

Ten new species of **Cardiidae** (**Mollusca, Bivalvia**) from New Caledonia and the tropical western Pacific

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ABSTRACT

The fauna of the tropical Indo-west Pacific is exceptionally diverse but poorly known with even relatively well-studied faunal components yielding new species after careful study, novel approaches (e.g., delineation of cryptic species *via* molecular analyses) and/or rigorous collection efforts. In an attempt to quantify the biodiversity of the western Pacific molluscan fauna, comprehensive, systematic collecting expeditions have been made since 1978, with a focus on New Caledonia. Building on earlier studies of cardiids from the western Pacific, we report one new genus of cardiid (*Pseudofulvia* n. gen.) and 10 new cardiid taxa from the area: *Acrosterigma capricorne* n. sp., *Fulvia* (*Fulvia*) *colorata* n. sp., *F. (F.) vepris* n. sp., *F. (Laevifulvia) subquadrata* n. sp., *F. (L.) imperfecta* n. sp., *Pseudofulvia caledonica* n. gen., n. sp., *P. arago* n. gen., n. sp., *Ctenocardia gustavi* n. sp., *C. fijianum* n. sp., *C. (Microfragum) subfestivum* n. sp. The new species are easily differentiated from conspecifics in details of hinge, dentition, lunular shape and area, rib number and/or rib ornamentation, but often differ in gross morphological features, such as coloration, shape and size as well. *Ctenocardia gustavi* n. sp., *C. (Microfragum) subfestivum* n. sp. and *Pseudofulvia caledonica* n. gen., n. sp. are relatively large-bodied, with a wide distribution throughout the western Pacific. In contrast, *Acrosterigma capricorne* n. sp. and *Pseudofulvia arago* n. gen., n. sp. are known only from the Austral Islands and considering the intensive collecting efforts in the region, they appear restricted in their distributions.

KEY WORDS

Mollusca,
Bivalvia,
Cardiidae,
tropical western Pacific,
diversity,
new genus,
new species.

RÉSUMÉ

Dix nouvelles espèces de Cardiidae (Mollusca, Bivalvia) de Nouvelle-Calédonie et du Pacifique tropical ouest.

La faune de l'Indo-ouest Pacifique tropical est exceptionnellement variée, mais mal connue, et l'étude soignée des compositions faunistiques amène à la mise en évidence de nouvelles espèces, grâce également à des approches nouvelles (espèces cryptiques décelées par analyse moléculaire) et/ou par des efforts de récolte rigoureux. Dans le but d'évaluer la biodiversité de la faune de mollusques de l'ouest Pacifique, des expéditions de récoltes systématiques et complètes ont été réalisées depuis 1978, centrées sur la Nouvelle-Calédonie. En nous basant sur les études passées des Cardiidae de l'ouest Pacifique, nous mettons en évidence dans la région un genre nouveau de Cardiidae (*Pseudofulvia* n. gen.) et 10 espèces nouvelles: *Acrosterigma capricorne* n. sp., *Fulvia* (*Fulvia*) *colorata* n. sp., *F. (F.) vepris* n. sp., *F. (Laevifulvia) subquadrata* n. sp., *F. (L.) imperfecta* n. sp., *Pseudofulvia caledonica* n. gen., n. sp., *P. arago* n. gen., n. sp., *Ctenocardia gustavi* n. sp., *C. fijianum* n. sp., *C. (Microfragum) subfestivum* n. sp. Les espèces nouvelles sont facilement différenciées de leurs congénères par des détails de la charnière, les dents, la forme de la zone lunulaire, le nombre et/ou l'ornementation des côtes, mais diffèrent souvent aussi par des caractères morphologiques plus généraux, comme la coloration, la forme et la taille. *Ctenocardia gustavi* n. sp., *C. (Microfragum) subfestivum* n. sp. et *Pseudofulvia caledonica* n. gen., n. sp. sont de dimensions relativement importantes, avec une large distribution à travers l'ouest Pacifique. Par contre *Acrosterigma capricorne* n. sp. et *Pseudofulvia arago* n. gen., n. sp. ne sont connus que des Îles Australes et, compte tenu de l'intensité des efforts de récolte dans la région, semblent être de distribution restreinte.

MOTS CLÉS

Mollusca,
Bivalvia,
Cardiidae,
Pacifique tropical ouest,
diversité,
genre nouveau,
espèces nouvelles.

Jacques Vidal passed away while this paper was in press. An obituary will be published by the Belgian Society of Malacology, with a list of his publications, and the present paragraph is essentially a personal evocation from the Paris malacology group.

Unlike most amateurs whose retirement is the continuation and culmination of a hobby pursued during active life, Jacques Vidal had surprisingly never contacted or visited the museum until the year of his retirement in 1984. However, when he approached the malacology group that year, it was obvious that he had been a covert bivalvist and had mentally prepared himself for that moment since long before. He knew exactly what he came to the museum for: do research on the taxonomy of the Cardiidae, and no other bivalve group. This second career as volunteer bivalve taxonomist lasted nearly 23 years, a little less than his first career as petroleum geologist which he exercised between 1954 and 1984. During his "cardiid

tenure" at MNHN, Jacques networked extensively and eclectically with other cardiid enthusiasts, collectors, curators, dealers and researchers. All valued his sharp eye for species segregation, and he excelled especially on frontier Indo-Pacific faunas. For a Frenchman of his generation (he was born in 1926), it would have been natural to publish his results in French in a French journal, yet his first paper in 1991 was in English in an Australian journal, quite a demonstration of openness indeed. Except the summer months spent at his house in Brittany, Jacques devoted a very regular and dedicated schedule to his cockles, up until May 2006. His illness was fortunately short and he died on September 22, 2006, while most of us in malacology were in the field in Espiritu Santo. The cockles, his museum colleagues, and all his friends and correspondents will miss him.

Philippe Bouchet
on behalf of the Paris malacology group

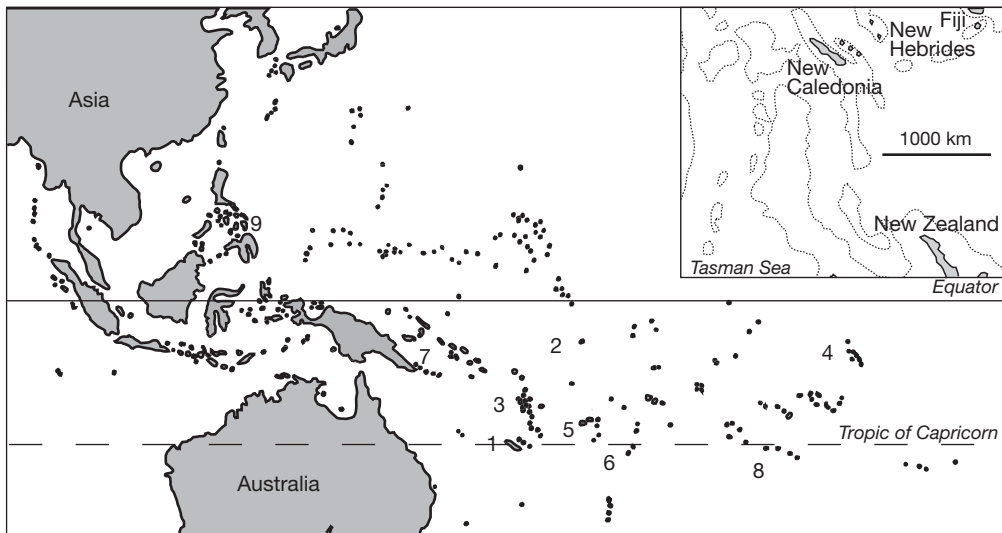


FIG. 1. — Simplified schematic map showing main collecting areas for French expeditions from 1978 to 2004 (delimited by numbers 1-9). Extensive dredging efforts occurred at station 1 (inset map, after Poutiers [1992] where dotted lines represent 1000 m isobaths). Refer to text for specific locality information.

INTRODUCTION

The family Cardiidae is one of the most diverse, abundant and well-known marine bivalve families of shallow tropical seas (Morton 2000; Hylleberg 2004). Members of the family have been the focus of detailed morphological (Yonge 1936, 1981; Kawaguti 1950, 1968, 1983; Savazzi 1985; Norton *et al.* 1992; Ohno *et al.* 1995; Carter & Schneider 1997; Morton 2000; Farmer *et al.* 2001), taxonomic (Bartsch 1947; Keen 1951; Poutiers 1981, 1992; Vidal 1994, 1999) and phylogenetic studies (Kafanov & Popov 1977; Keen 1980; Schneider 1995, 1998a, b; Schneider & O'Foighil 1999; Schneider & Carter 2001). Known from the Triassic, the family has also been well-studied paleontologically; especially noteworthy is a huge and well-documented radiation of extinct lymnocardines described from the Mediterranean (Nevesskaja *et al.* 2001). However, even given this wealth of attention, the family has never been systematically revised and the biodiversity of the family, especially in remote tropical regions, is still poorly known with large, conspicuous species regularly discovered (see Vidal 1994, 1997a, 2000a, 2003).

