisting of approx. 6 teleoconch whorls. Protoconch angulated with 2 and one half whorls. First teleoconch whorl with eight varices, succeeding whorls with nine varices, every third increasing in size. One strong spiral cord present on the shoulder. Body whorl with one to three weak intervarical nodes, and very weak and fine spiral cords. Terminal varix with three major spines, all pointing more or less apically. Up to two spinelets between shoulder and mid spines. One spinet between mid and anterior body spine. Outer lip with labial tooth. Inner lip adherent. Siphonal canal with up to five major spines, and one spinelet between the body whorl and siphonal canal and one spinelet between the two to three most posterior major spines. Colour whitish cream to brown.

**REPRODUCTION:** Egg capsules illustrated in Middelfart (1996). Inferred intracapsular metamorphosis from protoconch morphology and escape aperture size of egg capsules (Middelfart 1996).

**HABITAT:** This species can be found intertidal on sand flats, seawards of mangroves. It is not very abundant.

**RECORDS:** Locally: Phuket Island, Butang Group (Ponder & Vokes 1988), mud flats seaward of mangroves Andaman Sea (identified as *M. trapa*, Tantanasiriwong 1978). Regionally: The Andaman Islands to East Java (Ponder & Vokes 1988).

*Murex poppei* Houart, 1979  
Pl. 1 (3), PMBC 11829

*Murex (Murex) poppei* Houart, 1979: 141, text figs. 1, 2B, pl. 5, figs. 1, 1A, 2, 3.

**MATERIAL EXAMINED:** Several specimens from the intertidal zone on North Phuket and one specimen (PMBC 11829) from 15 metres depth near Koh Lanta, Krabi Province.

**DESCRIPTION:** Shell up to 123 mm (max. 130 mm, Ponder & Vokes 1988), consisting of six and to thirds of a whorl. Protoconch angular and axial ribbed, consisting of more than two whorls. First teleoconch whorl with nine varices, with two spiral cords. On the succeeding whorls every third varix becomes progressively stronger. Suture strongly impressed, and subsutural ramp with folds. Body whorl with five major spiral cords, three of them running into major spines. Axial ornamentation lacking. Fine lamellae present on body whorl. Fine spiral cords on subsutural ramp and between major spiral cords. terminal varix with three major spines, the two adapically pointing posteriorly. Spinelets between major spines quite large. Outer lip with strong labial tooth. Inner lip detached more than half way. Siphonal canal with up to eight spines, six to seven of them with spinelets between them. Colour cream to reddish brown.

**HABITAT:** Intertidal zone on the northern shores of Phuket Island, between small rocks

on mud. A single specimen was located at 15 metres depth on sandy mud near Koh Lanta (observation by Mr. M. Bech).

**RECORDS:** Locally: Phuket Island, Andaman sea (Ponder & Vokes 1988). Regionally: Burma to North Sumatra, Indonesia and Sabah, Malaysia (Ponder & Vokes 1988).

*Murex pecten* Lightfoot, 1786  
Pl. 1 (4) (PMBC 8621)

Synonyms from Ponder & Vokes (1988):

*Murex tribulus* var. *pecten* Lightfoot, 1786: 188 (No. 4001) (Based on Rumphius, 1705: pl. 26, fig. 3).

*Murex tribulus duplicatus* Chemnitz, 1795: 103, pl. 189, fig. 1821, pl. 190, fig. 1822 (not binominal).

*Murex histrix* Röding, 1798: 145 (No: 1820) (refers to Favanne, 1784, pl. 38, figs. A1, A2 and Knorr, 1757.72, pl. 20 [=27], fig. 1.

*Murex pecten* Montfort, 1810: 619, pl. 155.

*Aranea gracialis* Perry, 1810: pl. 47.

*Aranea tiremis* Perry, 1811: pl. 45, pl. 45, fig. 3.

*Haustellum nobile* Schumacher, 1817: 214.

*Murex ternispina* Lamarck, 1822: 158.

*Murex duplicatus* 'Chemnitz' Mörch, 1852: 98.

*Murex tribulus nobilior* 'Linné', Mörch, 1852: 98.

**MATERIAL EXAMINED:** One specimen from Pak Meng Beach, Trang Province (PMBC 8621).

**DESCRIPTION:** Shell 141 mm (max. 150 mm, Ponder & Vokes 1988), consisting of eight teleoconch whorls. Protoconch with more than two and one half whorl (Ponder & Vokes 1988). First teleoconch whorl with nine varices and three strong spiral cords and one adapical weak spiral cord. Suture impressed almost like a canal, with numerous folds. Body whorl with three varices and five very weak intervarical axial nodes. Spiral ornamentation consist of seven major cords running into major spines. Small cords run into spinelets and fine spiral cords run into tertiary spines or adhere to the outer lip. The body whorl surface is scabrous. Outer lip erect and crenulate. Anal sulcus wide. Inner lip detached three quarters of its length. Siphonal canal very long

ornamented with fifteen spiral cords that gets progressively smaller anteriorly. Fifteen major spines present, and fourteen spinelet projection in a ninety degree angle under the siphonal canal. Colour cream, spiral cords lighter than areas between cords. Outer lip with brownish mark on the edge.

ANATOMY: The penis and radula are illustrated in Ponder & Vokes (1988).

HABITAT: Observed near Koh Talibong on sandy bottom subtidally (pers. comm. Mr. M. Bech).

RECORDS: Locally: No previous records. Found in Burma, Andaman Islands, Straits of Malacca (Ponder & Vokes 1988). Regionally: East Africa to Fiji Islands (Ponder & Vokes 1988).

*Murex carbonnieri* (Jousseaume, 1881)  
Pl. 1 (5) PMBC 9591

*Acupurpura carbonnieri* Jousseaume, 1881: pl. 46, fig. 2 (in Ponder & Vokes 1988).

MATERIAL EXAMINED: Five specimens from Bang Ban Beach, Ranong (PMBC 9591).

DESCRIPTION: Shell up to 72 mm (max. 125 mm, Ponder & Vokes 1988), consisting of seven whorls. Protoconch with more than two whorls. First whorl with eight equal sized varices, with one spiral cord. Suture adpressed with numerous folds. Body whorl with three varices and three to four weak intervarical folds. Three major spiral cords run into major spines on the varices. Two minor spiral cords run into spinelets on the varices. Between these spiral cords are minor spiral treads. The surface sculpture is scabrous. The varix bears three major spines. Only the shoulder spine projects adapically. The outer lip is crenulate, erect, with an enlargement abapically, probably a labial tooth. The inner lip is slightly detached more than halfway to the anal sulcus. Anal sulcus wide but deep. Siphonal canal with five to six spines and up to three spinelets. Colour cream. Spiral ornamentation with brown dots where major and minor spiral cords meet the spaces between axial

folds. Outer lip with brown cords between dentation.

ANATOMY: The penis is illustrated in Ponder & Vokes (1988).

REPRODUCTION: Egg capsules and mode of development described in D'Asaro (1991). The egg capsules of *M. trapa* described in Natarajan (1957) are probably of *M. carbonnieri* (Ponder & Vokes 1988).

RECORDS: Locally: No previous records, but present on the Andaman Islands (Ponder & Vokes 1988). Regionally: East Africa, Red Sea, Persian Gulf to the Philippines (Ponder & Vokes 1988).

*Haustellum* Schumacher, 1817

*Haustellum dolichourus* Ponder & Vokes,  
1988  
Pl. 1 (6) PMBC 2583

*Haustellum dolichourus* Ponder & Vokes, 1988: fig. 89, I.

MATERIAL EXAMINED: East of Koh Similan, 80 m (1 specimen, PMBC 2583), west coast of Koh Phuket, 10 - 30 m (3 specimens, coll. Dr. J. Hylleberg).

DESCRIPTION: Shell up to 80 mm, consisting of seven whorls. Protoconch consists of three smooth whorls. First teleoconch whorl consists of nine to ten varices and three spiral cords. Every third varix start to develop a shoulder spine on the third teleoconch whorl. The suture is impressed with numerous small folds. Body whorl with three varices, two to three intervarical axial folds, and several major spiral cords with one to two spiral tread between them. One major shoulder spine present. Two to four spinelets present most anteriorly. Subsutural ramp with three to four cords and a few treads. Outer lip slightly crenulate, erect anteriorly. Seven denticles present inside outer lip. Aperture circular. Inner lip almost fully erect anteriorly. Anal sulcus almost absent. Siphonal canal long. Up to two small spine may be present on the posterior part of the siphonal canal. Colour cream. Spiral cords light to dark brown. Aperture white.

ANATOMY: The penis and radula are illus-

trated in Ponder & Vokes (1988).

**HABITAT:** Sandy bottom, 10 - 30 metres (pers. comm. Dr. J. Hylleberg).

**RECORDS:** Locally: 42 m, 43 km North north-east of Phuket Island, 72 m 88 km west of Ranong, dredged from sandy mud bottom at a depth of 80 metres (identified as *Murex kiiensis* Kira, 1959 (Tantanasiriwong 1978)). Regionally: Madagascar to Papua New Guinea (Ponder & Vokes (1988)).

*Chicoreus* Montfort, 1810

*Chicoreus ramosus* (Linné, 1758)

Pl. 2 (1) PMBC 11822

Synonyms from Houart, 1992:

*Murex ramosus* Linné, 1758: 747.

*Purpura incarnata* Röding, 1798: 142.

*Purpura fusiformis* Röding, 1798: 144.

*Murex inflatus* Lamarck, 1822: 160.

*Murex frondosus* Mörch, 1852: 97.

*Murex fortispinna* François, 1891: 240, fig. 241.

**MATERIAL EXAMINED:** Several lots in the PMBC reference collection. PMBC 11822 is here illustrated.

**DESCRIPTION:** Teleoconch up to 310 mm in length (Hylleberg & Nateewhatana 1992). Spire low with up to nine teleoconch whorls (Hylleberg & Nateewhatana 1992). The protoconch smooth with more than 2 whorls, and sinusigeral terminal varix. Body whorl bearing three varices, with 5 major foliaceous processes. Shoulder process short to very long, and always the longest of the 5 major processes. Intervarical nodes weak to strong. Spiral structures with major cords connecting major spines spirally, and minor treads connecting minor varical spinelets. Between these more spiral threads are present. Aperture large, circular with adherent or slightly erect smooth inner lip. Anal callus large, deep anal sulcus. Outer lip crenulate with thick labial tooth. Siphonal canal broad, narrowly open, dorsally bent with 2 to 3 processes. Shell white with brown spiral ornamentation. Outer lip and parts

of columella pink to orange.

**ANATOMY:** The anatomy of this species is described in Middelfart (1992c).

**REPRODUCTION:** Egg capsules can be found from May to February. They are most frequent in the beginning and end of the spawning season. The development and protoconch are described in Middelfart (1992). The larvae are planktotrophic in Thailand.

**HABITAT:** Shallow coral reefs and gravel bottom with abundant bivalve fauna (e.g., Chalong Bay, Koh Phuket (Jalk 1992)).

**REMARKS:** A more detailed description of the shell of *C. ramosus* is given in Hylleberg & Nateewhatana (1992).

**RECORDS:** Locally: Widely distributed in the Gulf of Thailand and the Andaman Sea (Chantrapornsyl & Nateewhatana 1992), on coral reefs at a depth of 5 metres (Tantanasiriwong 1978). Regionally: From East Africa and the Red Sea to French Polynesia (Houart 1992).

*Chicoreus brunneus* (Link, 1807)

Pl. 2 (2) PMBC 11819

Synonyms from Houart (1992):

*Purpura brunnea* Link, 1807: 121 (reference to Martini, 1777: figs. 990, 991, 993, 994).

*Murex vesicolor* Gmelin, 1791: 3530 (not *M. vesicolor* Gmelin, 1791: 3531).

*Triplex rubicunda* Perry, 1810: pl. 25.

*Triplex flavicunda* Perry, 1810: pl. 25; 1811, pl. 6, fig. 2.

*Murex adustus* Lamarck, 1822: 162.

*Murex erythrostomus* Dufo, 1840: 56.

*Purpura scabra* Mörch, 1852: 97.

*Murex australiensis* A. Adams, 1854: 72.

*Murex despectus* A. Adams, 1854: 72.

*Murex huttoniae* Wright, 1878: 85, pl. 9, figs. 1-2.

*Murex oligacanthus* Euthyme, 1889: 269, pl. 7, figs. 2-3.

**MATERIAL EXAMINED:** PMBC 8337, 8338, 8339, 8340, 8341 (69 specimens from Ao Chalong), PMBC 8336 (6 specimens from Koh Phi Phi).

**DESCRIPTION:** Maximum length recorded 90 mm, and eight teleoconch whorls. The protoconch consist of three smooth whorls.

First teleoconch whorl with nine varices. Second to fourth whorl with three varices and two intervarical nodes. The rest of the teleoconch with three varices and one intervarical node. The spiral sculpture consists of ten to eleven elevated major cords. Six of these cords run into major frondose spines on the body whorl while four run into the major spines on the siphonal canal. The cords are scabrous if not worn. The terminal varix bears six frondose spines, with intermediate spinelets. The outer lip is erect, crenulate, and lirate. The inner lip is detached anteriorly. The siphonal canal bears four rarely five spines. Shell colour black or dark brown. Columella lip white, yellow, red or light brown. Outer lip coloured as inner lip, but with brown cords between lirae.

**ANATOMY:** The anatomy is described in Middelfart (1993a).

**REPRODUCTION:** Spawning has been observed in the end of March. Egg capsules and larvae are described in Middelfart (1992). The descriptions of egg capsules and mode of development in D'Asaro (1991) and Risbec (1932) might be of another species (for discussion see Middelfart (1994)).

**HABITAT:** On dead coral in the intertidal zone outside PMBC and Koh Phi Phi, on rocks between four and ten metres with abundant oyster fauna on western Koh Racha Yai, and on level bottom in Ao Chalong.

**REMARKS:** A more detailed description of the teleoconch of *C. brunneus* is given in Middelfart (1993a).

**RECORDS:** Locally: Ao Chalong, Koh Phi Phi (Middelfart 1993a), Andaman Sea (Houart 1992), and on coral reefs between tide marks and down to a depth of eight metres (Tantanasiriwong 1978). Regionally: East Africa to Samoa (Houart 1992).

*Chicoreus torrefactus* (Sowerby, 1841)  
Pl. 2 (3 and 4) PMBC 11820 and 11821

Synonyms from Houart (1992):

*Murex torrefactus* Sowerby, 1841: pl. 199, fig. 120; 1841b: 141.

*Murex rubiginosus* Reeve, 1845: pl. 8, fig. 32.

*Murex affinis* Reeve, 1846: pl. 35, fig. 182 (not *M. affinis* Gmelin, 1791).

*Murex benedictinus* Löbbecke, 1879: 79.

*Murex rochebruni* Poirier, 1883: 57, pl. 5, fig. 1.

*Chicoreus (Chicoreus) kilburni* Houart & Pain, 1982: 51, pl. 3, figs. 1-4.

**MATERIAL EXAMINED:** Several lots from the Islands around Phuket Island (PMBC 8342 and 8348 (50 specimens), PMBC 8343 (10 specimens), PMBC 8344 (48 specimens) and PMBC 8345).

**DESCRIPTION:** Shell up to 126 mm with up to 10 teleoconch whorls. Protoconch smooth with more than 3 whorls. First teleoconch whorl with nine varices, second to seventh whorl with three varices and two intervarical nodes. The rest of the teleoconch with one intervarical node. Most specimens with an impressed suture. The spiral sculpture consists of elevated nodose cords in a variety of sizes. The most prominent cords run into the major spines. Each of the major spiral cords consist of one or more smaller side cords. The terminal varix usually bears five spines, with intermediate spinelets. The variation in the morphology of the terminal varix is described in Middelfart (1993b).

The anal sulcus is deep and broad. Inner lip only detached at the pseudoumbilicus. Small plicae can be present parietally. Siphonal canal can be long in delicate shells or short in more robust shells. Three to four spines present on the siphonal canal. Colour light to dark brown. Inner lip pale to deep orange. Outer lip white, brown or purple. Spines with tones of brown or purple.

**ANATOMY:** The radula is illustrated in Houart (1992).

**REPRODUCTION:** Spawning has been ob-



served in mid March. Egg capsules and larvae have been described by Middelfart (1992). The egg capsules described in D'Asaro (1991) and Cernohorsky (1966) might be of an other species (for discussion see Middelfart (1994)).