In an effort to quantitatively document the biodiversity of invertebrates from a wide range of habitats in remote tropical settings, the Nouméa branch of IRD (formerly ORSTOM), in association with the MNHN, have been pioneers. Since 1978, the waters of New Caledonia and of the tropical south-western Pacific have been the focus of extensive invertebrate sampling programs by these two groups (see Richer de Forges 1990, 1993; Richer de Forges & Menou 1993; Richer de Forges *et al.* 1996, 1999, 2000a, b; Richer de Forges & Chevillon 1996) (Fig. 1; Table 1). One goal of several of these expeditions was to study and compare the species richness of coral reef ecosystems with (Expédition MONTROUZIER 1993) and without (LIFOU 2000) barrier reef and lagoonal environments. Examination of molluscan samples from all of the collections yielded an initial nine new species and two subspecies of Cardiidae (Vidal 1993, 1994, 1997a, b, 1999) (Table 1). Further examination of earlier collections, coupled with analysis of material from the more recent expeditions, has resulted in the discovery of an additional 10 new species and one new genus that we report here.

TABLE 1. — FRENCH EXPEDITIONS TO THE CENTRAL PACIFIC FROM 1978 TO 2004.

Name	Year	Vessel	Locality sampled	Figure 1 reference
VAUBAN	1978-1979	RV <i>Vauban</i>	Lagoon of New Caledonia	1
LAGON 1-6	1984	RV <i>Vauban</i>	Lagoon of New Caledonia	1
CHALCAL 1	1984	RV <i>Coriolis</i>	Chesterfield and Bellona	1
LAGON 7-9	1985	RV <i>Vauban</i>	Lagoon of New Caledonia	1
MUSORSTOM 4	1985	RV <i>Vauban</i>	Slope north and south of New Caledonia	1
LAGON 10	1986	RV <i>Vauban</i>	Lagoon of New Caledonia	1
MUSORSTOM 5	1986	RV <i>Coriolis</i>	Chesterfield, Bellona and Lord Howe Ridge	1
SMIB 2	1986	RV <i>Vauban</i>	S of Île des Pins, on southern slope	1
LAGON 11	1987	RV <i>Vauban</i>	Lagoon of New Caledonia	1
BIOGEOCAL	1987	RV <i>Coriolis</i>	SE slope of New Caledonia, Loyalty Basin	1
CORAIL 2	1988	RV <i>Coriolis</i>	Chesterfield	1
LAGON 12	1988	RV <i>Alis</i>	Lagoon of New Caledonia	1
LAGON 13	1989	RV <i>Alis</i>	Lagoon of New Caledonia	1
MUSORSTOM 6	1989	RV <i>Alis</i>	Loyalty Ridge	1
MUSORSTOM 7	1992	RV <i>Alis</i>	Wallis and Futuna	2
BERYX 11	1992	RV <i>Alis</i>	Norfolk Ridge	1
BATHUS 1	1993	RV <i>Alis</i>	E outer slope of Grande Terre	1
BATHUS 2	1993	RV <i>Alis</i>	SW outer slope of Grande Terre	1
BATHUS 3	1993	RV <i>Alis</i>	Outer slope, Loyalty Ridge, Norfolk Ridge	1
BATHUS 4	1993	RV <i>Alis</i>	Outer slope at W and N of Grande Terre, Grand Passage	1
HALIPRO 1	1994	RV <i>Alis</i>	E and SW outer slope	1
MUSORSTOM 8	1994	RV <i>Alis</i>	Vanuatu	3
MUSORSTOM 9	1997	RV <i>Alis</i>	Marquesas Islands	4
MUSORSTOM 10	1998	RV <i>Alis</i>	Fiji	5
SUVA 4	1999	RV <i>Alis</i>	Fiji	5
BORDAU 1	1999	RV <i>Alis</i>	Fiji	5
BORDAU 2	2000	RV <i>Alis</i>	Tonga	6
SALOMON 1	2001	RV <i>Alis</i>	Solomon Islands	7
BENTHAUS	2002	RV <i>Alis</i>	Austral Islands	8
PANGLAO	2004		Philippines	9
Expedition	1993	(<i>Dawa</i>)	Touho on the E coast and Koumac on the W coast of Grande Terre	1
MONTROUZIER			Grande Terre	
Atelier LIFOU	2000	(RV <i>Alis</i>)	Baie du Santal, Lifou, Loyalty Islands	1

MATERIALS AND METHODS

The bulk of the material examined in this study originates from the littoral workshops and the offshore expeditions on French research vessels from IRD (RV *Vauban* and *Alis*) and IFREMER (RV *Coriolis*) during the last 25 years (Table 1). These collections are largely housed in the MNHN, but several lots of specimens taken into account are from other expeditions, other museums (e.g., Florida Museum of Natural History), or are in private collections.

The descriptions generally follow standard morphometrics and character descriptions for bivalves. These include: $H \times L \times W$ with H, height, distance

from the umbo to the ventral margin, perpendicular to the hinge line; L, length, maximum dimension parallel to the hinge line and to the two adductor scars (Fig. 2A) (Cox *et al.* 1969: N42); W, width, thickness or tumidity of the two valves closed together (Fig. 2C). When only one valve is present, the extrapolated W is in brackets (Vidal 1999).

Certain measurements and descriptions delineate features found widely in bivalves, but with shapes or placements specific to the Cardiidae; these are briefly reviewed here. The lunular area (II in Fig. 2E, F), which corresponds to the lunule of traditional bivalve morphology, is the external antero-dorsal part of the shell situated between the umbo and approximately the posterior end of the

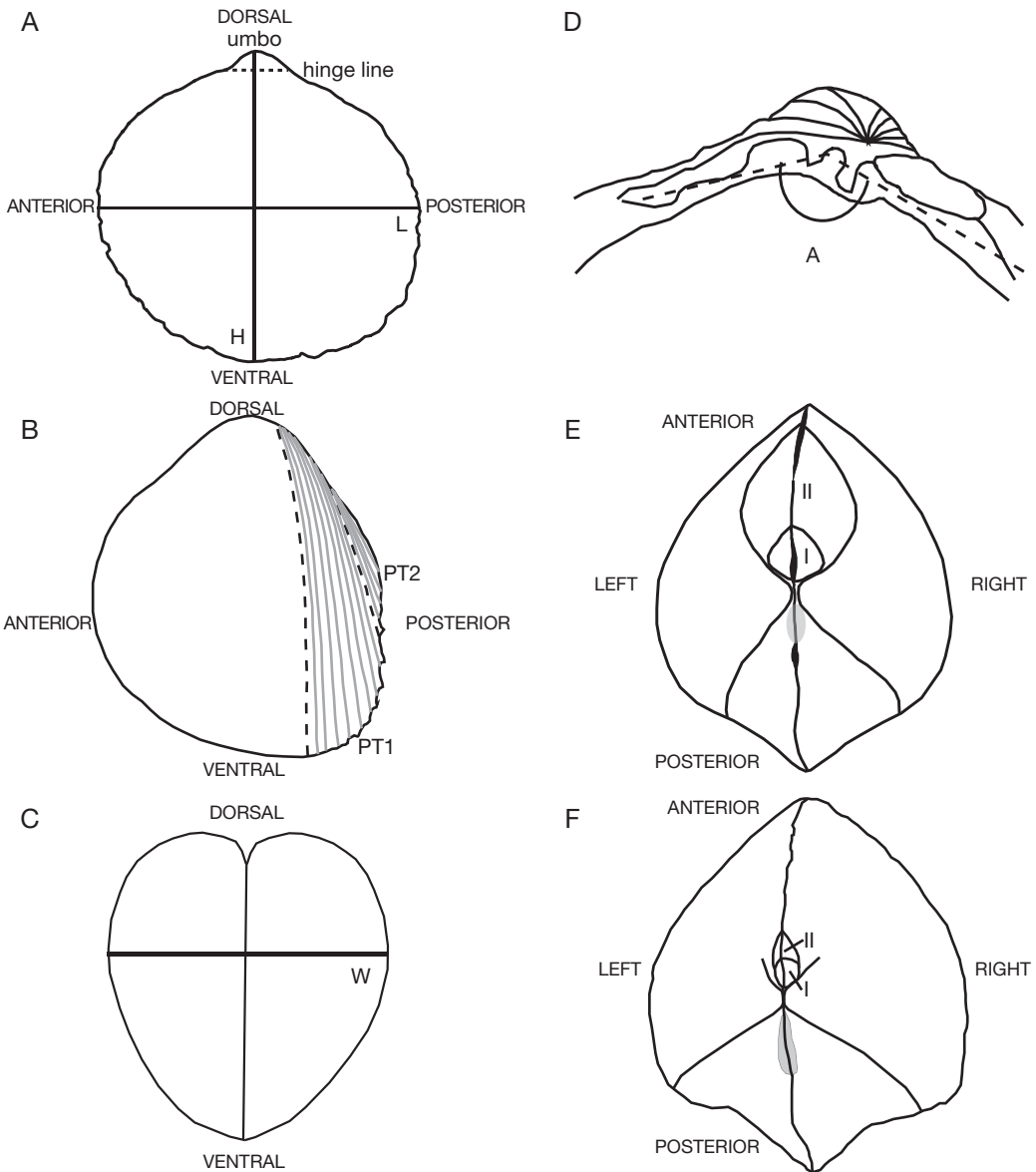


FIG. 2. — Morphometrics used in this study to differentiate cardiid taxa: **A**, delineates height (**H**) and length (**L**) measurements; **B**, external shell regions **PT1**, **PT2** (typical of *Pseudofulvia* n. gen.); **C**, width (**W**); **D**, angle **A**, the angle formed by the most dorsal cardinal and laterals; **E**, **I**, the lunular heart and **II**, the lunular area (typical of *Fulvia*); **F**, **I**, the lunule s.s. and **II**, the lunular area (typical of *Ctenocardia*). For **A**, **B**, **D** the left valve is figured. Refer to Materials and methods for further description of these terms, see also Vidal (1994).

anterior lateral shelf. Although variable in width, this zone is often delimited by a rounded margin angle, exhibits a distinctive coloration and is of-

ten distinctly ribbed, with ribs that are flattened, depressed, furrowed or lacking, depending on the taxon. In *Fulvia* Gray, 1853 and *Laevicardium*

Swainson, 1840, a smooth zone without ribs and marginal serrations further extends the lunular area anteriorly (sublunule of Vidal 1994). Within the lunular area, the margin of the zone close to the umbo is often more or less raised, thickened on both valves and sometimes this raised part extends towards the umbo, forming a more or less triangular flat pad. This pad is generally more developed on the right valve and may or may not touch the umbo. On a closed shell with conjoined valves, the pads often resemble a heart, and are referred to as the "lunular heart" (I in Fig. 2E) (Vidal 1994). Taxa in the genera *Fulvia* and *Laevicardium* exhibit this feature, as do taxa in *Vepricardium* Iredale, 1929, *Fragum* Roding, 1798, and the Protocardiinae. In some genera of Fraginae, including *Lunulicardia* Gray, 1853 where it is most pronounced, but also less so in *Ctenocardia* H. Adams & A. Adams, 1858, the lunular area suddenly subsides towards the umbo, forming a small hollow zone, what we refer to as the "lunule" (I in Fig. 2F).

In the Cardiidae, the hinge configuration is of subfamilial or generic importance. However, the distance between the laterals and the cardinals, which provides information about shell symmetry, can be important at the species level. The angle formed by the cardinals with respect to the laterals, characterized here as "angle A", is also a useful measurement (Vidal 1999). This measurement quantitatively illustrates the degree of pointing of the umbonal area and inflation of the valves (Fig. 2D). Specific characters of the external shell used in this study include rib number as well as shape, size and disposition of ribs; interstices and presence or absence of spines, tubercles, bars, hollows and the position of these ornaments on top of, or on the anterior or posterior regions of the ribs, or in the interstices. The presence or absence of granulations and pustules, aligned on a given part of the exterior shell surface, is a generic and sometimes specific character. Periostracal insertions may be longitudinally placed on the top, or on the posterior margin, of the ribs. These insertions are of generic or subgeneric importance, and can be informative at the specific level in certain taxa (e.g., among species of *Fulvia* and *Vepricardium*).

Occasionally, coloration and markings may exhibit characteristic and consistent patterns that are informative in delineating taxa. Coloration of the margin, the posterior zone (internal and/or external), the lunular area, the umbonal cavity, and certain parts of the hinge, such as the nymphal plate, are generally consistent irrespective of ontogeny, ecology or geography and are thus useful in circumscribing species.

Locality information is presented from broader to more specific and includes, when available: campaign (upper case), locality, station number, latitude and longitude, depth (m), environment and shell type/number. Shell measurements (H × L × W) are given for types and type localities refer to the holotype and often one or more paratypes. When additional paratypes are recognized and their localities differ from type localities, paratype localities are stated under material examined. All shells are deposited in MNHN unless stated otherwise. Descriptions of new species follow a standard format with a general shell description first, followed by comments on the lunular region, coloration, hinge, rib and rib ornamentation; this last discussed from posterior to anterior slope. The hinge is discussed only when it is informative in delineating species, and is not discussed if it is typical of the genus. Seven of the 10 newly described species have morphometric measurements summarized in tabular format for quick review (Tables 2-8). These taxa were chosen as they had significant amounts of material for examination and comparison (see individual descriptions for *F. vepris* n. sp., *F. imperfecta* n. sp., *Pseudofulvia arago* n. gen., n. sp. that do not have individual tables).

ABBREVIATIONS

Acronyms of institutions and repositories

FLMNH	Florida Museum of Natural History, Gainesville;
IFREMER	Institut français de Recherche pour l'Exploitation de la Mer;
IRD	Institut de Recherche pour le Développement (formerly ORSTOM);
MNHN	Muséum national d'Histoire naturelle, Paris;
NSMT	National Science Museum, Tokyo;
ORSTOM	Organisme de Recherche scientifique dans les Territoires d'Outre-Mer.

TABLE 2. — *Fulvia colorata* n. sp., measurements (mm) and rib number (N) of type material.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, east of Guadalcanal, Solomon Island	16.1	14.3	10.2	0.89	0.71	51
MNHN	Paratype 1, Philippines, Panglao, stn T6	16.4	14.0	10.9	0.85	0.78	55
MNHN	Paratype 2, Philippines, Panglao, stn T6	13.5	12.0	8.7	0.89	0.72	45

Material

lv left valve;
 rv right valve;
 cv fresh-dead specimen (with ligament present and/or valves intact).

SYSTEMATICS

Family CARDIIDAE Lamarck, 1809
 Subfamily CARDIINAE Lamarck, 1809
 Genus *Fulvia* Gray, 1853
 Subgenus *Fulvia* Gray, 1853

Fulvia (Fulvia) colorata n. sp.
 (Fig 3A-C; Table 2)

TYPE MATERIAL. — Holotype: cv, 16.1 × 14.3 × 10.2 mm. Paratypes (2): cv, 16.4 × 14.0 × 10.9 mm; cv, 13.5 × 12.0 × 8.7 mm.

ETYMOLOGY. — Strongly coloured.

TYPE LOCALITY. — SALOMON I, 2001, E of Guadalcanal, Solomon Islands, stn CP 1810, 9°47.7'S, 160°50.5'E, 53 m.

MATERIAL EXAMINED. — **Philippines.** PANGLAO 2004, Bohol Island, W of Baclayon, stn T6, 9°35.1'N, 123°51.2'E, 34-82 m, coarse muddy sand with large sponges, 2.VI.2004, 2 cv (paratypes) + 1 lv.

DISTRIBUTION. — Known from the Solomon and Philippines Islands.

DESCRIPTION

Shell small, subrectangular and rather elongate (L/H 0.89), almost symmetrical, with posterior margin almost straight in its middle.

Lunular area well-differentiated, smooth, slightly concave, with a significant, typically rounded lunular heart. Sublunule short and smooth.

External and internal coloration with numerous dense, brown small spots, more or less concentrically arranged and sometimes entirely white.

Ribs 45-55.

Ribs are higher and flatly rounded on the posterior third of the valve, with wider interstices compared with other shell regions and periostracal insertions largely restricted to the tops of the ribs. On the most median and anterior shell areas, ribs very low, almost flat and discernible by periostracal insertions present on posterior rib margin; interstices narrower than ribs.

Ocular organs present.

MICROHABITAT

The material from the Philippines was fresh dead and likely lived where it was collected, from 34-82 m in coarse muddy sands.

REMARKS

Fulvia colorata n. sp. differs from four small *Fulvia* found in this region (*F. undatopicta* Pilsbry, 1904, *F. hungerfordi* Sowerby, 1901, *F. scalata* Vidal, 1994, *F. dulcis* Deshayes, 1863) in three consistent gross morphological features. *Fulvia colorata* n. sp. 1) is more elongate and less inflated (L/H 0.85-0.89, compared with 0.94-1.16 for other four taxa, Table 9); 2) exhibits specific colour patterning of numerous densely-packed small brown spots that are never observed in these other taxa; and 3) completely lacks granulations, which all the other species possess to varying degrees. *Fulvia colorata* n. sp. also differs from another similar *Fulvia* from this region, *F. lineonotata* Vidal, 1994, in being less elongate (*F. colorata* n. sp. L/H 0.85-0.89, compared with 0.8-0.9, see Table 9) and possessing a much shorter sublunular area.

Fulvia (Fulvia) vepris n. sp.
 (Fig. 3D-F)

TYPE MATERIAL. — Holotype: cv, 15.8 × 15.8 × 10.8 mm. Paratypes (2): cv, 15.7 × 16.2 × 11.0 mm; cv, 11.0 × 11.7 × 6.2 mm (Dautzenberg coll.).

TABLE 3. — *Fulvia subquadrata* n. sp., measurements (mm) and rib number (N) of type material.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, New Caledonia, Touho	6.4	6.4	4.7	1.00	0.73	36
MNHN	Paratype 1, New Caledonia, Touho	8.3	8.0	(6.4)	0.96	0.80	42
MNHN	Paratype 2, New Caledonia, Touho	8.0	8.0	(6.0)	1.00	0.75	38
MNHN	Paratype 3, New Caledonia, Touho	6.8	6.6	(4.8)	0.97	0.73	36
MNHN	Paratype 4, New Caledonia, Touho	6.0	6.1	4.6	1.02	0.75	39

TYPE LOCALITY. — New Caledonia, exact locality not specified.