**HABITAT:** The species has been observed in the coral reefs on Koh Racha Yai and on gravel bottom in Ao Chalong. Specimens have been located by Sea Gypsies on 15-20 metres depth around Koh Maiton on what is believed to be gravel bottom.

**REMARKS:** For more information on shell variation see Middelfart (1993b).

**RECORDS:** Locally: Andaman Sea, Thailand (Houart 1992), Koh Maiton, Koh Lanta, Phuket Island (Middelfart 1993b), and dredged from sandy mud bottom at a depth of twenty six metres (identified as *Chicoreus saulii* (Sowerby, 1841) (Tantanasiriwong 1978). Regionally: Natal Southeast Africa to Fiji Islands (Houart 1992).

*Chicoreus banksii* (Sowerby, 1841)  
Pl. 2 (5) PMBC 10030

Synonyms from Houart (1992):

*Murex banksii* Sowerby, 1841: Pl. 191, fig. 82; 1841b: 140.

*Triplex cornucervi* Perry, 1811: pl. 7, fig. 4 (non *Purpura cornucervi* Röding, 1798).

*Murex crocatus* Reeve, 1845: pl. 33, fig. 168.

**MATERIAL EXAMINED:** Koh Maiton (3 specimens, 1 specimen labelled PMBC 10030), Koh Racha Yai, 15 m (1 specimen).

**DESCRIPTION:** Teleoconch up to 83 mm, consisting of about nine whorls. The protoconch consist of more than two whorls (Houart 1992). Early teleoconch whorls corroded away. Body whorl with three varices and one to two intervarical nodes. Numerous fine scabrous spiral cords present. Terminal varix with six densely arranged foliaceous spines. Small spinelets present between major spines. Outer lip crenulate and erect. Inner lip slightly to fully erect. Aper-

ture almost circular with a deep anal sulcus and prominent anal callus. Siphonal canal with three major spines and three minor spinelets. Colour light brown, with dark brown spiral cords. Spines dark brown.

**ANATOMY:** Radula illustrated in Houart (1992).

**HABITAT:** One specimen was found under a big *Porites* sp. coral at 15 metres depth on Koh Racha Yai. Three specimens were found at 20 metres depth, on gravel bottom, off Koh Maiton by Sea Gypsies.

**RECORDS:** Locally: No previous records. Regionally: East Africa to Fiji Islands (Houart 1992).

*Chicoreus palmarosae* (Lamarck, 1822)  
Pl. 2 (6) PMBC 11824

Synonyms from Houart (1992):

*Murex palmarosae* Lamarck, 1822: 161.

*Triplex rosaria* Perry, 1811: pl. 6, fig. 3.

*Triplex foliatus* Perry, 1810, pl. 23.

*Murex argyna* Mörch, 1852: 97.

**MATERIAL EXAMINED:** Koh Racha Yai, around 50 m (2 specimens, one labelled PMBC 11824).

**Description:** Teleoconch up to 111 mm (max. 130 mm, Houart 1992) consisting of nine and one half whorl. Protoconch consists of one and three fourths of a whorl (Houart 1992). First teleoconch whorl with nine varices and four spiral cords. Every third varix progressively becomes stronger after the first teleoconch whorl. Body whorl with numerous fine cords, all with tiny knobs or scabrous sculpture. Two to four intervarical axial folds present. Terminal varix with four foliaceous spines, the shoulder spine being the biggest. The outer lip is erect and crenulate. Lirae for at short distance into the aperture. Inner lip crenulated, and slightly detached from pseudoumbilicus almost to the anal notch. Siphonal canal long with three foliaceous spines. Colour light brown with dark brown spiral ornamentation. The edges of

the spines are light to dark pink. The inner an outer lip edge brown.

REPRODUCTION: Egg capsules and mode of development are described in D'Asaro (1991).

RECORDS: Locally: No previous records. Regionally: East Africa to the Solomon Islands (Houart 1992).

*Chicoreus capucinus* (Lamarck, 1822)  
Pl. 2 (7) PMBC 11823

Synonyms from Houart (1992):

- Murex capucinus* Lamarck, 1822: 164.  
*Murex quadrifrons* Lamarck, 1822: 170.  
*Murex castaneus* Sowerby, 1834: pl. 64, fig. 44.  
*Murex lignarius* A. Adams, 1853: 268.  
*Murex bituberculatus* Baker, 1891: 133, pl. 11, fig. 4.  
*Murex permaestus* Hedley, 1915: 745, pl. 85, fig. 91.

MATERIAL EXAMINED: Ao Nam Bor on mangrove roots (50 specimens, PMBC 10225, one specimen, PMBC 11823 illustrated herein).

DESCRIPTION: Teleoconch up to 58 mm (max. 124.3 mm, Houart 1992), consisting of more than eight whorls. Protoconch consist of about two smooth whorls. First whorls with nine detached varices with four spiral cords. Suture adpressed. Four spiral cords on the subsutural ramp, that increases in thickness anteriorly. Five major spiral cords present on the body whorl. Shell surface scabrous. Terminal varix elaborately lamellate near suture. The rest of the varix and siphonal canal without major spines. Several small spinelet projects from the varix. Outer lip bent, slightly erect and crenulate. Inner lip fully adherent. Anal sulcus broad and shallow. Siphonal canal without spines. Several spiral cords present, every second enlarged. Colour brown to black. Aperture bluish white to purplish brown. Outer lip with a brown edge. Inner lip light to dark brown.

ANATOMY: Radula see Houart (1992).

REPRODUCTION: Spawning has been observed from May to August. The egg capsules and mode of development is described

in Middelfart (1996).

HABITAT: The species can be found on mangrove roots around Phuket Island, especially in localities with abundant oysters.

RECORDS: Locally: On *Rhizophora apiculata* (Bl.) prop roots in mangrove forests (Tantanasiriwong 1978). Regionally: Singapore to Fiji Islands (Houart 1992).

*Naquetia* Jousseau, 1880

*Naquetia triqueter* (Born, 1778)  
Pl. 2 (8) PMBC 11825

Synonyms from Houart (1992):

- Murex triqueter* Born, 1778: 288 (reference to Martini, 1777: fig. 1038).  
*Purpura cancellata* Röding, 1798: 143.  
*Purpura variegata* Röding, 1798: 143.  
*Triplex flexuosus* Perry, 1811: pl. 7, fig. 1.  
*Murex trigonulus* Lamarck, 1816 (not 1822): pl. 417, fig. 4.  
*Murex roseotinctus* Sowerby, 1860: 429, pl. 49, fig. 6.

MATERIAL EXAMINED: Koh Racha Yai (1 specimen, PMBC 11825).

DESCRIPTION: Teleoconch 73 mm, with more than eight whorls (apex broken). Protoconch with more than three whorls (Houart 1992). Suture impressed. Body whorl three varices, two to three intervarical axial nodes, and eleven to twelve major spiral cord. Very weak spiral cords present between major spiral cords. Varices scabrous and more elaborate near the siphonal canal; this varix is different from the previous varices. It is more elaborate near the siphonal canal. The same kind of determinate growth can be found in *Strombus* species. The outer lip is erect and crenulate. The anal sulcus is narrow. Inner lip slightly erect. Siphonal canal with four major spiral cords and four major spines. Colour reddish brown with dark brown dots where spiral cords cross intervarical axial nodes. Varices dark brown. Aperture white.

ANATOMY: Radula illustrated in Houart (1992).

RECORDS: Locally: No previous records. Regionally: Christmas Islands to Tuamotu Islands (Houart 1992).

*Pteryarchia* Houart, 1995

*Pteryarchia tripterus* (Born, 1778)  
Pl. 2 (9) PMBC 11830

*Murex tripterus* Born, 1778: 287 (in Radwin & D'Attilio 1976).

**MATERIAL EXAMINED:** One specimen with a hermit crab from Koh Racha Yai, at 10 metres (PMBC 11830).  
**DESCRIPTION:** Shell 60 mm (max. 50 mm, Radwin & D'Attilio 1976), consisting of more than seven and one half whorl. Suture adpressed. Body whorl with three wing like varices and one intervarical node. Four to five major spiral cords present. Each of these spiral cords is composed of one larger central cord and one smaller cord on each side. Minor treads are present on the body whorl. Surface sculpture scabrous. Terminal varix with expansion in the shoulder region. Outer lip with sharp edge, and nine denticles just inside the outer lip. Aperture angled in the outer lip side. Inner lip slightly detached in the anterior end and crenulate. Anal sulcus almost indistinct. Siphonal canal with wing-like expansion, fused with the varix on the body whorl. Colour white, aperture rind faint yellow.

**REMARKS:** *P. tripterus* is now the type species of the new genera *Pteryarchia* Houart, 1995 (see Houart 1995b).

**RECORDS:** Locally: No previous records. Regionally: Indo-West Pacific (Radwin & D'Attilio 1976), and Red Sea to Queensland, Australia (Nicolay 1976).

*Pteryarchia bipinnatus* (Reeve, 1845)  
Pl. 2 (10) PMBC 11831

*Murex bipinnatus* Reeve, 1845: sp. 6 (in Radwin & D'Attilio 1976).

**MATERIAL EXAMINED:** One worn specimen with a hermit crab from Koh Racha Yai, 7-10 metres (PMBC 11831).

**DESCRIPTION:** Shell 32 mm (up to 55 mm, Radwin & D'Attilio 1976), consisting of more than six whorls. Suture adpressed. Body whorl with three varices, one weak intervarical node. About seven spiral cords present on the subsutural ramp, and about seven major cords anteriorly on the body whorl. Outer lip erect, with about six denticles inside the aperture. Inner lip slightly detached up to the parietal area. Siphonal canal long, with a small wing-like varix which is most elaborate anteriorly. Colour entirely white.

**RECORDS:** Locally: No previous records. Regionally: Indo-West Pacific (Radwin & D'Attilio 1976).

*Pterynotus* Swainson, 1833

*Pterynotus pinnatus* (Swainson, 1822)  
Pl. 2 (11) PMBC 2588

*Murex pinnatus* Swainson, 1822: 17 (in Radwin & D'Attilio 1976).

**MATERIAL EXAMINED:** Koh Tapao Noi (1 specimen, PMBC 2588).

**DESCRIPTION:** Shell 50 mm (max. 75 mm, Radwin & D'Attilio 1976) consisting of more than seven whorls. Suture adpressed. Body whorl with three wing-like varices, and one intervarical node. Several spiral cords present. Shell surface covered with fine axially arranged scabrous lamellae. Terminal varix expanded in the shoulder region. Outer lip erect and finely crenulate. Inner lip smooth and anal sulcus almost indistinct. Siphonal canal long with a wing-like varix more than half its length. The varix is fused with the varix on the body whorl. The siphonal canal is slightly bent. Colour entirely white.  
**RECORDS:** Locally. Dredged from gravel bottom at a depth of 30 m (identified as *Pterynotus alatus* (Röding, 1798), syn. of *P. pinnatus*, Tantanasiwong (1976)). Regionally: Western Pacific to Eastern Indian Ocean (Radwin & D'Attilio 1976).

*Attiliosa* Emerson, 1968*Attiliosa orri* (Cernohorsky, 1976)  
Pl. 2 (12) PMBC 2488

*Muricopsis orri* Cernohorsky, 1976: 116, figs. 12-20 (in Houart 1994).

**MATERIAL EXAMINED:** Koh Surin, Ranong (1 specimen, PMBC 2488).

**DESCRIPTION:** Shell 28 mm, with more than eight whorls. Suture adpressed. Body whorl with five varices and several minor spiral cords. Surface with axial lamellae. Terminal varix with four spines, the shoulder spine and the most anterior the longest. Outer lip erect and finely crenulate. Seven denticles present inside aperture. Inner lip detached in the parietal area. Two plicae present abapically. Anal sulcus wide. Siphonal short and bent. Colour cream, aperture white.

**RECORDS:** Locally: South of Andaman Islands, 55 m (Houart 1994), dredged from and mud bottom at 40 m (identified as *Muricopsis infans* (E.H. Smith, 1884) in Tantanasiwong (1976)).

## Ergalataxinae

*Ergalatax* Iredale, 1931*Ergalatax margaritica* (Broderip, 1833)  
Pl. 3 (1) PMBC 11832

Synonyms from Houart (1995a), a more extensive synonymy of the two subspecies *E. margaritica margaritica* and *Ergalatax margaritica crassulnata* (Hedley, 1915) is described in Cernohorsky (1982):

*Murex margaritica* Broderip, in Broderip & Sowerby, 1833: 177.

*Murex undatus* Dillwyn, 1817: 732 (not Gmelin, 1791), ref. to Chemnitz, v. 11, figs. 1851, 1852.

*Purpura lineolata* De Blainville, 1832: 206 (not Risso, 1826).

*Purpura squamosa* Deshayes, 1832: 427, pl. 2, figs 6-8 (not Lamarck, 1816).

*Purpura violacea* Lesson, 1842: 186.

**MATERIAL EXAMINED:** Ao Makkam, Koh Phuket (11 specimens, 1 specimen labelled PMBC 11832), Ban Saphan Noi, Gulf of Thailand, 5 m (7 specimens), PMBC reef flat (10 specimens), and the rocky shore of North Phuket (95 specimens).

**DESCRIPTION:** Shell up to 38 mm consisting of more than six whorls. Protoconch with more than two whorls. Suture adpressed. Body whorl with nine to twelve axial folds (nine in big specimens and twelve in small specimens). Surface sculpture elaborate scabrous. Spiral ornamentation with three major spiral cords and several minor cords on the body whorl. Outer lip crenulate with five to six denticles inside the aperture. Inner lip fully adherent with one to four denticles abapically on the columella. Anal sulcus may be narrow and deep, but in some specimens it is quite wide. Siphonal canal short and narrow. Colour black with or without white spiral cords. The first whorls of the shells most commonly have white spiral cords on the shoulder spiral cord. However, white spiral cords can also be found between the major spiral cords on the body whorl. The outer and inner lip light brown to purple. Denticles white.

**ANATOMY:** The radula of this species is sexually dimorphic (Fujioka 1984). The radulae are illustrated in Fujioka (1984), Fujioka (1985a) and Houart (1995a).

**REPRODUCTION:** Egg capsules have been observed in the end of May (Middelfart 1996). The mode of development is planktotrophic.

**HABITAT:** Very abundant in the intertidal zone, especially on muddy shores with rock boulders and rubble.

**RECORDS:** Locally: On coral rubble (Tantanasiwong 1976). Regionally: East Africa to French Polynesia (Houart 1995a).

*Ergalatax contracta* (Reeve, 1846)  
Pl. 3 (2) PMBC 11833

Synonyms from Houart (1995a):

- Buccinum contractum* Reeve, 1846a: pl. 8, fig. 53.  
*Murex calcareus* Dunker, 1860: 230.  
*Purpura Ricinula siderea* Martens, 1874: 95, pl. 5,  
fig. 49 (not of Reeve).  
*Urosalpinx innotabilis* Smith, 1879: 201, pl. 20, fig. 32.  
*Ocenebrina pilsbryana* Baker, 1891: 57.  
*Pentadactylus ceylonicum* Preston, 1909: 137, pl. 22, fig. 17.  
*Urosalpinx smithi* Schepman, 1911: 351, pl. 21, fig. 5.  
*Urosalpinx bandana* Schepman, 1911: 351, Pl. 21, fig. 6.

**MATERIAL EXAMINED:** The intertidal zone on North Phuket (2 specimens, 1 specimen labelled PMBC 11833, Laem Pan Wa, Koh Phuket (5 specimens, PMBC 2600, 7°39'50"N, 98°99'40"E, 15 metres depth on artificial reef (1 specimen), and Prachuap Khiri Khan, Gulf of Thailand (1 specimen).

**DESCRIPTION:** Shell up to 31 mm, consisting of more than seven teleoconch whorls. Protoconch smooth with more than three whorls. First teleoconch whorl with eight to ten varices and three spiral cords. Body whorl with eight axial folds and several approx. similar sized spiral cords. Surface sculpture scabrous. Outer lip erect with seven denticles inside the aperture. Inner lip fully adherent with three denticles abapically. Siphonal canal short and narrow. Colour light cream with white aperture.

**ANATOMY:** The radula is illustrated in Houart (1995a).

**REPRODUCTION:** Egg capsules described in Habe (1960) and Amio (1963).

**HABITAT:** On North Phuket it has been found at the water's edge at low water spring tide, on boulders and small stones. There are also records from deeper waters on artificial reefs, in sea grass beds, and in egg masses from *C. ramosus* collected from oyster reefs. The species was found to predate heavily on egg capsules of *Thais sacellum* (Gmelin, 1798) on artificial reefs.

**RECORDS:** Locally: On muddy bottom at a depth of eight metres (Tantanasiriwong 1976). Regionally: From East Africa to French Polynesia (Houart 1995a).

*Orania* Pallary, 1900

*Orania livida* (Reeve, 1846)  
Pl. 3 (3) PMBC 11834

Synonyms compiled from Tan (1995):

- Buccinum lividum* Reeve, 1846: sp. 87, pl. 11, fig. 87.  
*Buccinum bimucronatum* Reeve, 1846: sp. 88, pl. 11, fig. 88.  
*Ricinula carbonaria* Reeve, 1846: sp. 22, pl. 4, fig. 22. (?).  
*Sistrum alfredensis* Bartsch, 1915: p. 60-61.  
*Drupa schroederi* Wissema, 1947: p. 204, pl. 6, figs. 151, 152.

**MATERIAL EXAMINED:** North Phuket intertidal on rocks (140 specimens), North Phuket on one rock on sand flat (71 specimens), North Phuket on rocks (1 specimen, PMBC 11834), and Ao Nam Bor on mangrove roots (14 specimens).

**DESCRIPTION:** Teleoconch up to 24 mm (max. 35 mm, Radwin & D'Attilio 1976), consisting of approx. six whorls. Protoconch with about two whorls. First teleoconch with nine varices and one centred spiral cord. Suture adpressed. Body whorl with six to eight varices and four to six major spiral cords. A highly variable number of minor spiral cords present between major spiral cords (0 to 4). Subsutural ramp with fine spiral treads. Surface sculpture scabrous. Outer lip finely crenulate, with five to seven denticles inside aperture. Inner lip fully adherent and smooth. Anal sulcus shallow and narrow. Siphonal canal short, quite open, and with a variable number of spiral cords. Shell dark brown, aperture brown to purplish brown.

**ANATOMY:** The radula is a *Orania* type (pers. comm. Mr. R. Houart) (for *Orania* type radula see Houart 1995a)

**REPRODUCTION:** Egg capsules have been located on the northern shores of Koh

Phuket in July or August. This species has intracapsular metamorphosis.

**HABITAT:** Intertidal zone on North Phuket, and on mangrove roots in Ao Nam Bor, Koh Phuket.

**RECORDS:** Locally: No previous records. Regionally: Only known from the Philippines (Radwin & D'Attilio 1976).

*Lataxiena* Jousseaume, 1883

*Lataxiena blosvillei* (Deshayes, 1832)  
Pl. 3 (4) PMBC 11800

Synonyms from Tan (1995):

*Fusus blosvillei* Deshayes 1832: p. 155.

*Fusus lividus* Philippi, 1847: *Fusus*, sp. 6. pl. 2. fig. 8.

*Fusus heptagonalis* Reeve, 1847: *Fusus*, sp. 26. pl. 7. fig. 26.

*Fusus pachyraphe* Smith, 1880: p. 205, pl. 20. figs. 37, 37a.

*Bedevea pensa* Iredale, 1940: p. 434-435, pl. 32, fig. 4.

**MATERIAL EXAMINED:** North Phuket on boulders and small stones at low water spring tide (37 specimens, including PMBC 11800) and Phuket Bay (1 specimen).

**DESCRIPTION:** Teleoconch up to 46 mm (50 mm, Radwin & D'Attilio 1976), consisting of more than eight whorls. Protoconch smooth with sinusigeral terminal varix and of about three whorls. First teleoconch whorl with eleven to twelve varices and two spiral cords. Suture adpressed, undulating, and with axial lamellae. Body whorl with eight to nine axial folds and minor spiral treads on the subsutural ramp. In some specimens a major cord is present on the subsutural ramp. Between this major cord and the next major spiral cord usually three minor spiral cords present. Between the second and third major spiral cord usually three minor spiral cords present. From the third major spiral cord on the body whorl to the last major spiral cord on the siphonal canal one minor tread is usually present between major spiral cords. Surface sculpture elaborately scab-

rous. Outer lip crenulate with six to ten denticles inside aperture. Inner lip fully adherent and smooth. Siphonal canal short and narrowly opened. Colour from fully cream, to light brown. In light brown specimens some of the spiral cords are dark brown, and has brown cords running into the aperture between denticles.

**REPRODUCTION:** Oviposition has been observed in October in the laboratory at PMBC. The mode of development is planktotrophic.

**HABITAT:** On North Phuket between boulders and stones with abundant growth of oyster spat and barnacles.

**RECORDS:** Locally: Malayan peninsula (Tan 1995). Regionally: Philippines to Queensland, Australia (Radwin & D'Attilio 1976).

*Maculotriron* Dall, 1904

*Maculotriron serriale* (Deshayes, 1834)  
Pl. 3 (5) PMBC 2492

Synonymy from Houart (1995a):

*Buccinum serriale* Deshayes in Laborde & Linant, 1834: 66, figs. 32-34.

*Buccinum pulicaris* Lesson, 1842a: 238.

*Columbella pulicaris* Lesson, 1842b: 200.

*Triton bracteatus* Hinds, 1844: 11, pl. 4, figs. 5, 6.

*Colombella epidelia* Duclos in Chenu, 1848: pl. 25, figs. 17, 18.

*Tritonidea petterdi* Brazier, 1872: 22.

*Clathurella waterhousae* Brazier, 1896: 345.

**MATERIAL EXAMINED:** Reef flat, Nai Yang, Koh Phuket (2 specimens, PMBC 2492, largest specimen illustrated).

**DESCRIPTION:** Largest shell 13 mm, consisting of five whorls. Protoconch with three and one half smooth whorls. First teleoconch whorl with twelve varices, and three spiral cords. A fourth small tread initiates after approx. half of the first teleoconch whorl. Suture adpressed, undulating and with axial lamellae. Body whorl with fourteen axial folds

and alternating minor and major cords (1:1). Outer lip crenulate, with six denticles inside the aperture. Inner lip fully adherent with two denticles abapically. Siphonal canal short, narrow, with four spiral major cords. Colour cream. First, fifth, sixth and ninth major spiral cord brown where it crosses the axial folds. The three most anterior major cords on the siphonal canal are dark brown where the cross axial folds. Some of the surface pigmentation can be seen on the outer lip and through the shell from the inside of the aperture.

**ANATOMY:** The radula is illustrated in Fujioka (1985a).

**RECORDS:** Locally: Littoral, on coral rubble (Tantanasiriwong 1976). Regionally: East Africa to Hawaiian Archipelago (Houart 1995a).

*Muricodrupa* Iredale, 1918

*Muricodrupa fiscella* (Gmelin, 1791)

Pl. 3 (6) PMBC 2484

Synonyms compiled from Houart (1995a) and Tan (1995), an even more extensive synonymy is described in Cernohorsky (1982):

*Murex fiscellum* Gmelin, 1791: 3552, ref. to Chemnitz (1788), figs. 1524, 1525 [Tan (1995) does not consider the figure in Chemnitz (1788) sufficient to determine species].

*Murex funiculus* Wood, 1828: 15, fig. 17 [type material lost (Cernohorsky, 1982a), lectotype selected and figured in Tan (1995); type locality: Philippines].

*Murex ricinuloides* Qouy & Gaimard, 1833: 534, pl. 36, figs. 13-16.

*Murex iostoma* Sowerby, 1834: pl. 64, fig. 42.

*Murex moriformis* Lesson, 1844: 538.

*Purpura pothuani* Eydoux & Souleyet, 1852: 605, pl. 39, figs. 30-31.

*Purpura muricoides* Hombron & Jacquinot in Rousseau, 1854: 87.

*Purpura stellaris* Hombron & Jacquinot in Rousseau, 1854: 88.

*Coralliophila confragosa* H. & A. Adams, 1865: 432.

*Sistrum triangulatum* Pease, 1868: 278, pl. 23, fig. 15.

**MATERIAL EXAMINED:** Laem Pan Wa, Koh Phuket (1 specimen, PMBC 2485), Nai Yang, Koh Phuket (2 specimens, largest specimen illustrated, PMBC 2584).

**DESCRIPTION:** Up to 18 mm, consisting of more than five teleoconch whorls. Protoconch consisting of two smooth whorls. First teleoconch whorl with eleven axial folds, and four spiral cords. Suture adpressed. Body whorl (including siphonal canal) with seven axial folds and four erect spiral cords groups. The spiral cords groups may consist of more than one major spiral cords. A deep depression (almost fenestrate pattern) is usually present between axial folds and spiral cord groups. Surface sculpture elaborately scabrous. Outer lip finely crenulate and with six denticles inside the aperture. Siphonal canal narrow and short. Colour whitish, with brown patches between spiral and axial ornamentation. Aperture slightly purple.

**ANATOMY:** Radula illustrated in Houart (1995a).

**HABITAT:** Coral rubble in the intertidal zone.

**RECORDS:** Locally: Littoral on coral rubble (Tantanasiriwong 1976). Regionally: South Africa, Red Sea to Hawaiian Archipelago (Houart 1995a).

Rapaninae

*Mancinella* Link, 1807

*Mancinella alouina* (Röding, 1798)

Pl. 3 (7) PMBC 11836

Synonyms from Tan (1995):

*Volema alouina* Bolten in Röding, 1798: p. 58, sp. 728 (refers to Martini (1777), 3: pl. 101, figs. 967, 968).

*Murex mancinella* Linnaeus, 1758: p. 3538, no. 47; Dillwyn, 1817: p. 707; Hanley, 1855 (p. 295-296) (nomen dubium).

*Volema glacialis* Bolten in Röding, 1798: p. 58, sp. 729 (refers to Martini (1777), 3: pl. 101, figs. 967, 968).

*Purpura gemmulata* Lamarck, 1816: pl. 397, figs 3.a, b.  
*Purpura mamorata* Pease, 1865: p. 515.

**MATERIAL EXAMINED:** Five metres, Siam Bay, Koh Racha Yai (84 specimens, 1 specimen, PMBC 11834), 2 metres, Koh Maiton (1 specimen).

**DESCRIPTION:** Shell up to 46 mm, consisting of more than five whorls. Suture adpressed. Body whorl consisting of six to eight prosocline nodose folds. Each fold bears four nodes. An additional node may be present adapically and abapically. The adapical node is created by the anal canal and the abapical node is created by the siphonal canal. Shell surface with fine cords equally spaced. Outer lip slightly crenulate with ten to sixteen lirae running into the aperture. Inner lip fully adherent and smooth. Siphonal canal narrow and short. Colour cream yellow. Nodes with a ring of reddish brown around the tip of the nodes. Aperture yellow. Lirae reddish.

**ANATOMY:** The radula is described and illustrated in Arakawa (1962).

**HABITAT:** The species has been found subtidally to a depth of 5 m on Koh Racha Yai. Most abundant on exposed rocks.

**RECORDS:** Locally: On rocks around low water mark (*Mancinella mancinella* (Linnaeus, 1758), Tantanasiwong (1976). Regionally: Oman (Bosch & Bosch 1989) to French Polynesia (Tröndle & Houart 1992).

*Mancinella echinulata* (Lamarck, 1822)  
 Pl. 3 (8) PMBC 11837

**MATERIAL EXAMINED:** 1 to 5 m, Koh Racha Yai (13 specimens, 1 specimen labelled PMBC 11837), 2 m, Koh Maiton (1 specimen).

**DESCRIPTION:** Shell up to 46 mm, consisting of more than five whorls. Suture adpressed and undulating. Body whorl with seven to eight prosocline folds. Each fold bears three to six nodes on each fold (usually four). One node created by the anal canal, and one node created by the siphonal canal may be present on each fold. Shell surface scabrous. Outer lip slightly crenulate, with seven to ten lirae inside the

aperture (usually eight). Inner lip fully adherent. Siphonal canal short and narrow. Colour cream yellow. Aperture white inside with a rich yellow rim fully surrounding it. **ANATOMY:** Sexually dimorphism in radula is present in this species (Fujioka 1985b). The radula is also illustrated in Arakawa (1958).

**HABITAT:** On Koh Racha Yai and Koh Maiton the species can be found mixed with its sibling *M. alouina*.

**RECORDS:** Locally: On rocks around low water mark (Tantanasiwong 1978). Regionally: From Natal, South Africa (Kilburn & Rippey 1982) to Indonesia (Dharma 1988).

*Mancinella echinata* (Blainville, 1832)  
 Pl. 3 (9) PMBC 11812

*Purpura echinata* Blainville, 1832: p. 222, sp. no. 44, pl. 11, fig. 2 (in Tan 1995).

**MATERIAL EXAMINED:** Five metres, Koh Talu, Ban Saphan Noi, Gulf of Thailand (4 specimens, one labelled PMBC 11812), PMBC reef flat (one specimen).

**DESCRIPTION:** Shell up to 55 mm, consisting of more than six whorls. Suture adpressed and undulating. Body whorl with numerous fine spiral cords and nine to twelve prosocline folds bearing four nodes each. Shell surface scabrous. Outer lip erect and slight crenulate. Thirteen to sixteen lirae inside the aperture. Pseudoumbilicus placed high. Inner lip fully adherent from pseudoumbilicus to anal sulcus. Anal sulcus wide. Siphonal canal short and narrow. Shell colour light brown, if not worn. Aperture entirely white.

**ANATOMY:** Radula described in Arakawa (1962).

**REPRODUCTION:** Oviposition has been observed in the laboratory at PMBC in September. Mode of development planktotrophic.

**HABITAT:** On dead *Porites* sp. corals.

**RECORDS:** Locally: On coral rocks around low water mark (Tantanasiwong 1976). Regionally: From India (Subba Rao &



Surya Rao 1993) to Queensland, Australia (Wilson 1994).

*Mancinella tuberosa* (Röding, 1798)  
Pl. 3 (10) PMBC 11809

Synonyms from Tröndle & Houart (1992):

*Galeodes tuberosa* Röding, 1798: 53.

*Purpura pica* Blainville, 1832: 213, pl. 9, fig. 9.

**MATERIAL EXAMINED:** Three to five metres, Koh Racha Yai, Siam Bay (19 specimens, one labelled PMBC 11809).

**DESCRIPTION:** Shell up to 50 mm, consisting of more than four whorls. Suture adpressed, hardly visible, and undulating. Body whorl with six to seven prosocline folds bearing two to three nodes. The shoulder node is the largest. Several fine spiral cords on the entire body whorl. Outer lip with small denticles, and fifteen to seventeen lirae inside the aperture. Inner lip fully adherent. Anal sulcus small and narrow. Colour whitish, with dark brown on the axial folds. Some specimens have a white shell layer on the nodes. Outer lip with a dark brown rim between the shoulder node and the anal sulcus, between the consecutive anterior nodes and the most anterior node and the siphonal canal. Inner lip with one reddish brown area parietal, and one small area near the siphonal canal. A small dot of reddish brown may be present on the left side of the siphonal canal.

**ANATOMY:** Radula illustrated in Arakawa (1962).

**REPRODUCTION:** Oviposition was observed in the lab. on PMBC in September. Mode of development planktotrophic.

**HABITAT:** The specimens described herein were found in crevices on the rocky shores of Koh Racha Yai, at three to five metres depth.

**RECORDS:** Locally: No previous records. Regionally: India (Subba Rao & Surya Rao 1993) to French Polynesia (Tröndle & Houart 1992).

*Mancinella virgatus* (Dillwyn, 1817)  
Pl. 3 (11) PMBC 11838

Synonyms (pers. comm. R. Houart and Tröndle & Houart (1992):

*Murex virgatus* Dillwyn, 1817: 732 (new name for *plicatus* Gmelin, 1791, not Lightfoot, 1786).

*Murex plicatus* Gmelin, 1791: 3551, ref. to Chemnitz, figs. 1141, 1142 (not *M. plicatus* Lightfoot, 1786).

*Purpura aculeata* Deshayes & Milne-Edwards, 1844: 104.

*Purpura distinguenda* Dunker, in Dunker & Zelebor, 1866: 910, pl. 1, fig. 3.

*Murex hippocastanum* Linnaeus, 1758: 751, sp. 471.

*Purpura pseudohippocastanum* Dautzenberg, 1929: 229.