ETYMOLOGY. — The name alludes to the similarities with members of the genus *Vepricardium* in many gross shell features, more so than any other *Fulvia* studied thus far. The existence of this new intermediate form, which shares four significant characters with *Vepricardium*, provides the first evidence that these genera may be more closely related than previously thought (Schneider 1992, 1995).

DISTRIBUTION. — New Caledonia.

DESCRIPTION

Shell small, subcircular and subsymmetrical, very slightly oblique, and not posteriorly straightened.

Lunular area small, slightly flattened, margin convex in left valve, concave in right valve; lunular heart long and narrow; no sublunule.

Exterior whitish with rare, irregular, concentric pink blotching; last five posterior ribs light pink; umbo dark pink, with pink colour extending ventrally as a ray. Lunular area white. Interior white, except for a slight pink colour in the umbonal cavity and a strongly pink-stained posterodorsal margin. Adductor scars with pink spotting and staining.

Hinge plate characteristic of the genus *Fulvia* (Vidal 1994: 97) in being narrow, thin and moderately curved (120-150°), occasionally angled in the anterior. However, the hinge differs slightly from other *Fulvia* in being symmetrical and with a long ligament.

Ribs 52-54.

Ribs (*c.* 14) are larger in the posterior third of the shell than in the medio-anterior shell regions, and the periostracal line bears tubercles. The last five ribs in the posterior are split into two parts by a slight furrow and bear more numerous, regularly disposed, tubercles than ribs in the anterior area of the shell. On the most median and anterior part of

the shell, the ribs are low, flatly rounded, slightly asymmetrical, with their posterior margin slightly raised and bearing thin periostracal insertions; interstices narrow. The anterior most ribs are flatter and larger compared with adjacent anterior ribs.

REMARKS

As the name suggests, *Fulvia vepris* n. sp. shares some characters with species in the genus *Vepricardium*: solidity of the shell, absence of a sublunular area, relatively high ribs on the median shell region and presence of carbonaceous tubercles. However, like species of *Fulvia*, *F. vepris* n. sp. exhibits localized periostracal insertions, possesses a well-developed lunular heart and has a typical *Fulvia* hinge. The tubercles on the anterior and posterior zones are unique to *F. vepris* n. sp. and immediately distinguish it from all other members of the genus. *Fulvia vepris* n. sp. can be further differentiated from *F. colorata* n. sp. in being more solid, less elongate (L/H 1.03 compared with 0.89 for *F. colorata* n. sp., Table 9) and less intensely coloured. *Fulvia vepris* n. sp. is represented by a sole lot of three shells from the Dautzenberg collection (New Caledonia) housed at the MNHN.

Subgenus *Laevifulvia* Vidal, 1994

Fulvia (Laevifulvia) subquadrata n. sp. (Fig. 3G-I; Table 3)

TYPE MATERIAL. — Holotype: cv, 6.4 × 6.4 × 4.7 mm. Paratypes (4): 1 lv, 8.3 × 8.0 × (6.4) mm; 1 lv, 8.0 × 8.0 × (6.0) mm; 1 rv, 6.8 × 6.6 × (4.8) mm; cv, 6.0 × 6.1 × 4.6 mm.

TYPE LOCALITY. — Expédition MONTROUZIER 1993, Baie de Touho, E coast of New Caledonia, stn 1250, 20°46.7'S, 165°13.7'E, 3-6 m, in sandy mud (paratypes come from type locality).

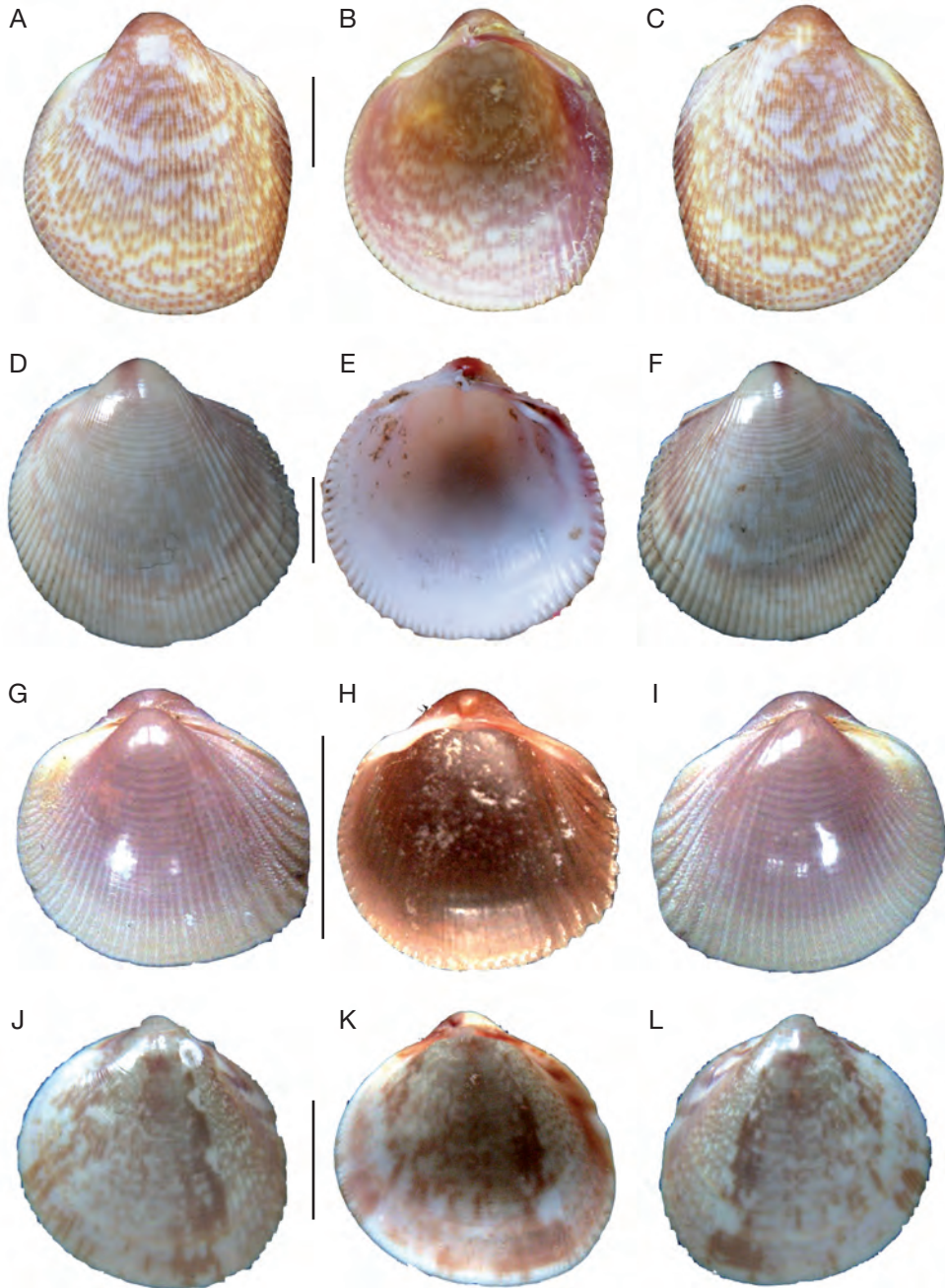


FIG. 3. — A-C, *Fulvia colorata* n. sp.; D-F, *F. vepris* n. sp.; G-I, *F. subquadrata* n. sp.; J-L, *F. imperfecta* n. sp. Scale bars: 5 mm.

ETYMOLOGY. — In reference to the quadrate character of the shell that differentiates it from other small or juvenile *Fulvia* in this region.

MATERIAL EXAMINED. — New Caledonia. Expédition MONTROUZIER 1993, Baie de Touho, stn 1250, 20°46.7'S, 165°13.7'E, 3-6 m, sandy mud, numerous

cv and valves. — Baie de Touho, stn 1237, 20°49.9'S, 165°13.8'E, 0-1 m, fine sand, numerous cv and valves. — Anse de Tiouandé, stn 1267, 20°43'S, 165°02.0'E, 0 m, fine sand, 1 valve. — Baie de Gatope, stn 1295, 20°58'S, 164°39.5'E, 0 m, fine sand, 1 rv + 1 lv.

Solomon Islands. SALOMON I 2001, stn 1767, 8°19.4'S, 160°39.9'E, 98-200 m, 4 valves. — Stn 1768, 8°21.4'S, 160°41.8'E, 194-286 m, 1 rv.

DISTRIBUTION. — Known from the northern part of New Caledonia and the Solomon Islands.

DESCRIPTION

Shell very small to small (max. H = 8.8, L = 9.0 mm), subquadrangular; almost symmetrical. Posterior margin quite straight and forming a weak, rounded angle with the middle third of the shell. Anterior margin rounded and slightly angled in the lunular area.

Lunular area narrow, flattened, occasionally slightly concave in the right valve; lunular heart small and well-formed; sublunule short.

Colour uniformly red-brown, rarely entirely white, shell neither translucent nor glossy; except for lunular region that ranges from white to translucent.