**MATERIAL EXAMINED:** Intertidal on rocks, south of PMBC (16 specimens), intertidal rocks Racha Yai (20 specimens, 1 labelled PMBC 11838).

**DESCRIPTION:** Shell up to 38 mm, consisting of more than five whorls. Suture adpressed and undulating. Body whorl with eight prosocline folds bearing four nodes. The shoulder node is the largest. Fine spiral cords on the entire body whorl, but most are clear between nodes. Outer lip erect and crenulate. Five denticles present inside the aperture, all running into lirae. The three central denticles are the largest. Inner lip fully adherent with one weak plicae (white band crossing columella). Anal sulcus narrow. Siphonal canal short and narrow. Shell colour dark brown. Areas between axial folds white. Spiral cords white. Outer lip with a purple to black rim. Denticles white with purple lirae. Inner lip purple with a white oblique band centrally.

**ANATOMY:** The radula is described and illustrated in Arakawa (1962) and Fujioka (1985a).

**REPRODUCTION:** Egg capsules have been observed *in situ* on the intertidal rocks south of PMBC in August. The mode of development is planktotrophic.

**HABITAT:** Intertidal rocky shores with abundant oysters.

**RECORDS:** Locally: On rocky shores (identified as *Thais hippocastanum* (L. 1758) (Tantanasiriwong 1976)). Regionally: Oman

(ident. as *Thais savignyi* Deshayes, 1844, in Bosch & Bosch (1989)) to French Polynesia (*M. aculeata* in Tröndle & Houart (1992)).

*Mancinella intermedia* (Kiener, 1836)  
Pl. 3 (12) PMBC 2585

*Purpura intermedia* Kiener, 1835: 51, pl. 12, fig. 34 (in Tröndle & Houart 1992).

**MATERIAL EXAMINED:** Koh Racha Yai (1 specimen, PMBC 2585).

**DESCRIPTION:** Shell 28 mm, consisting of more than five whorls. Suture adpressed. Body whorl with six prosocline folds, each with two strong nodes and one anterior weak node. Four major spiral cords present on the body whorl, crossing the nodes. Subsutural ramp with ten small spiral cords. ~~Between the shoulder nodes and the preceding node, ten spiral cords.~~ Five and seven spiral cords present between the two anterior major spiral cords respectively. Outer lip crenulate with five denticles inside the aperture. Inner lip fully adherent, with two small plicae on the central part of the lip. Anal callus present, anal sulcus quite narrow. Siphonal canal short and deep. Shell colour dark brown on axial folds. A white patch is present succeeding a node, in respect to the growth direction. Four dots of brown present on the outer lip. Inner lip light brown, plicae white.

**ANATOMY:** The radula is described and illustrated in Arakawa (1962) and Fujioka (1985a).

**RECORDS:** Locally: On rocky shores (Tantanasiriwong 1978). Regionally: India (Subba Rao & Surya Rao 1993) to French Polynesia (Tröndle & Houart 1992).

*Thais Röding, 1798*

*Thais rufotincta* Tan, 1996  
Pl. 3 (13) PMBC 11840

*Thais rufotincta* Tan & Sigurdson, 1996a: 85-93, figs. 5-7, pl. 2 (a-p), pl. 3 (a-f).

**MATERIAL EXAMINED:** North Phuket, on small stones around low water spring tide (85 specimens, 1 pink labelled PMBC 11840 and 1 grey labelled

PMBC 11839), on rocks North Phuket (11 specimens), on rocks in Ao Nam Bor, Koh Phuket (7 specimens), and on poles for fish traps in Ao Nam Bor, Koh Phuket (10 specimens).

**DESCRIPTION:** Shell up to 34 mm, consisting of more than seven teleoconch whorls. Protoconch with a short carina and about two and one half whorl (Middelfart 1996). The first couple of whorls with about twenty axial folds and a strong carina (compare *Thais javanica* (Philippi, 1848) which bears about twenty axial folds on about the first four whorls). Suture adherent and undulating. Body whorl with about eight prosocline folds. Folds may be more or less elevated with spines on the carina. These spines are not pointing upwards like in *T. javanica*. Numerous spiral cords present of a similar size. Shell surface slightly scabrous. Outer lip sharp and slightly crenulate. The area between denticles and outer lip edge is clearly tapering (this is not seen in *T. javanica*, where the shell is the same thickness almost to the outer lip edge). Seven to eight denticles that all run into lirae inside aperture. Inner lip fully adherent and smooth. Anal sulcus narrow, with a small anal callus. Siphonal canal short and narrowly opened laterally. Colour dark to pale brown or pinkish. Whitish, or lighter coloured between axial folds on and just anteriorly to the carina. Few anterior spiral cords with brown spots in the axial fold region. Aperture pale yellowish pink, pale yellow or blueish grey.

**ANATOMY:** The anatomical characters are diagnostic of the species Tan (1995): *T. rufotincta* compared with the siblings *T. malayensis*, *T. javanica*, and *T. rufotincta*, and Tan & Sigurdson (1996 a): *T. rufotincta*. **REPRODUCTION:** Egg capsules have been observed in April-May and October-November on Koh Phuket. Egg capsules and larvae are described in Middelfart (1996, referred to a *Thais tissoti* (Petit, 1852)). The egg capsules are diagnostic for this species, in relation to *T. malayensis* (Middelfart (1996) for *T. malayensis* (identified as *Thais* sp. A.)) and *T. javanica*. *Thais pinnangensis*

Tan, 1996a has egg capsules similar to *T. rufotincta*, but this species has not been found on Koh Phuket.

The larvae are distinct to those of *T. javanica*.

**HABITAT:** Shores where muddy water prevails, on hard substrates with barnacles, but not on mangrove trees.

**REMARKS:** Some shells of *T. malayensis* and *T. javanica* are incredibly similar to those of *T. rufotincta*, and they occur mostly in the same habitats. The soft part characteristics of *T. rufotincta* was studied by Tan & Sigurdson (1996 a), who provided much information on most rapanines of the Malayan Peninsula. Researchers interested in these species should keep track of publications of Dr. K. S. Tan, The National University of Singapore.

**RECORDS:** Locally: Andaman Sea and Gulf of Thailand, Thailand (Tan & Sigurdson 1996 a). Regionally: South India to East Kalimantan (Tan & Sigurdson 1996 a).

*Thais javanica* (Philippi, 1848)  
Pl. 3 (14) PMBC 11808

Synonyms from Tan (1995):

*Purpura javanica* Philippi, 1848: p. 27 (neotype designated by Tan (1995)).

?*Ocenebra bantamensis* Martin, 1906: p. 133, pl. 21, figs. 305, 306.

**MATERIAL EXAMINED:** North Phuket in mytilid beds at low water spring tide (10 specimens, 1 labelled PMBC 11808).

**DESCRIPTION:** Shell up to 32 mm, consisting of about seven whorls. Protoconch with a strong and long carina and about 3.3 whorls (Middelfart in prep.). The first three to four whorls with about twenty axial folds, with a strong carina. Suture adpressed and undulating. Body whorl with seven to eight prosocline folds, bearing one strong carina and one anteriorly spiral elevated cord. Spines are usually present on carina and anterior spiral cord, where they cross axial folds. The spines on the carina are pointing

adapically in most specimens, as opposed to those of *T. rufotincta* (see above). Shell surface with numerous spiral scabrous cords. Outer lip sharp and crenulate. Up to eleven denticles running into lirae inside outer lip. There may be up to four lirae between carinate area and anal sulcus (this has not been found in *T. rufotincta*). Inner lip fully adherent and smooth, and "see-through" parietally. Anal sulcus wide, anal callus very small. Siphonal canal short and laterally opened. Colour light to dark cream. Aperture creamish orange to blueish grey. Lirae may be dark brown.

**ANATOMY:** The anatomy is described in Tan (1995).

**REPRODUCTION:** Egg capsules have been observed in October-November in mytilid beds and on other small solid substrates on North Phuket. Egg capsules are illustrated in Middelfart (in prep.) and Tan (1995). The larvae and protoconch are morphological different from those of *T. rufotincta*.

**HABITAT:** At low water spring tide in mytilid beds and on other small objects near mytilid beds.

**REMARKS:** This species may be difficult to separate from *T. rufotincta* and *T. malayensis* (see remarks under *T. rufotincta*).

**RECORDS:** Locally: No previous records. Regionally: North West Australia (Wilson 1994) to the Malayan Peninsula (this study and Tan (1995)).

*Thais gradata* (Jonas, 1846)  
Pl. 4 (1) PMBC 11803

Synonyms from Tan (1995):

*Purpura gradata* Jonas, 1846: p. 14-15.

*Purpura trigona* Reeve, 1846: *Purpura*. sp. 53, pl. 11, fig. 53.

*Purpura grateloupiana* Petit, 1850: p. 402-403, pl. 13, fig. 1.

**MATERIAL EXAMINED:** North Phuket, intertidal on pipes to shrimp farms and other solid objects (145 specimens, 1 labelled PMBC 11803).

**DESCRIPTION:** Shell up to 41 mm, consisting of more than seven whorls. Suture adpressed, just under the penultimate ca-

rina. Body whorl with seven to ten folds each with one shoulder node. Large shells might lack the nodes on the body whorl. Subsutural ramp steep, with numerous fine spiral cords. Anterior to the carina, numerous alternating major and minor spiral cords. Outer lip erect and crenulate. Four denticles with proceeding lirae present inside aperture. On the outer lip in the subsutural ramp area, a pronounced indentation. Inner lip fully adherent and smooth. Anal sulcus narrow and deep. Siphonal canal short and deep. Subsutural ramp brown in a star pattern, exceeding to the nodes on the shoulder. Each axial fold brown. Each major spiral cord anterior to the shoulder region with a dotted pattern of brown. These dots do not necessarily follow the axial folds. Aperture cream, lirae brownish.

**ANATOMY:** The radula is described and illustrated in Fujioka (1985a).

**REPRODUCTION:** Oviposition has been observed in September-October on North Phuket. Egg capsules from Singapore are illustrated in Tan (1995).

**HABITAT:** Shores with muddy water, in the mid intertidal zone on hard substrates with abundant growth of acorn barnacles.

**RECORDS:** Locally: No previous records. Regionally. From the Malayan Peninsula (Lim 1963, Tan 1995) to North Australia (Wilson 1994).

*Thais malayensis* Tan, 1996  
Pl. 4 (2) PMBC 10257

*Thais malayensis* Tan, 1996b.

**MATERIAL EXAMINED:** Surat Thani Coastal Aquaculture Centre, Gulf of Thailand (2 specimens PMBC 10257, 1 cleaned specimen is illustrated here).

**DESCRIPTION:** Largest specimen 32 mm, consisting of more than seven whorls. First whorls with a strong carina with numerous spines that are almost fused. Suture adpressed and weakly undulating. Body whorl with ten axial weak folds. The spines on the body whorl are not elaborate compared to the earlier whorls where spines are pointing

adapically. Numerous scabrous spiral cords present on the body whorl. Outer lip sharp and crenulate. The outer lip is undeveloped in both specimens, and no denticle arrangement can be identified. Inner lip fully adherent and smooth. Anal sulcus wide, anal callus present. Siphonal canal short and laterally opened. Colour cream with brown axial bands. Inner lip creamish orange. Outer lip probably (undeveloped outer lip) with brownish lirae. **ANATOMY:** The anatomy is described in Tan (1995).

**REPRODUCTION:** Egg capsules illustrated in Thorson (1940, from Penang, Malaysia), Tan (1995, from Singapore) and Middelfart (1996, from the Gulf of Thailand). A few egg capsules from Ao Pang Nga, around Krabi, are illustrated together with the egg capsules of *Thais lacera* (Born, 1778) in Middelfart (1996). Thus, the species is occurring on the Andaman Sea side of Thailand, even though there are no specimens from this area in the PMBC reference collection.

**HABITAT:** A natural habitat is not known from Thailand.

**RECORDS:** Locally: Malayan Peninsula (Tan 1995), Surat Thani Coastal Aquaculture Centre, Gulf of Thailand, on oyster poles (*Thais* sp. A. in Middelfart (1996)). Regionally: Malayan Peninsula (Tan 1995).

*Thais bitubercularis* (Lamarck, 1822)  
Pl. 4 (3) PMBC 11841

Synonyms from Tan (1995):

*Purpura bitubercularis* Lamarck, 1822: p. 237, no. 8;  
refers to Seba, 1758: pl. 52, figs. 22, 23.

*Purpura undata* Lamarck, 1822: p. 238, no. 10.

*Purpura kienerii* Deshayes, 1844a: p. 101-102, sp. 66.

**MATERIAL EXAMINED:** Ao Nam Bor, on rocks (8 specimens, PMBC 10236), North Phuket, with hermit crabs (15 specimens), and North Phuket, intertidal on rocks (27 specimens, 1 labelled PMBC 11841).

**DESCRIPTION:** Shell up to 54 mm, consisting of about six whorls. Suture adpressed, and undulating. Body whorl with seven to nine axial oblique folds. Each fold bears two

nodes. The nodes are of a variable size, depending on the population. The nodes are usually the same size in a given habitat. Two spiral cords, with weak nodes are present anteriorly to the major nodes. Numerous fine spiral cords present. The shell surface is finely scabrous. Outer lip sharp and crenulate. Four to five denticles present inside the aperture. Inner lip fully adherent and smooth. Siphonal canal short and deep. Colour dark brown on axial folds. Between folds cream colour. The dark brown colour is spread out anteriorly on some shells. The colour of the aperture is cream.

**REPRODUCTION:** Oviposition has been observed in the end of May in the laboratory at PMBC (*T. kieneri*, Middelfart (1996)), and on rocks on North Phuket in the beginning of October.

**HABITAT:** Intertidal on rocks and other hard substrates, in areas with muddy water.

**RECORDS:** Locally: On rocky shores (Tantanasiriwong 1976). Regionally: Thailand (Tantanasiriwong 1976) to Queensland, Australia (Wilson 1994).

*Thais lacera* (Born, 1778)  
Pl. 4 (4) PMBC 11842

Synonymy from Mienis (1985):

*Murex lacerus* Born, 1778: 307.

*Mancinella mutabilis* Link, 1807: p. 115.

*Purpura carinifera* Lamarck, 1822: p. 241, no. 19.

**MATERIAL EXAMINED:** North Phuket at waters edge at low water spring tide, in patches of mytilids (47 specimens, 1 labelled PMBC 11842), Krabi Fish market (4 specimens, 2 labelled 10262).

**DESCRIPTION:** Shell up to 54 mm, consisting of more than six whorls. Protoconch with an elaborate carina, sinusigera character and three whorls. Early whorls generally with one elaborate carina, with numerous nodes. Suture generally adpressed on early whorls (impressed if two spiral cord can be seen). On older whorls the suture becomes more and more impressed, finally detached on approx.

the last quarter to three quarter of the body whorl. The body whorl bears one to two spiral ridges. The anterior is the strongest and in most specimens this is the only one present. The prominent spiral ridge bears eight spines. The shell surface is covered in numerous fine spiral cords from the subsutural ramp to the siphonal canal. The outer lip is elaborate crenulate, with a strong incision where the spiral ridge (ridges) and the anal sulcus are located. Inner lip only attached parietally. Anal sulcus located on outer lip. Anal callus present. Siphonal canal short and deep. Colour cream, with darker under tones in some young shells. Aperture colour varies from entirely white to orange.

**ANATOMY:** Radulae illustrated in Thorson (1940, as the radula of *Thais carinifera* (Lam.)).

**REPRODUCTION:** Egg capsules have been observed in July (Middelfart 1996) and October. Egg capsules are described in Middelfart (1996).

**HABITAT:** This species can be found at low water spring tide in mussel beds on North Phuket.

**RECORDS:** Locally: Sublittoral, 8 to 10 metres (Tantanasiriwong 1976). Regionally: The Eastern Mediterranean (Barash & Dakin 1977, Mienis 1985) to the central part of Indonesia (Dharma 1988).

*Thais sacellum* (Gmelin, 1791)  
Pl. 4 (5) PMBC 10241

Synonymy from Tan (1995):

*Murex rugosus* Born, 1780: p. 305 (in part), p. 9, figs. 6, 7 (not Martini, 1777: pl. 124, figs. 1155, 1156).

*Murex sacellum* Gmelin 1791: p. 3530, sp. 164 (refers to Chemnitz, 1788, vol. 10, p. 267, pl. 163, figs. 1561, 1562).

**MATERIAL EXAMINED:** 7°39'50"N, 98°99'40"E at 15 m on artificial reef (4 specimens, 1 specimen labelled PMBC 10241), North Phuket at waters edge at low water spring tide on rocks (1 specimen).

**DESCRIPTION:** Shell up to 43 mm consisting of more than six and one half whorl.

Early whorls with one prominent spinose carina. Suture adpressed. Body whorl with two to four spiral ridges. The carina is the most prominent. The spiral ridge anterior to the carina is less prominent and equals the size of the most anterior spiral ridge in specimens with an elaborate anterior spiral ridge. The ridges bears ten to twelve spines on the body whorl. The shell surface is covered with numerous spiral cords from the subsutural ramp to the siphonal canal. The outer lip crenulate with a variable number (four to twelve) of striae running into the aperture. Inner lip fully adherent. Anal sulcus open, with a small anal callus. Siphonal canal short and deep. Colour light brown, with dark brown axial cords crossing the spiral ridges where they bear spines. The dark brown coloration is spread out on the subsutural ramp. The aperture is entirely white.

**REPRODUCTION:** Egg capsules with embryos have been observed in mid December. The egg capsules are illustrated in Middelfart (1996).

**HABITAT:** One specimen was found on rocks covered by acorn barnacles and oysters at low water spring tide on North Phuket. Several specimens have been observed on artificial reefs at 12-15 metres depth near Koh Lanta.

**RECORDS:** Locally: No previous records. Regionally: India (Subba Rao & Surya Rao 1993) to Java, Indonesia (Dharma 1988).

*Thais armigera* (Link, 1807)

Synonymy from Tröndle & Houart (1992):

*Mancinella armigera* Link, 1807: 115.

*Purpura affinis* Reeve, 1846b: pl. 13, fig. 77.

**MATERIAL EXAMINED:** The specimen illustrated in Tantanasiwong (1976) could not be localised in the PMBC Reference Collection.

**ANATOMY:** Radula described by Arakawa (1962).

**RECORDS:** Locally: Andaman Sea, on boulders exposed to strong currents (Tantanasiwong 1976). Regionally: India (Subba Rao & Surya Rao 1993) to French Polynesia (Houart 1992).

*Semiricinula* von Martens, 1903

*Semiricinula marginatra* (Blainville, 1832)

Pl. 4 (6) PMBC 11853

Synonymy from Tan (1995) and Cernohorsky (1986):

*Purpura marginatra* Blainville, 1832: p. 218, sp. 36, pl. 10, fig. 1.

*Purpura cancellata* Kiener, 1836: p. 25-26, pl. 7, fig. 16.

*Sistrum affine* Pease, 1863: p. 243-245.

*Sistrum squamosum* Pease, 1868: 277, pl. 23, fig. 14.

**MATERIAL EXAMINED:** Around PMBC, intertidal, in rock crevices (21 specimens, 1 labelled PMBC 11853).

**DESCRIPTION:** Teleoconch up to 26 mm, consisting of more than four whorls. Suture adpressed and undulating. Body whorl with nine to ten prosocline folds. Each node consist of five nodes, the shoulder node the largest. The most anterior node near the siphonal canal is lacking in some specimens. The nodes are created by major spiral cords crossing the axial folds. One to three cords creates the nodes. A deep depression may be present between major cords and axial folds. A few minor sized cords present between major cords. The shell surface is slightly scabrous. Outer lip edge smooth and undulating. Four denticles present on outer lip. Groups of four denticles present inside aperture, corresponding to each growth seizure. Inner lip fully adherent. One plica present centrally on inner lip. Anal sulcus wide. Anal callus absent to small. Siphonal canal short and narrow, laterally opened. Colour dark brown. In some specimen dots of white may be present on major cords. Aperture bluish white with brown marks near the anal sulcus on the outer lip, and on the outer lip rim near each denticle. Inner lip with a weak brown rim.

**REPRODUCTION:** Egg capsules of this species are illustrated in Tan (1995).

**HABITAT:** The species has only been found on intertidal rocks outside PMBC.

**RECORDS:** Locally: Littoral on rocky shores

(identified as *Morula marginalba* Blainville, 1832, Tantanasiwong (1978)). Regionally: India (Subba Rao & Surya Rao 1993) to the Malayan Peninsula (this study and Tan (1995)).

REMARKS: I have chosen to group this species with the genotype of *Semiricinula* von Martens, 1903 (*Semiricinula turbinoides* (Blainville, 1832)), because of their similarities, although *Semiricinula* is believed to be monotypic (see e.g., Wilson 1994).

*Semiricinula turbinoides* (Blainville, 1832)  
Pl. 4 (7) PMBC 11854

Synonymy (pers. comm. R. Houart):

*Purpura turbinoides* Blainville, 1832: 217.

*Purpura muricina* Blainville, 1832: 218, pl. 10, fig. 2-4.

*Purpura muricoides* Blainville, 1832: p. 219, sp. 38, pl. 10, fig. 5.

*Purpura squamigera* Deshayes, 1832: 426, pl. 3, figs. 10-12.

*Purpura foliacea* Conrad, 1837: 268, pl. 20, fig. 24.

*Purpura infumata* Hombron & Jacquinot, 1853: Atlas, pl. 22, figs. 13, 14.

*Morula borneensis* Dall, 1923: p. 304-305 (in part).

*Morula brunneolabrum* Dall, 1923: 304.

MATERIAL EXAMINED: Ao Nam Bor mangrove, Koh Phuket, on branches and logs at the mangrove floor (102 specimens), and North Phuket on rocks intertidal (31 specimens, 1 specimen labelled PMBC 11854).

DESCRIPTION: Teleoconch up to 30 mm, consisting of more than seven whorls. Protoconch, globose, with impressed suture, smooth and one and three quarters whorls. First teleoconch with eighteen axial folds and two major spiral cords. Suture adpressed and undulating. Body whorl with six to seven prosocline folds. Numerous scabrous spiral cords present. Four to five spiral elevations present. The elevations are formed by one to three enlarged spiral cords. Subsutural ramp elaborately lamellose. Outer lip crenulate, with four denticles inside aperture. Inner lip adherent and smooth. Anal sulcus wide. Siphonal canal short and deep. Shell dark brown to black.

The spiral elevations are white in most specimens. Aperture reddish brown, with four white striae in most specimens.

ANATOMY: The radula is describe and illustrated in Fujioka (1985a, referred to as *Thais muricina* (Blainville, 1832)).

HABITAT: Logs and branches at the floor of mangroves, and high intertidal rocky habitats, in areas with silty water.

RECORDS: Locally: No records. Regionally: Australia (Wilson 1994) and Singapore and vicinity (Tan 1995).

*Drupa* Röding, 1798

*Drupa lobata* (Blainville, 1832)  
Pl. 4 (8) PMBC 11843

Synonyms from Emerson & Cernohorsky (1973) (in part):

*Purpura lobata* Blainville, 1832.

*Ricinella dactyloides* Schumacher, 1817 (*nomen oblitum*).

MATERIAL EXAMINED: Koh Racha Yai (2 specimens, 1 found alive at 2 m depth labelled PMBC 11843).

DESCRIPTION: Teleoconch up to 23 mm. The number of teleoconch whorls is obscure due to the encrustation's on the shells. Spire very short. The body whorl with four or five major scabrous spiral cords. The number of prosocline folds is difficult to define, but it seems to be close to six or seven. The terminal varix bears two adapical lobate processes and three more spinose processes. The outer lip is finely crenulate, with five denticles inside aperture. The inner lip is fully adherent and smooth. The anal sulcus deep and situated in the adapical process.

ANATOMY: The radula is described in Emerson & Cernohorsky (1973).

HABITAT: In the shallow subtidal zone on coral rocks or encrusted rocky surfaces.

RECORDS: Locally: Koh Phi-Phi, Similan Islands (Emerson & Cernohorsky 1973). Regionally: The Red Sea to Western Australia (Emerson & Cernohorsky 1973).

REMARKS: *D. lobata* and *Drupa grossularia* Röding, 1798 might be conspecific (Kool 1993).

*Drupa rubusidaeus* Röding, 1798  
Pl. 4 (9) PMBC 11844

Synonyms compiled from Wilson (1994) and Emerson & Cernohorsky (1973) (in part):

*Drupa rubusidaeus* Röding, 1798.  
*Murex nodus* Gmelin, 1791.  
*Drupa fragum* Röding, 1798.  
*Mancinella hystrix* Link, 1807.  
*Ricinella purpurata* Schumacher, 1817.  
*Murex hippocastanum* Wood, 1825.  
*Purpura spathulifera* Blainville, 1832.  
*Ricinula reeveana* Crosse, 1862.

**MATERIAL EXAMINED:** Koh Racha Yai, in the shallow subtidal (3 specimens, 1 labelled PMBC 11844).

**DESCRIPTION:** Teleoconch up to 53 mm. Spire very short. Body whorl with nine to ten prosocline folds, bearing five spines and numerous spiral cords. The shell surface is scabrous. The terminal varix with five spines, one created by the anal canal. The second most posterior spine is the largest. Outer lip slightly crenulate, with ten denticles inside aperture. The inner lip is fully adherent. The anal sulcus is narrow and runs into the most posterior spine. The anal canal is deep and short. Shell colour light brown. Aperture purple with a yellowish rim.

**ANATOMY:** The radula is described and illustrated in Emerson & Cernohorsky (1973) and Kool (1987).

**HABITAT:** The species can be found from two to six metres on wave exposed rocks.

**RECORDS:** Locally: No previous records. Regionally: The Red Sea to French Polynesia (Emerson & Cernohorsky 1973).

*Drupa ricinus ricinus* (Linnaeus, 1758)  
Pl. 4 (10) PMBC 11845

Synonyms from Emerson & Cernohorsky (1973) (in part):

*Murex ricinus* Linnaeus, 1758.  
*Murex hystrix* Linnaeus, 1758.  
*Murex morum globosum* Martini, 1777.

*Drupa tribulus* Röding, 1798.  
*Drupa rubusidaeus* Röding, 1798.  
*Sistrum album* Montfort, 1810.  
*Ricinula arachnoides* Lamarck, 1816.  
*Murex neritoides* Mawe, 1831.  
*Purpura albolabris* Blainville, 1832.

**MATERIAL EXAMINED:** Koh Racha Yai, 3-6 metres (9 specimens, 1 labelled PMBC 11845).

**DESCRIPTION:** Shell up to 29 mm, consisting of more than five whorls. Suture impressed. Body whorl with seven to eight prosocline folds bearing four spines. Shell surface with numerous fine spiral scabrous cords. Terminal varix with four spines, the shoulder spine the longest. The spine on the subsutural ramp is created by the anal canal. An additional small spine is present near the siphonal canal in some specimens. The crenulations on the outer lip are almost invisible. Outer lip with two groups of denticles and two single denticles. The most posterior group of denticles, is composed of three to four denticles. The other group of denticles is composed of two denticles. Inner lip fully adherent, with two to three denticles and one group of two denticles. The anal sulcus is wide and shallow and extends into the most posterior spine. The siphonal canal is short and deep. The colour is white. Aperture white with a yellow spotted ring on the outer lip and siphonal canal.

**ANATOMY:** Radula and penis are illustrated in Emerson & Cernohorsky (1973) and Kool (1993). The digestive system is described in Wu (1965).

**HABITAT:** Shallow subtidal on oceanic rocky coasts. Can often be found in shallow crevices.

**RECORDS:** Locally: On boulders in areas exposed to strong currents (Tantanasiriwong 1978), Koh Phuket and Koh Similan (Emerson & Cernohorsky 1973). Regionally: Red Sea (as the subspecies *Drupa ricinus hadari* Emerson & Cernohorsky, 1973) to the Galapagos Islands (Emerson & Cernohorsky 1973).



*Drupa morum morum* Röding, 1798  
Pl. 4 (11) PMBC 11846

Synonyms from Emerson & Cernohorsky (1973) (in part):

*Drupa morum* Röding, 1798.  
*Canrena neritoidea* Link, 1807.  
*Ricinula horrida* Lamarck, 1816.  
*Ricinella violacea* Schumacher, 1817.

**MATERIAL EXAMINED:** Koh Racha Yai, west side, 3-6 m (35 specimens, one juvenile and one adult labelled PMBC 11846, the adult is illustrated herein), Koh Maiton, 2 m (1 specimen).

**DESCRIPTION:** Shell up to 44 mm. The number of whorls is undetectable, as shells are very corroded at the apex. The protoconch consist of at least 3.5 whorls, with elaborate subsutural plicae (see Kool 1993). The body whorl bears seven prosocline folds, each with five spinose nodes. Numerous fine spiral cords present. The shell surface is finely scabrous. The outer lip is crenulate between nodes. Two groups of denticles and two single denticles present inside the outer lip. The adapical group consist of four denticles while the group anterior to this is composed of two denticles. The inner lip is fully adherent with three to five plicae. The siphonal canal is short and deep. The denticulation and the general shape of the aperture makes the apertural opening narrow. Juveniles have a much more open aperture. The groups of denticles in juveniles are not developed (four denticles present). The shell colour is white with black spines. The folds between the spines light brown. The aperture is purple.  
**ANATOMY:** The radula is described in Emerson & Cernohorsky (1973). The anatomy is described in Kool (1993).

**HABITAT:** Rocks exposed to the south-east monsoon at three to six metres. Often found in shallow crevices.

**RECORDS:** Locally: On boulders in areas exposed to strong currents (Tantanasiriwong

1978). Regionally: From East Africa, the Red Sea to the Eastern Pacific, including Clipperton Island and Easter Island, but not Maquesas Islands (Emerson & Cernohorsky 1973).

*Drupella* Thiele, 1925

*Drupella rugosa* (Born, 1778)  
Pl. 5 (1) PMBC 10278

Synonymy from Tröndle & Houart (1992):

*Murex rugosus* Born, 1778: 303.  
*Murex concatenatus* Lamarck, 1822: 176.

**MATERIAL EXAMINED:** Koh Talu, Gulf of Thailand (13 specimens, one labelled PMBC 10278), PMBC reef flat near water edge at low water spring tide (5 specimens), Koh Racha Yai (several specimens with hermit crabs).

**DESCRIPTION:** Teleoconch up to 33 mm consisting of more than six whorls. The protoconch is smooth, high conical, with a sinusigeral terminal varix and consist of about three whorls. The suture is adpressed and undulating. The body whorl bears ten to twelve prosocline folds. Five nodes are present on the folds, the shoulder node is the strongest. The most anterior node can be very weak. Numerous spiral elaborately scabrous cords present on the shell surface. The outer lip erect and crenulate. Six to seven denticles present on outer lip. Inner lip fully adherent with two to four small plicae. Anal sulcus quite narrow. Siphonal canal short and deep. Shell colour light brown. Nodes on axial folds black to reddish brown. A similarly coloured spiral band in present on the subsutural ramp. Aperture light to dark purple, rarely white.

**REPRODUCTION:** Oviposition has been observed in late May (Middelfart 1996). The mode of development is planktotrophic.

**HABITAT:** On corals, live and dead on intertidal reef flats to at least five metres.

**RECORDS:** Locally: Littoral, beneath coral rubble (Tantanasiriwong 1978, identified as *Drupella ochrostoma* (Blainville, 1832)). Regionally: Indo Pacific (Goto & Poppe 1996).

*Drupella cornus* (Röding, 1798)  
Pl. 5 (2) PMBC 10847

Synonymy from Tröndle & Houart (1992):

*Drupa cornus* Röding, 1798: 56.

*Purpura elata* Blainville, 1832: 207, pl. 11, fig. 1.

*Ricinula spectrum* Reeve, 1846c: pl. 3, fig. 19.

**MATERIAL EXAMINED:** Koh Hi, near Koh Phuket, two metres (3 specimens, all labelled PMBC 11847, largest specimen illustrated).

**DESCRIPTION:** Teleoconch up to 35 mm, consisting of more than six whorls. Protoconch with three to four whorls (Turner 1992 and 1994). Suture adpressed and undulating. Body whorl with eight to nine prosocline folds, composed of four spines. The shoulder spine is the largest. Numerous fine spiral scabrous cords present between spines. Outer lip crenulate between spines. Seven denticles present inside outer lip. The inner lip may be fully adherent or detached anteriorly. Three to four plicae present anteriorly on inner lip. Anal sulcus open. Siphonal canal short and deep. Shell colour entirely white. Some shells with a yellow tinge inside aperture.