Ribs 36-42.

Posterior third of valve sculpted by approximately 10 rounded ribs with rounded interstices of comparable width. In middle and anterior shell regions, ribs becoming narrower, flatter and least distinct in median third of valve. Periostracal insertions absent along the ribs. Entire external shell surface of adult specimens covered with abundant, pronounced, irregular granulations, except on lunular and sublunular areas.

MICROHABITAT

This species has been live-collected from 0-6 m in fine to muddy sand in Baie de Touho, New Caledonia.

REMARKS

Fulvia (Laevifulvia) subquadrata n. sp. lacks periostracal insertions on the external shell surface, like other *Laevifulvia* species, but unlike *F. (Fulvia) Fulvia (L.) subquadrata* n. sp. is most similar to juvenile specimens of *F. (L.) undatopicta* among small, co-occurring *Laevifulvia*. However, it is smaller (adult comparison), much more tumid, more subquadrate, more uniform in colour, with

stronger ribs and stronger and much more numerous, sporadically-distributed granulations (Table 9).

Fulvia (Laevifulvia) imperfecta n. sp. (Fig. 3J-L)

TYPE MATERIAL. — Holotype: cv, 10.9 × 10.3 × 5.8 mm. Paratype: cv, 8.4 × 8.2 × 4.3 mm.

TYPE LOCALITY. — SALOMON I 2001, E of Guadalcanal, Solomon Islands, stn CP 1809, 9°48.4'S, 160°51.0'E, 39-53 m.

ETYMOLOGY. — In reference to the "imperfect" character of lacking ribs on the posterior half of the posterior slope (zone PT2).

MATERIAL EXAMINED. — **Solomon Islands.** SALOMON I 2001, E of Guadalcanal, stn CP 1809, 9°48.4'S, 160°51.0'E, 39-53 m (holotype).

Philippines. Bohol Island, Pipe Point, 1 cv paratype, 8.4 × 8.2 × 4.3 mm (Ter Poorten collection).

Indonesia. Irian Jaya, Ostheimer Orr, stn 489, 1 cv, ANSP 206060 (*vide* Ter Poorten). — Not specified locality, 1 cv, 17.2 × 15.2 × 9.4 mm, 74 ribs (MNHN, H. Fischer collection).

DESCRIPTION

Shell small, thin, rounded and compressed, symmetrical, very slightly oblique.

Lunular area poorly differentiated, smooth; lunular heart long and very narrow, hardly visible in right valve; sublunule approximately as half as long as hinge.

Shell translucent with numerous, small, irregular, longitudinally-arranged brown splashes, most intense along the medio-anterior margin. Shell interior reflects exterior by transparency.

Hinge plate characteristic of the genus *Fulvia* (Vidal 1994: 97) in being narrow, thin and moderately curved (120-150°), occasionally angled in the anterior, but different in this taxon as notably and consistently red in coloration.

Ribs approximately 76.

Six to seven large ribs on the posterior slope, close to the median shell region (zone PT1, Fig. 2B), are coloured by white splotches observable both on the exterior and interior of the shell. The remaining part of the posterior margin (zone PT2, Fig. 2B) is larger than PT1, smooth and without marginal crenula-

TABLE 4. — *Pseudofulvia caledonica* n. sp., measurements (mm) and rib number (N, roughly estimated because of difficulty counting accurately) of type material and one additional exemplary specimen.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, New Caledonia, Passe de Koumac	13.4	12.1	8.2	0.90	0.68	43
MNHN	Paratype 1, New Caledonia, Passe de Koumac	12.0	10.9	(7.8)	0.91	0.72	43
MNHN	Paratype 2, New Caledonia, Passe de Koumac	9.6	8.6	6.4	0.90	0.74	43
MNHN	Paratype 3, New Caledonia, Lifou Is.	10.0	9.7	7.0	0.97	0.72	43
MNHN	Fiji, south of Viti Levu, stn DW 1388	8.2	7.7	(4.6)	0.94	0.60	43

tions. Ribs of the anterior and median shell regions (zones AT1 and MT, Vidal 1994) are virtually impossible to discern externally, but clearly evident as internal marginal crenulations, about 70 in number. Periostracal insertions absent along the ribs.

REMARKS

Fulvia (*L.*) *imperfecta* n. sp. is attributable to *Laevifulvia* because it lacks periostracal insertions on the external shell surface. Unlike co-occurring congeners, *F. (L.) imperfecta* n. sp. lacks any evidence of ribs on the posterior part of the posterior slope (zone PT2). Although many other character combinations also distinguish *F. (L.) imperfecta* n. sp. from the other new species of *Fulvia* described here (Table 9), this character most readily distinguishes this taxon from all others.

Genus *Pseudofulvia* n. gen.

DIAGNOSIS. — This new genus shares one important character with *Fulvia*: stronger ribs on the posterior slope than on the median and anterior shell regions (Vidal 1994). However, it differs from *Fulvia* in having: 1) very asymmetrical or “fragiform” outline, with a relatively pronounced keel or carina delimiting the posterior shell region (a character also shown by *Fulvia fragiformis* Vidal, 1994); 2) posterior ribs and interstices that are very strong and triangular; 3) poorly developed anterior ribbing; and 4) no ocular organs on the siphonal tentacles.

TYPE SPECIES. — *Pseudofulvia caledonica* n. sp. by present designation.

Pseudofulvia caledonica n. sp. (Fig. 4A-C; Table 4)

TYPE MATERIAL. — Holotype: cv, 13.4 × 12.1 × 8.2 mm. Paratypes (3): rv, 12.0 × 10.9 × (7.8) mm; rv, 9.6 × 8.6 × 6.4 mm; cv, 10.0 × 9.7 × 7.0 mm.

TYPE LOCALITY. — Expédition MONTRouZIER 1993, New Caledonia, Passe de Koumac, eastern slope, stn 1311, 20°40.4'S, 164°14.9'E, 10-60 m, hard bottom (first two paratypes come from type locality).

ETYMOLOGY. — After New Caledonia, where it was first discovered in relatively large numbers.

MATERIAL EXAMINED. — New Caledonia. Expédition MONTRouZIER 1993, Passe de Koumac, stn 1311, 20°40.4'S, 164°14.9'E, 10-60 m, hard bottom, 3 small cv live collected. — Passe de Koumac, stn 1323, 20°40.9'S, 164°14.8'E, 82-120 m, shelly muddy sand, 1 rv. — Grand Récif de Koumac, stn 1331, external slope, 20°40'S, 164°11.2'E, 55-57 m, 2 rv.

Atelier LIFOU 2000, Baie du Santal, Cap Aimé Martin, stn 1442, 20°46.4'S, 167°02.0'E, 47 m, on bottom of wall, 1 cv (third paratype). — Baie du Santal, off Peng, stn 1443, 20°53.8'S, 167°07.3'E, 48-52 m, 2 rv.

Fiji. MUSORSTOM 10, S of Viti Levu, stn DW 1384, 18°18.5'S, 178°05.8'E, 260-305 m, 1 rv. — Stn DW 1388, 18°18.5'S, 178°01.8'E, 313-446 m, 1 rv.

Philippines. PANGLAO 2004, Panglao Island, Napaling, stn S28, 24.VI.2004, 9°37.2'N, 123°46.4'E, 28-32 m, reef wall with small caves, 1 valve. — Bohol Island, Ubajan, stn S26, 23.VI.2004, 9°41.5'N, 123°51.0'E, 21 m, mud, 1 cv. — Balicasag Island, stn B37, 2.VII.2004, 9°30.9'N, 123°40.8'E, 19-20 m, floor of cave A with corals and sponges, 1 cv.

DISTRIBUTION. — Known from the northern part of New Caledonia, Loyalty Islands, the Philippines and Fiji.

DESCRIPTION

Shell small (maximum size: 13.4 × 12.1 × 8.2 mm), inequilateral with posterior region longer and slightly more oblique than anterior. Posterior slope flat and forming a rounded angle with the median area; middle of posterior margin straight.

Lunular area medium size and well-differentiated, flattened, two sides equal. Lunular heart small and triangular; sublunule very developed, prism-shaped, almost touching umbos and with numerous small pustules.

External coloration of brown stains resembling fish scales in shape on approximately 4 or 5 large ribs of the posterior slope, on the most posterior of the posterior slope ribs, on the umbo and on the lunular area. Interior white and translucent, with external markings showing through to shell interior. Lunular area yellow.

Cardinals unconnected in right valve, connected in left valve. Laterals approximately equidistant from cardinals.

Approximately 43 ribs, with 12 or 13 large ribs on the posterior slope (PT1 and PT2) and approximately 30 small ribs on median and anterior shell regions; these latter ribs are very smooth and thus difficult to discern and count.

On the posterior slope and keel (PT1 and PT2), ribs large, wide, roundly triangular and asymmetrical in shape. Interstices triangular and of same width as ribs; thin periostracal insertions on top of ribs; on the most posterior ribs these insertions bear successive calcareous tubercles. Ribs very thin and weak on the median anterior quarter, hardly visible externally, more obvious from the interior reflected in the internal serrations of the ventral margin and visible through the relatively transparent shell. Anterior quarter of shell with smooth lunular, sublunular and medio-posterior regions and with a non-serrated shell margin. Entire exterior shell surface with numerous small pustules, most abundant on the anterior shell region.

MICROHABITAT

Although shells were recovered from depths of 10-446 m, live-collected specimens were found only in muddy sediments, often associated with small caves from 19-21 m in the Philippines.

REMARKS

This taxon shares three characters with the genus *Fulvia*: 1) stronger ribs on the posterior slope compared with the median and anterior shell regions; 2) the presence of a significant and punctuated sublunule; and 3) possession of granulations on the exterior shell surface. It is also similar to species in the subgenus *F.* (*Fulvia*) due to the presence of periostracal insertions. However, unlike most other *Fulvia* studied thus far, *Pseudofulvia caledonica*

n. sp. has a "fragiform" outline, with a relatively pronounced keel or carina, very thin ribs in the median and anterior shell regions, posterior ribs and interstices very strong and triangular, periostracal insertions limited to specific shell regions (including the apex of posterior ribs) and the absence of ocular organs on siphonal tentacles.

Pseudofulvia arago n. sp. (Fig. 4D-F)

TYPE MATERIAL. — Holotype, live-collected cv, 27.0 × 23.3 × 17.5 mm.

TYPE LOCALITY. — BENTHAUS 2002, Austral Ridge, Arago Bank, stn 1985, 23°26.3'S, 150°44.2'W, 100-107 m.

ETYMOLOGY. — In reference to the discovery of this species from the Arago Bank.

MATERIAL EXAMINED. — The holotype.

DISTRIBUTION. — Presently only known from the Arago Bank, Austral Islands.

DESCRIPTION

Shell medium, thin but solid, rather fragiform and inequilateral with posterior slope higher, more flattened and truncated than medio-posterior and anterior shell regions; anterior margin well rounded.

Lunular area narrow, short, very slightly depressed, smooth, with margins slightly raised but not touching umbo, no sublunule.

External colour white to light yellow on the umbonal area; interior white with yellow to yellow-orange spots in the umbonal cavity.

Cardinals connected in the right valve, unconnected in the left valve.

Ribs approximately 80.

Ribs on posterior slope divided into two regions (PT1 and PT2, Fig. 2B) of comparable size, separated by a very slight depression on the margin. Posterior zone (PT2) with 9 or 10 flatly triangular ribs, ornamented with serrated tubercular scales on rib tops. Anterior zone (PT1) with approximately 9 or 10 ribs, wider and more triangular than ribs of PT2 and without ornaments. Median region with

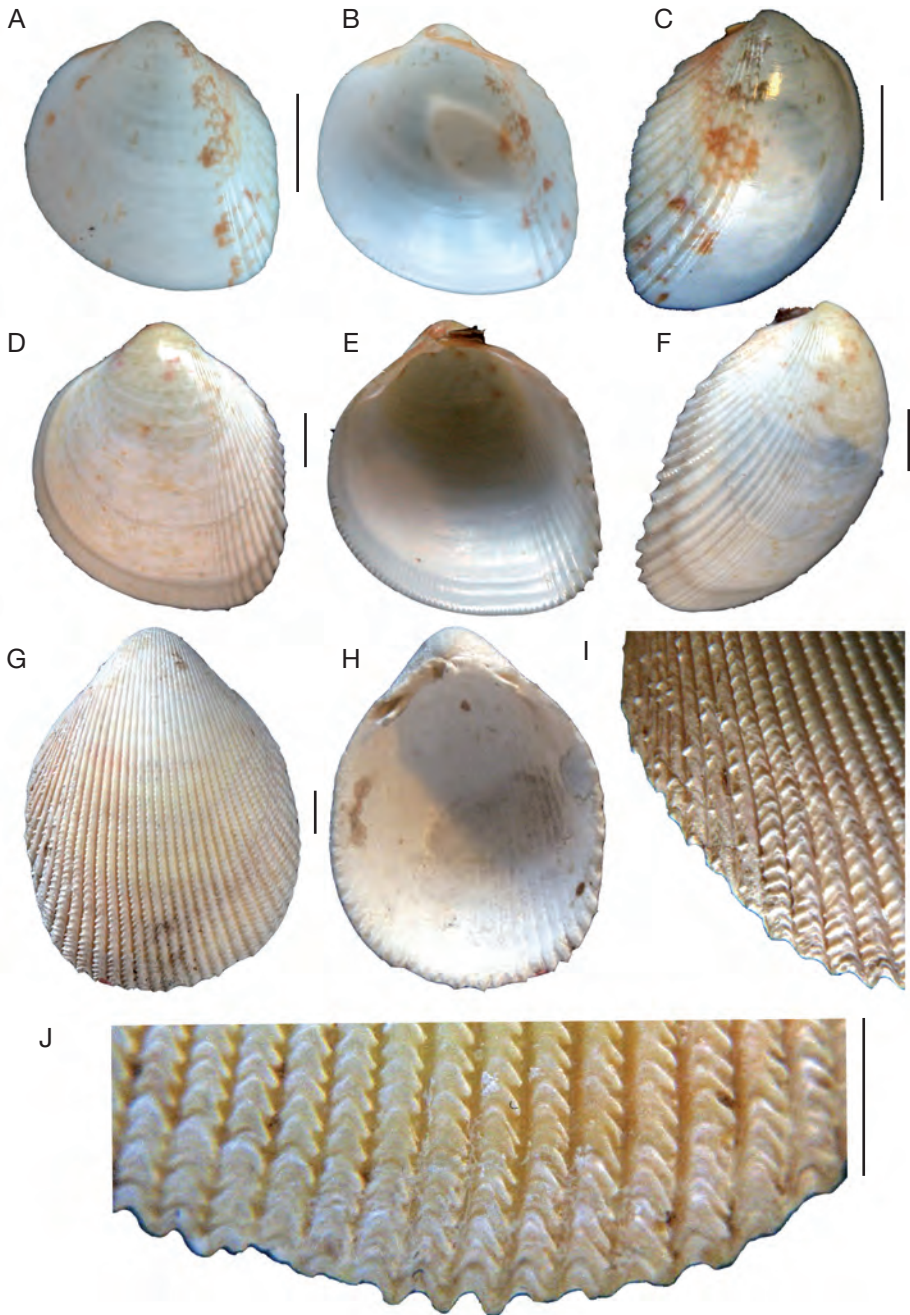


FIG. 4. — **A-C**, *Pseudofulvia caledonica* n. gen., n. sp.; **D-F**, *P. arago* n. gen., n. sp.; **G-J**, *Acrosterigma capricorne* n. sp.; **I**, highlighting detail of posterior and medio-posterior zones of left valve; **J**, highlighting medio-zones, with no herringbone structures in central region. Scale bars: 5 mm.

more than 60 narrow, flat to rounded ribs, with no indication of periostracal insertions.

Ocular organs absent.

ANATOMY

Siphonal area with two elongated apertures surrounded with thin, white tentacles.

MICROHABITAT

The single, live-collected specimen was recovered from 100-107 m.

REMARKS

This taxon shares one character with the genus *Fulvia*, stronger ribs on the posterior slope than on the median and anterior shell regions. However, unlike most other *Fulvia* studied so far, *Pseudofulvia arago* n. sp. has a "fragiform" outline, with a relatively pronounced keel or carina, very thin ribs in the median and anterior shell regions, posterior ribs and interstices very strong and triangular, no periostracal insertions on any shell region, no granulations on the exterior shell surface and finally, no ocular organs on siphonal tentacles. *Pseudofulvia arago* n. sp. is distinguished from *P. caledonica* n. sp. by its larger adult size, absence of exterior granulations, connected cardinals in the right valve and unconnected cardinals in the left valve, no sublunule and the complete absence of periostracal insertions.

Genus *Acrosterigma* Dall, 1900

Acrosterigma capricorne n. sp.
(Fig. 4G-J; Table 5)

TYPE MATERIAL. — Holotype: 1 rv, 40.5 × 30.6 × (26.8) mm. Paratypes (4): 1 lv, 39.2 × 30.2 × (27.4) mm; 1 rv, 30.4 × 25.0 × (22.0) mm; 1 rv, 26.1 × 21.2 × (18.4) mm; 1 rv, 58.1 × 47.6 × (35.0) mm.

TYPE LOCALITY. — BENTHAUS 2002, Austral Ridge, Banc Arago, stn DW 1985, 23°26.3'S, 150°44.2'W, 100-107 m (first two paratypes come from type locality).

ETYMOLOGY. — Found just south of the Tropic of Capricorn.