**ANATOMY:** Radula illustrated in Kool (1987). The radula is sexually dimorph (Arakawa 1957).

**REPRODUCTION:** Egg capsules and ontogeny are described in Turner (1992). The mode of development is planktotrophic.

**HABITAT:** These few specimens described herein were located at the base of an *Acropora* sp. coral, at two metres depth.

**RECORDS:** Locally: No previous records. Regionally: Indian Ocean (Poppe & Goto 1996) to French Polynesia (Tröndle & Houart 1992).

*Morula* Schumacher, 1817

*Morula granulata* (Duclos, 1832)  
Pl. 5 (3) PMBC 11849

Synonymy from Tan (1995):

*Purpura granulata* Duclos, 1832: p. 9, pl. 11, fig. 9.

*Purpura tuberculata* Blainville, 1832: p. 204-205, sp. 8, pl. 9, fig. 3.

*Siatrum chrysalis* Sowerby, 1908: p. 17, pl. 1, fig. 5.

**MATERIAL EXAMINED:** Intertidal, Koh Racha Yai (27 specimens), rocks south of PMBC (4 specimens, one labelled PMBC 11849).

**DESCRIPTION:** Teleoconch up to 25 mm, consisting of more than seven whorls. Protoconch smooth, high conical, with sinusigeral terminal varix and about three and three quarter whorls. Suture adpressed and undulating. Body whorl with seven to ten prosocline folds, each ornamented with five nodes. The node on the subsutural ramp, created by the anal canal is larger or of equal size to the shoulder node. The shell surface is entirely covered in spiral minutely scabrous cords on young shells. In older shells the spiral ornamentation is only present between nodes. The outer lip is slightly erect and crenulate between nodes. Four denticles present inside outer lip. The most posterior denticle is the largest. Inner lip fully adherent with two to three plicae. Anal sulcus narrow, anal callus present. Siphonal canal short and deep. Shell colour light brown, with black nodes. Some other parts of the axial folds might be black coloured as well. Aperture bluish white, with a black rim on the outer lip. A black band is present parietally. Siphonal canal black.

**ANATOMY:** Radula illustrated in Kool (1987). The digestive system is described in Wu (1965).

**REPRODUCTION:** Oviposition has been observed in the laboratory in late July. The egg capsules and planktotrophic larvae are described in Middelfart (1996).

**HABITAT:** Intertidal on oceanic rocky shores.

**RECORDS:** Locally: Littoral on boulders exposed to strong currents (Tantanasiriwong 1978). Regionally: Eastern Africa, as south as Algoa Bay (Kilburn & Rippey 1982) to French Polynesia (Tröndle & Houart 1992).

*Morula uva* (Röding, 1798)  
Pl. 5 (4) PMBC 11852

Synonyms compiled from Kool (1993) and Wilson (1994):

*Drupa uva* Röding, 1798.

*Ricinula nodus* Lamarck, 1816.

*Ricinula aspera* Lamarck, 1816.

*Ricinula papilosa* Schumacher, 1817.

*Ricinula morus* Lamarck, 1822.

*Purpura sphaeridia* Duclos, 1832.

*Ricinula alba* Mörch, 1852.

?*Sistrum striatum* Pease, 1868.

?*Morula nodilifera* Habe & Kosuge, 1966.

**MATERIAL EXAMINED:** Shallow subtidal, Koh Racha Yai (1 specimen, PMBC 11852).

**DESCRIPTION:** Teleoconch 17 mm, consisting of more than five whorls. Suture adpressed and undulating. Body whorl with nine prosocline folds, each ornamented with four small nodes. The node created by the anal canal and the shoulder node are the largest. One to three spiral cords present between nodes. Outer lip erect, with crenulations between nodes. Six denticles present inside the outer lip. The denticles between the shoulder node and the next anterior node are grouped together. Inner lip attached posterior to the pseudumbilicus. Three small plicae present near the inner lip edge anteriorly. One denticle further inside the aperture. Anal canal narrow running into node. Siphonal canal short and deep. Shell colour white, with black marks between nodes on axial folds. Aperture purple, with a black rim on the anterior edge of the outer lip. Siphonal canal black.

**ANATOMY:** An exhaustive description of the anatomy is given in Kool (1993).

**HABITAT:** Found on heavily encrusted coral boulders just subtidal.

**RECORDS:** Locally: No previous records. Regionally: From the Red Sea to Isla Guatelupe and Clipperton Island, Eastern Pacific (Kool 1993).

*Morulaanaxares* (Kiener, 1836)

Pl. 5 (5) PMBC 11850

*Purpuraanaxares* Kiener, 1836: p. 26-27, pl. 7, fig. 17  
(in Subba Rao & Surya Rao 1993).

**MATERIAL EXAMINED:** Ao Chalong, Koh Phuket, on rocks (12 specimens), on coral boulders and rocks around PMBC (27 specimens), and Ao Nam Bor, Koh Phuket, on mangrove roots (2 specimens, labelled PMBC 11850).

**DESCRIPTION:** Teleoconch up to 18 mm, consisting of more than eight whorls. Protoconch smooth, high conical, with a sinusigeral terminal varix and around three whorls. Suture adpressed and undulating. Body whorl with seven to eight prosocline folds, each ornamented with five nodes. Numerous fine spiral scabrous cords present. Outer lip smooth. Five to six denticles present inside outer lip. Inner lip adherent with one to three denticles anteriorly. Anal sulcus narrow, with anal callus. Siphonal canal short, narrow and deep. Shell colour black. The posterior, middle and anterior node on the axial folds, white. Aperture bluish or brownish white, with darker colour around denticles, anal sulcus and siphonal canal.

**ANATOMY:** The radula is illustrated and described in Fujioka (1985a).

**HABITAT:** Underside of coral rubble on reef flat, in crevices in rocks and on mangrove roots (rare), all in the intertidal zone.

**RECORDS:** Locally: Littoral, on rocky shores (Tantanasiriwong 1978). Regionally: East Africa (Kilburn & Rippey 1982) to northern Australia (Wilson 1994).

*Morula nodicostata* (Pease, 1868)

Pl. 5 (6) PMBC 11851

Synonymy from Tröndle & Houart (1992):

*Engina nodicostata* Pease, 1868a: 274, pl. 23, fig. 8.

*Engina variabilis* Pease, 1868a: 275, pl. 23, fig. 9.

**MATERIAL EXAMINED:** Under rocks and coral rubble, intertidal, around PMBC (10 specimens), Koh Maiton, intertidal (1 specimen, labelled PMBC 11851) and Koh Lipé, Koh Taroutao Marine Park, 3 m (1 specimen).

**DESCRIPTION:** Teleoconch up to 10 mm consisting of about six whorls. Protoconch high conical, smooth, with a sinusigeral terminal varix and approx. three and one half whorl (one observation). Suture adpressed and undulating. The first teleoconch whorl with ten axial folds (one observation). The body whorl with eight to ten prosocline folds,

each ornamented with three nodes. The shoulder node is the largest. Several spiral cords present. The shell surface is axial lamellate to scabrous. Outer lip erect and smooth, with five to six denticles inside aperture. Inner lip fully adherent with two to three denticles anteriorly. Anal canal narrow, with anal callus. Siphonal canal narrow and deep in fully developed specimens. Shell colour white, aperture white with a tinge of purple.

**ANATOMY:** The radula is described and illustrated by Fujioka (1985a).

**HABITAT:** Under surfaces of coral rubble and rocks, rarely exposed. Oceanic shores.

**RECORDS:** Locally: Littoral on coral rubble (Tantanasiwong 1978). Regionally: India (Subba Rao & Surya Rao 1993) to French Polynesia (Tröndle & Houart 1992).

*Morula musiva* (Kiener, 1836)

Pl. 5 (7) PMBC 11814

*Purpura musiva* Kiener, 1836: p. 58-59, pl. 9, fig. 22 (in Tan 1995).

**MATERIAL EXAMINED:** On rocks, intertidal around PMBC (18 specimens, 1 labelled PMBC 11814), Ao Chalong, Koh Phuket, on a rock intertidal (1 specimen), and North Phuket on rocks intertidal (9 specimens).

**DESCRIPTION:** Teleoconch up to 31 mm, consisting of more than six whorls. Suture adpressed and undulating. Body whorl with nine to ten prosocline folds, ornamented with four major nodes. One small additional node is present near the siphonal canal. Numerous fine, slightly scabrous spiral cords present. Outer lip erect and smooth, slightly flaring anteriorly. Four denticles present inside aperture. Inner lip fully adherent with two to three plicae anteriorly. Anal sulcus narrow, small anal callus present. Siphonal canal short and narrow. Colour whitish. Axial folds black except around the shoulder node and the second most anterior major node, where the area surrounding the node is white, and the node reddish brown. Aperture with two white bands entering the

aperture on the outer lip, and two white bands on the inner lip, one anteriorly in the plicate area and one near anal callus.

**ANATOMY:** The sexually dimorph radulae are described and illustrated in Fujioka (1984).

**REPRODUCTION:** Egg capsules have been observed in late August on rocks outside PMBC. The mode of development is planktotrophic (Tong 1988).

**HABITAT:** Intertidal on rocks. Very abundant on rocks in areas with muddy water.

**RECORDS:** Locally: No records. Regionally: Andaman Islands (Subba Rao & Surya Rao 1993) to the northern parts of Australia (Wilson 1994).

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

Pl. 5 (8) PMBC 11855

Synonyms from Tan (1995):

*Pentadactylus (Sistrum) spinosus* H. & A. Adams, 1853: p. 130.

*Murex iostomus* A. Adams, 1853: p. 267.

*Ricinula chrysostoma* Deshayes, 1844 in Reeve, 1846: sp. 12 (in part), pl. 2, fig. 12 only (*nomen dubium*).

**MATERIAL EXAMINED:** Koh Racha Yai (17 specimens), Koh Maiton down to 10 m (18 specimens, 1 labelled PMBC 11855), and reef flat outside PMBC (7 specimens).

**DESCRIPTION:** Teleoconch up to 27 mm, consisting of more than eight whorls. Protoconch high conical, smooth, with a sinusigeral terminal varix and almost three and one half whorl (one observation). First teleoconch whorl with eleven axial folds and about four spiral cords. Suture adherent and undulating. Body whorl with prosocline folds, and three spines. In some specimens up to three additional spines may be present, one between the middle and anterior spine and two between the anterior spine and siphonal canal. The shoulder spine is the largest. Shell surface with numerous fine spiral scabrous cords. Outer lip slightly erect and crenulate. Five to six denticles present inside outer lip. Inner lip fully adherent, with none to four small

plicae anteriorly. Anal sulcus quite wide. Siphonal canal slightly elongated, narrow and deep. Shell colour white with dark brown axial folds. Aperture entirely purple.

ANATOMY: The radula is described in Fujioka (1985a).

HABITAT: On coral boulders and rocks on oceanic localities, intertidal to ten metres. Very common.

RECORDS: Locally: Littoral, on reef flats or boulders (Tantanasiriwong 1978). Regionally: The Malayan Peninsula (Tantanasiriwong 1978) to French Polynesia (Tröndle & Houart 1992).

*Nassa* Röding, 1798

*Nassa francolina* (Bruguière, 1789)  
Pl. 5 (9) PMBC 2587

Synonyms from Houart (1996, in part):

*Buccinum francolinus* Bruguière, 1789: 261.

MATERIAL EXAMINED: Koh Phuket (1 specimen, PMBC 2587).

DESCRIPTION: Teleoconch 40 mm, consisting of more than six whorls. Suture adpressed. Body whorl smooth with numerous fine, equally spaced spiral cords. Outer lip sharp and smooth. Inner lip fully adherent and smooth. Anal sulcus narrow. Anal callus carinate. Siphonal canal short, quite narrow and laterally opened. Shell colour cream, with numerous fine brown cords. Numerous areas of cream on the spiral cords. A condensation of cream in the shoulder region. Aperture cream, with a brown dotted rim on the outer lip, and a light brown inner lip.

ANATOMY: The anatomy of the closely related species *Nassa sarta* (Bruguière, 1789) has been studied in detail in Kool (1993).

REPRODUCTION: The egg capsules are described in *e.g.*, D'Asaro (1991).

RECORDS: Locally: Littoral, beneath corals (Tantanasiriwong 1978). Regionally: East Africa (Kilburn & Rippey 1982) to French Polynesia (Tröndle & Houart 1992).

*Purpura* Bruguière, 1789

*Purpura persica* (Linnaeus, 1758)  
Pl. 5 (10) PMBC 11848

Synonyms from Tröndle & Houart (1992):

*Buccinum persicum* Linnaeus, 1758: 738.

*Purpura aterrima* Lesson, 1842b: 186.

MATERIAL EXAMINED: Koh Racha Yai, on rocks, just subtidally (2 specimens, 1 labelled PMBC 11848).

DESCRIPTION: Teleoconch up to 84 mm, consisting of more than five whorls. Protoconch high conical, with sinusigeral terminal varix and about three whorls (Kool 1993). Suture adpressed, spire low. Body whorl with several growth marks, but no real folds. Numerous spiral cords of approx. equal size. Aperture very large. Outer lip crenulate, with numerous lirae inside aperture. Inner lip fully adherent and smooth. Anal canal narrow. Anal callus present. Siphonal canal short and open laterally. Shell colour dark brown with about six spiral cords dotted in black and white. Aperture bluish white, striae light brown. Wide dark brown rim present on outer lip. Inner lip and anal sulcus light orange.

ANATOMY: The anatomy of this species is described in Kool (1993).

REPRODUCTION: Egg capsules are described in D'Asaro (1991) and Tirmizi & Zehra (1983).

RECORDS: Locally: Littoral, beneath rocks in areas exposed to strong currents (Tantanasiriwong 1978). Regionally: Mauritius to Marquesas (Kool 1993) and French Polynesia (Tröndle & Houart 1992).

*Rapana* Schumacher, 1817

*Rapana rapiformis* (Born, 1778)  
Pl. 5 (11) PMBC 9443

Synonymy from Subba Rao & Surya Rao (1993):

*Murex rapiformis* var. a Born, 1778: pt. 1.

*Murex rapa* Gmelin, 1791: 13: 3545, sp. 68 (non Linnaeus).

*Buccinum bulbosum* Dillwyn, 1817: 2: 631, sp. 104.

**MATERIAL EXAMINED:** Fish landing, Pattani (5 specimen, PMBC 9443). This Gulf of Thailand material has been used in this description as the material studied in Tantanasiwong (1978) could not be localized.

**DESCRIPTION:** Teleoconch up to 87 mm, consisting of more than five whorls. Protoconch high conical, sinuigeral terminal varix and about three whorls (Kool 1993). Suture impressed. Young whorls carinate. Body whorl with eleven to eighteen process, in two spiral rows. Surface with numerous wide spiral cords. Minute axial lamellae present. Outer lip crenulate. Numerous lirae present inside outer lip. Pseudoumbilicus very elaborate. Inner lip adherent from pseudoumbilicus to anal sulcus. Anal sulcus is a dent in the outer lip. Siphonal canal elongated and narrowly opened laterally. Shell colour light brown, with speckles of darker brown. Aperture white.

**ANATOMY:** The anatomy is described in Kool (1993).

**RECORDS:** Locally: Sublittoral, trawled from mud bottom at a depth of 8 to 12 metres (Tantanasiwong 1978). Regionally: India (Subba Rao & Surya Rao 1993) to Australia (Wilson 1994). Has been introduced into the Black Sea (Wilson 1994).

#### Muricopsinae

##### *Homalocantha* Mörch, 1852

*Homalocantha anatomica* (Perry, 1811)  
Pl. 5 (12) PMBC 11835

Synonyms from Radwin & D'Attilio (1976):

*Hexaplex anatomica* Perry, 1811: pl. 8, fig. 2.

*Murex rota* Mawe, 1823: 131.

*Murex pele* Pilsbry in Pilsbry & Bryan, 1918: pl. 9, figs. 9, 12.

**MATERIAL EXAMINED:** One very worn specimen with a hermit crab from 3 m depth, Koh Man (PMBC 11835).

**DESCRIPTION:** The present shell is unsuitable for description. See Radwin & D'Attilio (1976) for description of the species, and illustrations of shell and protoconch.