MATERIAL EXAMINED. — **Austral Islands.** BENTHAUS 2002, Austral Ridge, Tubuai Is., stn DW 1961, 23°20.9'S,

149°23.5'W, 470-800 m, 1 lv. — Récif Neilson, stn DW 1925, 27°00.3'S, 146°05.1'W, 560-790 m, 1 rv (fourth paratype). — Marotiri Is., stn DW 1885, 27°51.8'S, 143°32.6'W, 700-800 m, 1 rv. — Marotiri Is., stn DW 1887, 27°52.00'S, 143°32.7'W, 750-1000 m, 1 rv. — Tubuai Is., stn DW 1958, 23°19.6'S, 149°30.3'W, 80-150 m, 1 lv. — E of Rapa, stn DW 1891, 27°37.1'S, 144°15.4'W, 800-850 m, 1 rv. — E of Rapa, stn CP 1892, 27°38.8'S, 144°15.6'W, 742-1000 m, 1 lv. — E of Rapa, stn CP 1910, 27°38.2'S, 144°15.4'W, 840-1200 m, 1 lv. — Récif Neilson, stn DW 1923, 27°01.3'S, 146°05.3'W, 360-840 m, 1 rv and 1 lv. — Rurutu/Avera, stn DW 1996, 22°29.1'S, 151°21.9'W, 489-1050 m, 1 lv. — Stn DW 1997, 22°29.1'S, 151°22.3'W, 700-1350 m, 1 rv (third paratype). — E coast of Rurutu, stn DW 2003, 22°27.6'S, 151°18.9'W, 250-330 m, 1 lv.

DISTRIBUTION. — Found only on Austral Ridge, southwest Pacific.

DESCRIPTION

Shell of medium size, specimens on hand ranging from about 25 mm in length to 58.1 mm (paratype 4). Rather elongate (L/H range 0.76-0.91, mean 0.83) and moderately inflated (W/L range 0.65-0.90, mean 0.76). Shell never oblique, almost symmetrical; posterior margin always curved, never truncated.

Lunular area narrow, slightly hollowed, with margins somewhat raised along entire extent.

External colour uniformly yellow; internal shell coloration white.

Hinge characteristic of the *Acrosterigma uniornatum* species group (Vidal 1999: 271), with a rather symmetrical, moderately angled (A = 122-130°, see Fig. 2D) hinge and cardinals connected in the right valve by a shallow saddle.

Ribs 42-47.

Posterior half of shell with a similar arrangement of oblique scales on top and posterior side of individual ribs. Ornamentation of the posterior slope may contrast with that of the medio-posterior slope, the axial furrow on the posterior ribs, generally present in *Acrosterigma*, but absent in this species group can be sporadically present, with sessile, oblique scales less numerous and more tubercular (Fig. 4I). The first ribs of the posterior zone, and the last ribs of the median zone can bear short scales on the anterior flank of the ribs, forming an asymmetrical chevron-like structure together with the longer top and posterior scales. These

TABLE 5. — *Acrosterigma capricorne* n. sp., measurements (mm) and rib number (N) of type material.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, French Polynesia, Austral Ridge	40.5	30.6	(26.8)	0.76	0.86	43
MNHN	Paratype 1, French Polynesia, Austral Ridge	39.2	30.2	(27.4)	0.77	0.91	43
MNHN	Paratype 2, French Polynesia, Austral Ridge	30.4	25.0	(22.0)	0.82	0.88	43
MNHN	Paratype 3, French Polynesia, Austral Ridge	26.1	21.2	(18.4)	0.81	0.87	44
MNHN	Paratype 4, French Polynesia, Austral Ridge	58.1	47.6	(35.0)	0.82	0.74	44

anterior scales progressively disappear towards the anterior and the posterior, where the scales shorten and become limited to the posterior flank of the ribs (Fig. 4I, J). On the medio-anterior slope the posterior scales appear on the anterior flank of the ribs, forming a herringbone structure. These angled scales become progressively curved, low-rounded ornaments on the anterior slope.

MICROHABITAT

Found in depths from 80-1350 m. Recently dead material found at the shallowest depth, with older shells found at deeper depth. This indicates that *A. capricorne* n. sp. may live at the shallow end of this depth range, and be transported down slope *post mortem*. However, this species, like other taxa in the *Acrosterigma uniornatum* species group (Vidal 1999: 271), is really generally found at greater depth than most other Cardiidae (except Protocardiinae) in the western Pacific.

REMARKS

This species is allied to the *A. uniornatum* species-complex (Vidal 1999). It differs from other members of the group mainly in patterns of ornamentation on the external shell surface. The ornamentation on the medio-posterior slope has more marked axial furrows, with oblique scales less numerous and more tubercular than on the adjacent posterior slope, compared with congeners (Fig. 4I, J).

Subfamily FRAGINAE Stewart, 1930

Genus *Ctenocardia* H. Adams & A. Adams, 1858

REMARKS

Before description of new taxa allied to the genus *Ctenocardia* can occur, a brief discussion concerning

the genus and closely similar genera is necessary, as the genus *Ctenocardia*, like all Fraginae, has never been formally revised. Although the original description by H. Adams & A. Adams (1858) is brief, *Ctenocardia* was first recognized as distinct from other cardiids due to a heart-shaped form, an abruptly truncate anterior, a carinate beak and spinose ribs, this latter character being the main character differentiating the genus from other subfamily members. Much later, Habe (1951) described the genus *Microfragum* as having a small, flabelliform shell, with a more or less lobate posterior margin, not noticeably convex and without spikes on the radial ribs. This genus was erected in order to differentiate the type species, *Cardium festivum* Deshayes, 1855, from other members of the subfamily Fraginae. However, similarities among some members of *Ctenocardia* and *Microfragum* were evident and first recognized by Prashad (1932). Although Prashad (1932) did not include *M. festivum* in the subgenus *Ctenocardia*, the form and general facies of *M. festivum* were noted as similar to *Cardium* (*Ctenocardia*) *fornicatum* Sowerby, 1841. After examination of the type specimens of both genera by us, it is clear that these taxa share many shell features in common, yet are still distinct. The rib lamellae though similar to other members of *Ctenocardia* in being "mosaistracal" (*sensu* Vokes 1977) in nature, are distinct in being less spinose, thinner and more flattened and serrated. Similarly, the somewhat quadrate and keeled gross shell shape, most pronounced in juvenile specimens of *M. festivum*, is reminiscent of other *Ctenocardia* members, but adult *M. festivum* are less keeled and more flabelliform (although see *C. translatum* (Prashad, 1932)) than *Ctenocardia*. Finally, the presence of a second posterior lateral on the right valve is present in *Microfragum*, but less pronounced and less blade-like than in other *Ctenocardia* species, where it forms a pocket with the anterior lateral. To formally recognize both these

TABLE 6. — *Ctenocardia fijianum* n. sp., measurements (mm) and rib numbers (N) of type material.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, Fiji, Viti Levu, Beqa Lagoon	12.0	9.9	(9.0)	0.82	0.91	39
MNHN	Paratype 1, Fiji, Viti Levu, Beqa Lagoon	9.0	7.2	(6.0)	0.80	0.83	41
MNHN	Paratype 2, Fiji, Viti Levu, Beqa Lagoon	6.9	5.7	(4.6)	0.83	0.81	38

similarities and differences, we propose relegating *Microfragum* to a subgenus of *Ctenocardia*, with *C. (M.) festivum* and *C. (M.) subfestivum* n. sp. the only taxa presently allied to this subgenus. “*Microfragum*” *erugatum* (Tate, 1889) is not a member of this group and belongs in *Fragum*, as recognized by Vidal (2001), but in contrast with Schneider (1998a). “*Microfragum*” *ebaranum* (Yokoyama, 1927) belongs in the genus *Afrocardium*, and is a synonym of *A. richardi* (Audouin, 1827) (see Vidal 2000b).

Ctenocardia fijianum n. sp.

(Fig. 5A-D; Table 6)

TYPE MATERIAL. — Holotype, 1 lv, 12.0 × 9.9 × (9.0) mm; Paratypes (2): 1 rv, 9.0 × 7.2 × (6.0) mm; 1 rv, 6.9 × 5.7 × (4.6) mm.

TYPE LOCALITY. — Fiji Islands. SUVA 4, Viti Levu, Beqa Lagoon, stn DW 15, 18°23.3'S, 178°10.5'E, 32-34 m (paratypes come from type locality).

ETYMOLOGY. — Named after the Fiji Islands, the type locality.

DISTRIBUTION. — Presently only known from Fiji Islands, south coast of Viti Levu, Beqa Lagoon.

DESCRIPTION

Shell small (holotype is the largest known: 12.0 × 9.9 × (9.0) mm), inequilateral. Posterior slope with a pronounced keel, forming a point on the ventral margin. Anterior and median slopes of the valve rounded and slightly concave just in front of the posterior slope; posterior slope very concave.

Lunular area small with a raised margin. Lunule small and flat, hardly differentiated from the lunular area.

Shell grey-white externally (although specimens may be more colourful in life), with pink spot on the lunular area close to the lunule. Interior grey-

white, the external pink spot present internally, elongate and restricted to the hinge.

Anterior laterals slightly closer to cardinals than to the posterior lateral(s). Second small posterior lateral not observed.

Ribs 38-41.

Highly ornamented, square-sided, flat-topped ribs, receding anteriorly on the anterior region of the valve and posteriorly on the posterior slope. Interstices much narrower than ribs and finely striated; on posterior slope, the tops of ribs with thin, arched, concentric lamellae that become broader and longer and often overhang interstices; broader lamellae irregularly distributed and separated by a variable number (3-20+) of smaller lamellae. Ornamentation of anterior similar to posterior.

MICROHABITAT

Ctenocardia fijianum n. sp. was recovered from depths of 32.0-35.6 m.