**RECORDS:** Locally: No previous records. Regionally: East Africa to Hawaiian Archipelago (Radwin & D'Attilio 1976).

#### DISCUSSION

Four of the species studied in this paper have been described since the checklist by Tantanasiwong (1978) was published, viz., *Murex poppei* Houart 1979, *Haustellum dolichourus* Ponder & Vokes 1988, *Thais rufotincta* Tan & Sigurdson 1996a and *Thais malayensis* Tan & Sigurdson 1996b.

The following species have not to my knowledge been recorded from the Andaman Sea, Thailand: *M. pecten*, *M. carbonnieri*, *C. banksii*, *C. palmarosae*, *N. triqueter*, *P. tripterus*, *P. bipinnatus*, *O. livida*, *H. anatomica*, *M. tuberosa*, *T. javanica*, *T. gradata*, *T. sacellum*, *S. turbinoides*, *D. rubusidaeus*, *D. cornus*, *M. uva*, and *M. musiva*.

At present there is still problems with the exact generic and subfamilial placement of several species. The classification of any animal group should be done, if possible, with a clear reflection of the phylogeny of the group, and in such a way that each postulated group is monophyletic. Anatomical characters are very reliable in phylogenetic studies, whereas shell characters, at least in Muricidae, show a high degree of convergence (Kool 1993).

The ergalataxines have muricine radulae, but differs from this subfamily in shell characters. The muricine egg capsules are also different from those of the ergalataxines. Kool (1993) found that the anatomy of *Cronia* and *Morula* is distantly related to the muricines, and that they may need subfamilial status (subfamily Ergalataxinae). Thus, the placement of *Ergalatax*, *Lataxiena*, and *Orania* in the muricine subfamily is not justified due to the possibility of polyphyly. The separations of ergalataxine genera is mostly done by shell and radula characters. It is not known if this is justified in anatomical characters. The reproductive characters does not seem to indicate any generic grouping (see e.g., D'Asaro 1991; Middelfart 1996; Phillips 1975).

The subfamilial and generic classification of

the rapanines is confusing. *Nucella*, *Acanthina*, *Trochia*, *Forreria* and *Haustrum* previously included in Thaididae/Thaidinae of authors have been transferred to the Ocenebrinae (Kool 1993). The subfamily Rapaninae of authors have been lumped with Thaididae/Thaidinae of authors, forming Rapaninae *sensu* Kool (1993), as Rapaninae of authors is monophyletic with Thaididae/Thaidinae of authors.

The result of following Kool's (1993) new classification scheme of the rapanines is the question if we are able to rely of shell characters in species, when placing them in the various existing genera. If an anatomical analysis was performed on the very difficult groups like *Thais*, *Morula*, *Semiricinula*, and *Mancinella*, then it might be possible with more certainty to give them a consistent generic name. In the present study this has not been possible within the given time frame, and the generic grouping has been done from shell characters.

In the future much rearrangement will undoubtedly occur, but this does not affect the species identifications. Thus, for any ecologist or other researcher interested in the groups of muricids studied herein it is safe to use the given names, as a change in generic name is insignificant for the species identification.

In any case it is advisable to deposit at least one specimen of each muricid species included in ecological or faunal studies in a museum or reference collection, for future reference.

The number of species included in this paper is by no means complete for the study area. The Rapaninae is probably close to fully documented, as their habitat is mostly the intertidal or shallow subtidal zones. Several species of Muricinae may probably be recorded in the future. To illustrate this point I have studied two revisions of five genera of Muricinae (Ponder & Vokes 1988 and Houart 1992), to see which species that are not currently recorded in the Reference Collection at PMBC, but might be present in the Thai Andaman Sea. The inferences have

been performed from the distribution data provided in these revisions.

In the following • indicates that there is no local record, but a record from the Andaman Sea or nearby region, + indicates that the species has been recorded from the Thai area of the Andaman Sea, but not deposited in the Reference Collection of PMBC, and <> indicates that the species has been recorded in the western and eastern part of the Indo-West Pacific, but not in the Andaman Sea, Thailand (in instances with one local record eastern or western of the main area of distribution this record has been disregarded). The references are given with depth data (see discussion later).

From Ponder & Vokes (1988): • *Haustellum haustellum haustellum* (Linné, 1758), down to 128 m. • *Murex ternispina* Lamarck, 1822, 2-62 m. + *Murex spectabilis* Ponder & Vokes 1988, depth ?. + *Murex altispira* Ponder & Vokes 1988, 9-59 m. • *Murex aduncospinosus* Sowerby, 1841, down to 2050 m. • *Murex troscheli troscheli* Lischke, 1868, 6-280 m. + *Murex tenuirostrum tenuirostrum* Lamarck, 1822, down to 110 m. • *Murex tribulus* Linné, 1758, down to 20 m.

From Houart (1992): <> *Naquetia cumingii* (A. Adams, 1853), depth ?. <> *Naquetia barclayi* (Reeve, 1858), 70-100 m. <> *Chicomurex laciniatus* (Sowerby, 1841), 40-200 m. + *Chicoreus aculeatus* (Lamarck, 1822), depth ?. <> *Chicoreus cnissodus* (Euthyme, 1889), 30-70 m. + *Chicoreus axicornis* (Lamarck, 1822), 40-80 m. + *Chicoreus microphyllus* (Lamarck, 1822), depth ?. • *Chicoreus saulii* (Sowerby, 1834), 15-140 m.

Thus, nine additional species might occur, and six species actually existing in the area have not yet been deposited in the Reference Collection at PMBC. And these are records from only five genera.

The subfamily Ergalataxinae is still largely unknown, with only six species are present in the Reference Collection, from the Andaman Sea, of Thailand. Houart (1995a) described 19 species of Ergalataxinae from New Caledonia, of which the more common

ergalataxines were excluded. Thus quite a few more species of this subfamily are to be expected from deeper waters.

Representatives of Trophoninae and Typhinae are entirely lacking in the Reference Collection. These species are also of a deeper water occurrence. The subfamily Muricopsinae is only represented by one species in the Reference Collection, which probably is an incomplete reference of the subfamily.

The lack of material from deeper water is illustrated in Fig. 1. The vertical distribution has been separated into six sections, 0-5 m, 5-10 m, 10-15 m, 15-20 m, 20-50 m and over 50 m. Species which have been found at e.g., 3 and 12 metres are included in the sections 0-5 m, 5-10 m and 10-15 m and so forth.

The data from Ponder & Vokes (1988) and Houart (1992) (see above) have been added as an overlay.

It is my hope that this paper will encourage researchers in Thailand to gather more in-

formation on the muricid family, in respect to diversity and distribution in the Gulf of Thailand and Andaman Sea Thailand. The material should be deposited in the Reference Collection at Phuket Marine Biological Centre. In cases of undescribed species found by local or foreign researchers it is highly recommended that the holotype or at least one paratype is deposited in the Reference Collection.

#### ACKNOWLEDGEMENTS

Mr. P. Somneuk is thanked for handing over precious specimens collected by Sea Gypsies. I thank Dr. K. S. Tan for identification of some *Thais* spp. Dr. A. Nateewhatana and Mr. S. Bussarawit are thanked for making my work in the Reference Collection possible. Mrs. Rachanee is thanked for assisting in finding and cataloguing species in the Reference Collection. Dr. W. F. Ponder and Mr. I. Loch are thanked for letting me inspect the muricid collection at The Australian Museum Sydney.

Dr. D. Machintosh and Mr. H. Jalk from cenTER, University of Aarhus, are thanked for letting me use their hardware.

Mr S. Steinfeldt, B. Gribsholt, M. Bech and H. Jalk are thanked for handing over specimens of special interest as well as being dive buddies on numerous adventures.

I am grateful for the very generous advice on species identities and subfamilial classification as well as comments on the manuscript provided by Mr. R. Houart.

I am grateful to Dr. J. Hylleberg for giving me the opportunity to study in Thailand, and for nurturing my interest in systematics.

I am deeply grateful to my partner Annie for helping on fatalistic trips with the boat "ANDELON", shell keeping, and for "Kee Gai".

This study was conducted under the auspices of the Tropical Marine Mollusc Programme, supported by DANIDA.

The study was fully financed by the Danish Natural Science Research Council.

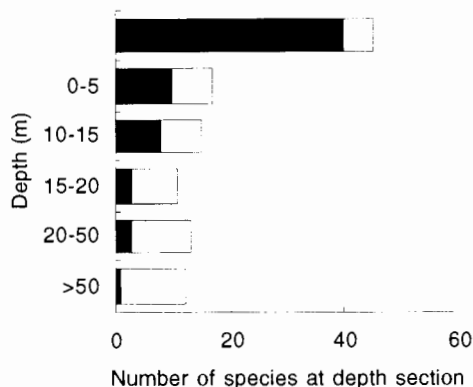


Figure 1. The number of species found at a particular depth section. Black bars are records from this study (Reference Collection at PMBC). White bars are records of species of five muricine genera occurring in areas adjacent to Thailand, or occurring in Thailand but not deposited in the Reference collection at PMBC (data from Ponder and Vokes 1988, Houart 1992).



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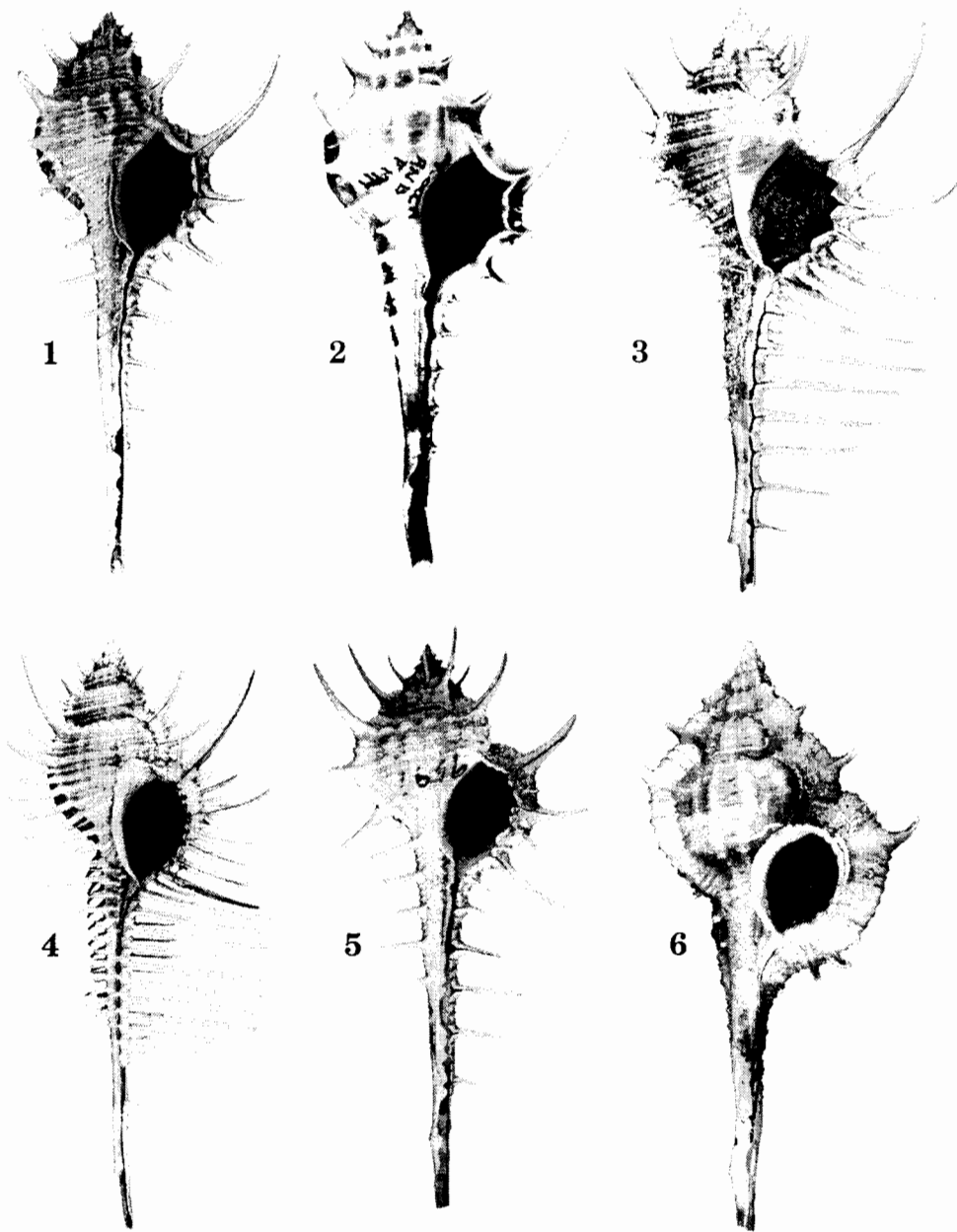


Plate 1. 1: *Murex trapa* (Röding, 1798), 62 mm, PMBC 11828. 2: *Murex occa* Sowerby, 1834, 70 mm, PMBC 11826. 3: *Murex poppei* Houart, 1979, 83 mm, PMBC 11829. 4: *Murex pecten* Lightfoot, 1786, 141 mm, PMBC 8621. 5: *Murex carbonnieri* (Jousseau, 1881), 72 mm, PMBC 9591. 6: *Haustellum dolichourus* Ponder & Vokes, 1988, 61 mm, PMBC 2583.

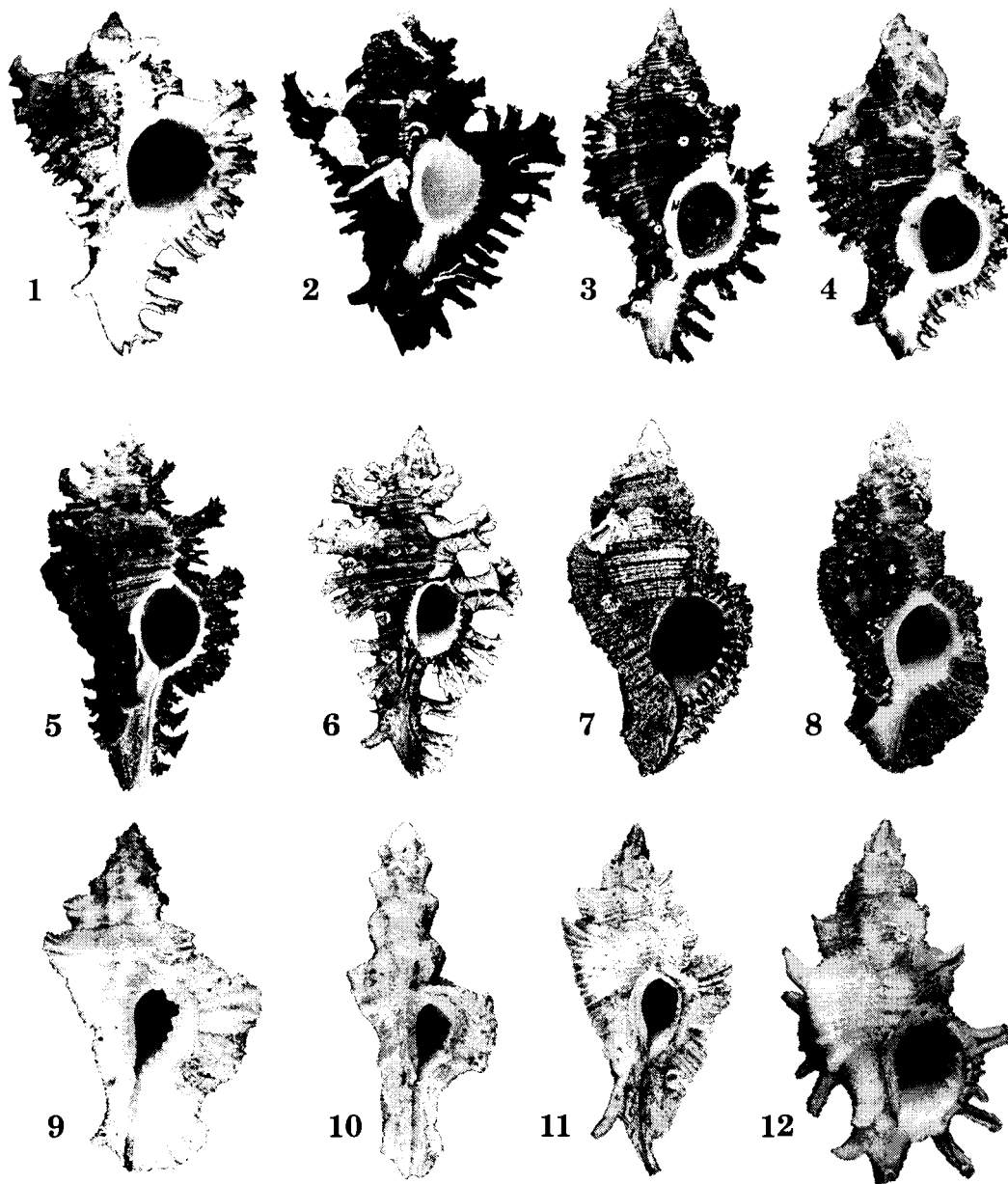


Plate 2. 1: *Chicoreus ramosus* (Linnaeus, 1758), 80 mm, PMBC 11822. 2: *Chicoreus brunneus* (Link, 1807), 87 mm, PMBC 11819. 3: *Chicoreus torrefactus* (Sowerby, 1841), 108 mm, PMBC 11820. 4: *Chicoreus torrefactus* (Sowerby, 1841), 108 mm, PMBC 11821. 5: *Chicoreus banksii* (Sowerby, 1841), 83 mm, PMBC 10030. 6: *Chicoreus palmarosae* (Lamarck, 1822), 111 mm, PMBC 11824. 7: *Chicoreus capucinus* (Lamarck, 1822), 56 mm, PMBC 11823. 8: *Naquetia triqueter* (Born, 1778), 73 mm, PMBC 11825. 9: *Pteryarchia tripterus* (Born, 1778), 60 mm, PMBC 11830. 10: *Pteryarchia bipinnatus* (Reeve, 1845), 32 mm, PMBC 11831. 11: *Pterynotus pinnatus* (Swainson, 1822), 50 mm, PMBC 2588. 12: *Attiliosa orri* (Cernohorsky, 1976), 28 mm, PMBC 2488.

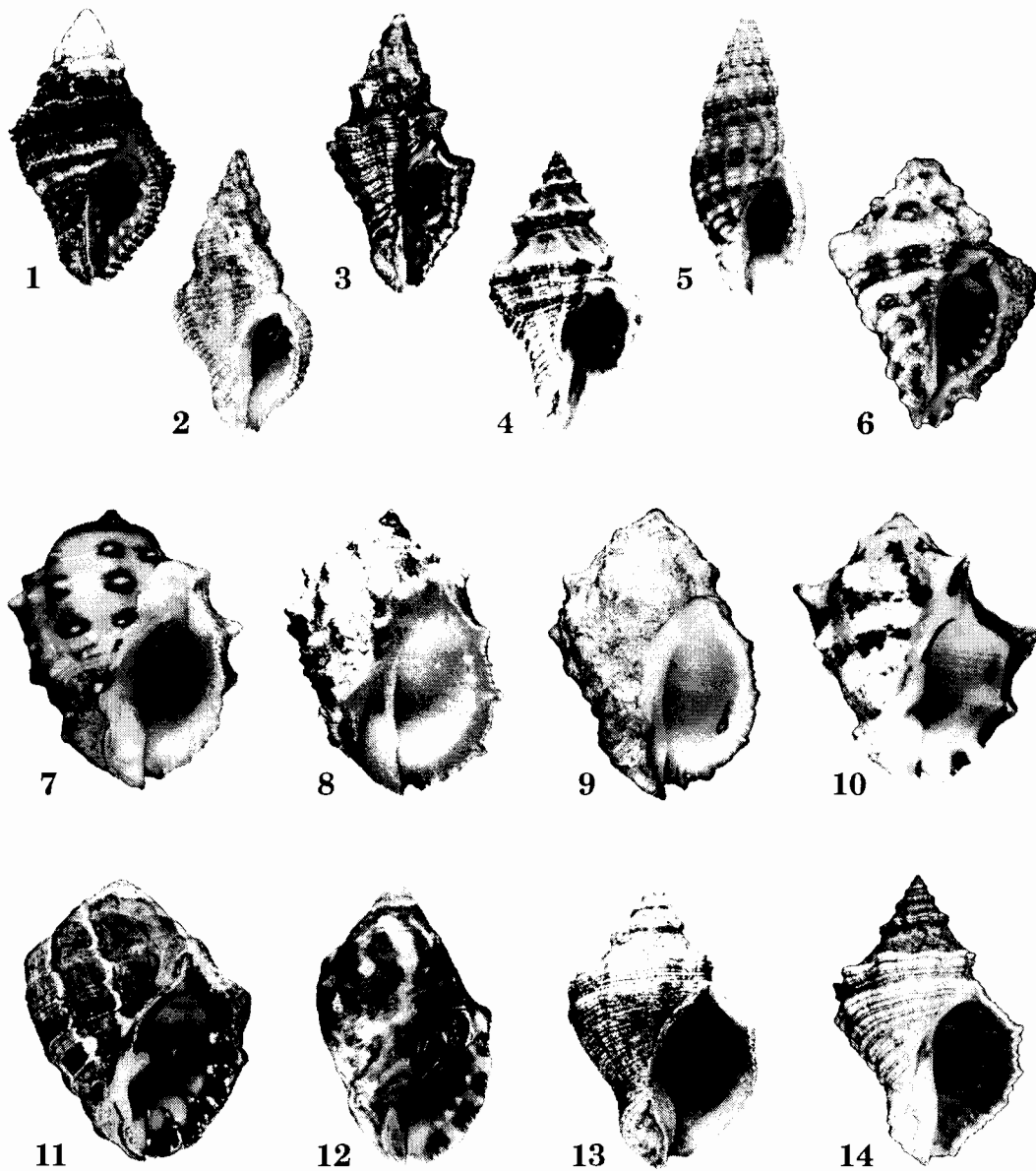


Plate 3. 1: *Ergalatax margariticola* (Broderip, 1833), 27 mm, PMBC 11832. 2: *Ergalatax contracta* (Reeve, 1846), 31 mm, PMBC 11833. 3: *Orania livida* (Reeve, 1846), 23 mm, PMBC 11834. 4: *Lataxiena blosvillei* (Deshayes, 1832), 43 mm, PMBC 11800. 5: *Maculotriron serriale* (Deshayes, 1834), 13 mm, PMBC 2492. 6: *Muricodrupa fiscella* (Gmelin, 1791), 14 mm, PMBC 2484. 7: *Mancinella alouina* (Röding, 1798), 37 mm, PMBC 11836. 8: *Mancinella echinulata* (Lamarck, 1822), 46 mm, PMBC 11837. 9: *Mancinella echinata* (Blainville, 1832), 46 mm, PMBC 11812. 10: *Mancinella tuberosa* (Röding, 1798), 43 mm, PMBC 11809. 11: *Mancinella virgatus* (Dillwyn, 1817), 26 mm, PMBC 11838. 12: *Mancinella intermedia* (Kiener, 1836), 28 mm, PMBC 2585. 13: *Thais rufotincta* Tan, 1996, 32 mm, PMBC 11839. 14: *Thais javanica* (Philippi, 1848), 36 mm, PMBC 11808.

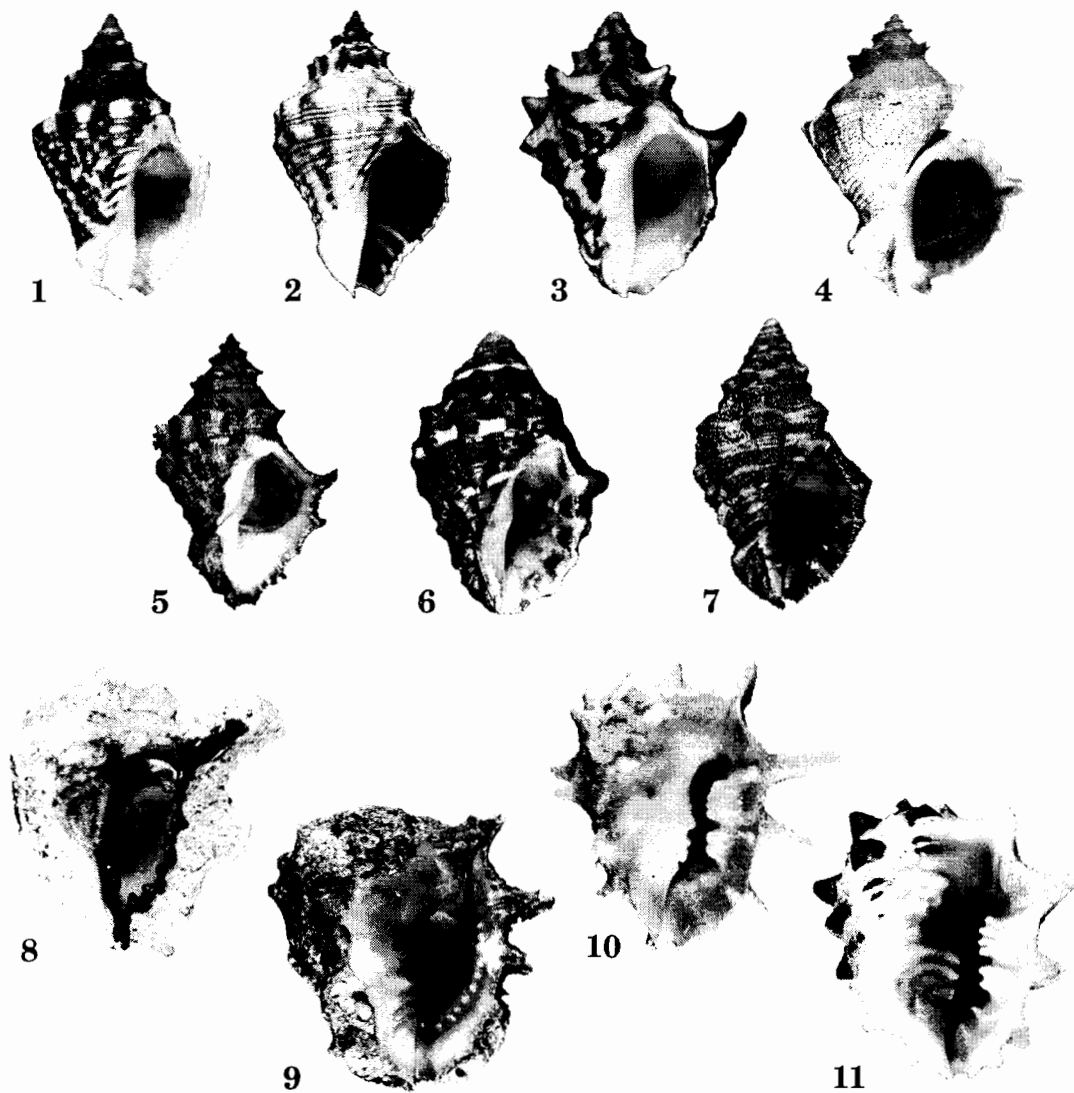


Plate 4. 1: *Thais gradata* (Jonas, 1846), 41 mm, PMBC 11803. 2: *Thais malayensis* Tan, 1996, 29 mm, PMBC 10257. 3: *Thais bitubercularis* (Lamarck, 1822), 41 mm, PMBC 11841. 4: *Thais lacera* (Born, 1778), 46 mm, PMBC 11842. 5: *Thais sacellum* (Gmelin, 1791), 36 mm, PMBC 10241. 6: *Semiricinula marginatra* (Blainville, 1832), 20 mm, PMBC 11853. 7: *Semiricinula turbinoides* (Blainville, 1832), 27 mm, PMBC 11854. 8: *Drupa lobata* (Blainville, 1832), 24 mm, PMBC 11843. 9: *Drupa rubusidaeus* (Röding, 1798), 40 mm, PMBC 11844. 10: *Drupa ricinus ricinus* (Linnaeus, 1758), 29 mm, PMBC 11845. 11: *Drupa morum morum* Röding, 1798, 44 mm, PMBC 11846.

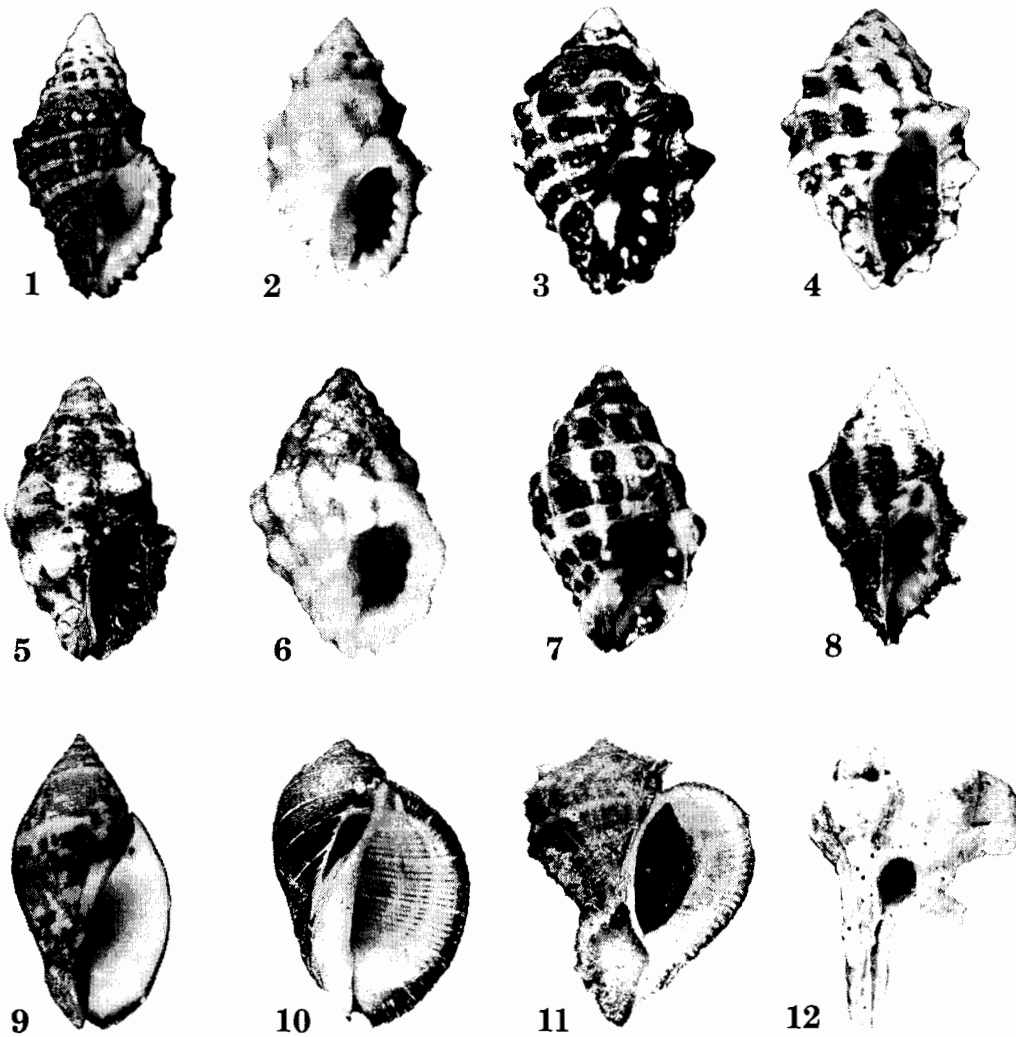


Plate 5. 1: *Drupella rugosa* (Born, 1778), 34 mm, PMBC 10278. 2: *Drupella cornus* (Röding, 1798), 30 mm, PMBC 11847. 3: *Morula granulata* (Duclos, 1832), 25 mm, PMBC 11849. 4: *Morula uva* (Röding, 1798), 17 mm, PMBC 11852. 5: *Morula anaxares* (Kiener, 1836), 18 mm, PMBC 11850. 6: *Morula nodicostata* (Pease, 1868), 10 mm, PMBC 11851. 7: *Morula musiva* (Kiener, 1836), 22 mm, PMBC 11814. 8: *Habromorula spinosa* (H. & A. Adams, 1853), 23 mm, PMBC 11855. 9: *Nassa francolina* (Bruguiere, 1789), 40 mm, PMBC 2587. 10: *Purpura persica* (Linnaeus, 1758), 83 mm, PMBC 11848. 11: *Rapana rapiformis* (Born, 1778), 70 mm, PMBC 9443. 12: *Homalocantha anatomica* (Perry, 1811), 48 mm, PMBC 11835.