REMARKS

Ctenocardia fijianum n. sp. is most similar to *Ctenocardia gustavi* n. sp. (next entry), in size, shape, lunule and rib features. However, it differs from *C. gustavi* n. sp. in four main aspects, including: 1) a steeper posterior slope (as examined from keel to most posterior rib); 2) median region of the shell adjacent to the posterior slope more concave, and coupled with a more pronounced keel, results in a more angular shell outline; 3) a shallower lunule; and 4) pronounced recession of the flat rib tops.

Ctenocardia gustavi n. sp.

(Fig. 5E-G; Table 7)

TYPE MATERIAL. — Holotype: 1 cv, 14.2 × 13.0 × 10.8 mm. Paratypes (5): 1 cv, 14.0 × 13.1 × 10.6 mm; 1 rv, 20.0 ×

TABLE 7. — *Ctenocardia gustavi* n. sp., measurements (mm) and rib number (N) of type material and seven additional exemplary specimens.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, New Caledonia, Passe de Touho	14.2	13.0	10.8	0.92	0.83	40
MNHN	Paratype 1, New Caledonia, Baie du Santal	14.0	13.1	10.6	0.94	0.81	41
MNHN	Paratype 2, New Caledonia, Baie du Santal	20.0	17.3	(15.6)	0.86	0.90	41
MNHN	Paratype 3, New Caledonia, Baie du Santal	18.5	17.0	(13.6)	0.92	0.80	42
FLMNH 297515	Paratype 4, Cook Islands, Niue Island	17.0	15.4	(13.2)	0.91	0.86	44
FLMNH 288940	Paratype 5, Marianas Islands, Guam, Anae Island	14.1	12.7	10.0	0.90	0.79	45
FLMNH 297514	Cook Islands, Niue Island	13.2	12.1	(10.0)	0.92	0.83	43
FLMNH 297516	Cook Islands, Niue Island	15.6	14.4	(12.0)	0.92	0.83	43
FLMNH 288939	Marianas Islands, Guam, South Orote	13.3	12.0	10.4	0.90	0.87	44
FLMNH 288925	Papua New Guinea, Louisiade Archipelago	15.0	13.5	11.6	0.90	0.86	39
FLMNH 280199	Indonesia, Sulawesi	17.0	16.7	(14.0)	0.98	0.84	39
FLMNH 280281	Indonesia, Sulawesi	17.7	17.0	14.5	0.96	0.85	42
FLMNH 280350	Indonesia, Sulawesi	17.3	16.7	14.3	0.97	0.86	45

17.3 × (15.6) mm; 1 lv, 18.5 × 17.0 × (13.6) mm; 1 valve, 17.0 × 15.4 × (13.2) mm; 1 cv, 14.1 × 12.7 × 10.0 mm.

TYPE LOCALITY. — Expédition MONTROUZIER 1993, New Caledonia, Passe de Touho, outer slope of barrier reef, stn 1273, 20°50.4'S, 165°22.8'E, 20 m, hard bottom.

ETYMOLOGY. — Dedicated to Gustav Paulay, who first drew attention to a specimen of this species from Niue.

MATERIAL EXAMINED. — **New Caledonia.** Atelier LIFOU 2000, Baie du Santal, off Drueulu, stn 1413, 20°55.3'S, 167°03.0'E, 3-10 m, white sand, 1 rv. — Near Îlot Huca Hutigué, stn 1421, 20°52.4'S, 167°08.5'E, 4 m, coarse sand on hard bottom, 1 tiny valve. — Off Peng, stn 1423, 20°54.0'S, 167°07.3'E, 12 m, sandy bottom, 1 cv + 2 rv + 1 lv. — Baie de Gaatcha, stn 1424, 20°54.9'S, 167°03.0'E, 4 m, fine sand and seaweeds, 3 tiny valves. — Off Kiki, stn 1427, 20°47.6'S, 167°09.35'E, 10 m, coarse sand and corals, 1 cv + 1 valve. — Near Pointe d'Easo, stn 1429, 20°47.5'S, 167°07.1'E, 8-18 m, corals, 1 rv. — Pointe d'Easo, stn 1430, 20°47.5'S, 167°07.1'E, 20-25 m, corals with sediments, numerous small cv + valves. — Near Pointe d'Easo, stn 1434, 20°52.5'S, 167°08.1'E, 5-20 m, hard bottom, 2 cv + 3 rv + 1 lv (second and third paratypes). — Pointe Lefèvre, stn 1435, 20°55.2'S, 167°00.7'E, 5-30 m, 1 rv. — Baie de Gaatcha, stn 1436, 20°55.5'S, 167°04.2'E, 10-20 m, corals, 2 small cv. — Pointe de Chépénéhé, stn 1438, 20°47.7'S, 167°09.35'E, 16 m, sand, several valves. — Pointe de Chépénéhé, stn 1439, 20°47.7'S, 167°09.35'E, 5-30 m, hard bottom, 2 cv. — Cap Aimé Martin, stn 1442, 20°46.4'S, 167°02.0'E, 47 m, wall bottom, several small valves. — Off Peng, stn 1443, 20°53.8'S, 167°07.3'E, 48-52 m, wall bottom, several small valves. — Baie de

Gaatcha, stn 1444, 20°55.0'S, 167°05.2'E, 9-20 m, pebbles and coarse sand, several valves. — Baie du Santal, Mépinyo, 20°50.8'S, 167°09.7'E, 10-12 m, 3 lv + 3 rv. — Near Cap Aimé Martin, stn 1448, 20°45.8'S, 167°01.65'E, 20 m, hard bottom, 1 cv. — Near Cap Aimé Martin, stn 1450, 20°45.8'S, 167°01.65'E, 27-31 m, hard bottom, 3 small cv. — Between Cap Mandé and Cap Lefèvre, stn 1452, 20°54.6'S, 167°02.1'E, 2-25 m, hard bottom, 1 cv (first paratype). — Same locality as previous, stn 1453, 20°54.6'S, 167°02.1'E, 21-30 m, hard bottom with gorgons, 1 cv + 1 rv. — Cila, Baie du Santal, stn 1456, 20°49.3'S, 167°10.4'E, 25-30 m, wall, 1 lv. — Off Ngoni, stn 1458, 20°46.7'S, 167°03.1'E, 17-24 m, 1 cv + 2 rv + 1 lv. — Baie de Gaatcha, stn 1463, 20°55.05'S, 167°03.35'E, 20-30 m, sand and coral fragments, 1 cv + 1 rv + 4 lv.

Solomon Islands. SALOMON 1 2001, stn DW 1822, 9°51.8'S, 160°51.8'E, 51-54 m, 1 valve.

Philippines. PANGLAO 2004, Panglao Island, Napaling, stn S28, 9°37.2'N, 123°46.4'E, 28-32 m, reef wall with small caves, 24.VI.2004, 1 valve. — Bohol Island, Baklayon Takot, 9°37.1'N, 123°52.6'E, 8-15 m, 1 cv.

Niue Island. Niue, 2 km N of Alofi wharf, near base of outer reef slope, 26-30 m, in sand pockets, 1986, B. Holthuis & G. Paulay, 1 lv (fourth paratype) (FLMNH 297515, BNIUE 187). — Niue, off Alofi wharf, deep sand channel, in sand 27-33 m, B. Holthuis & G. Paulay, 1986 and 1991, 2 rv (FLMNH 297516, BNIUE 091). — Niue, North Alofi, off water tank, outer reef slope, terrace 28-30 m, Holthuis & Paulay, 1991, 1 rv (FLMNH 297514, BNIUE 413).

Mariana Islands. Guam, Agana Bay, 91-122 m, 1989, B. D. Smith, 3 valves (FLMNH 287333). — Guam, S Orote, 2000, L. Kirkendale, 1 cv (FLMNH 288939). — Guam, Anae Is., south fore reef, 20 m, 1999, G. Paulay, 1 cv (fifth paratype) (FLMNH 288940). — Guam, off Cocos, west side, site No. 2, biological dredge, 73-92 m, 2000, several valves and small cv (FLMNH 288124).

Caroline Islands. Palau, south side of Malakal Channel, slope of reef, *c.* 8 m, 1996, G. Paulay, 1 rv (FLMNH 296965).

Papua New Guinea. Louisiade Archipelago, fringing reef slope, muddy sand, 6 m, 1998, L. Kirkendale, 1 cv (FLMNH 288925). — Bismarck Archipelago, Tungelo Island, Mascot Channel, on coral reef rubble ledge, 40 m, 2°40.79'S, 150°25.970'E, 2.VII.2003, L. Kirkendale, 1 live-collected cv (FLMNH 351689).

Indonesia. Sulawesi, CCW 1999, stn 12, 00°29.28'S, 122°04.21'E, 30 m, G. Paulay, 1 lv (FLMNH 280281, BSULA 35). — CCW 1999, stn 18, 0°21.13'S, 121°50.28'E, 1-18 m, 1 small lv (FLMNH 280131, BSULA 48). — CCW 1999, stn 19, 0°20.28'S, 121°55.45'E, 1-4 m, 1 small cv (FLMNH 280076, BSULA 50). — CCW 1999, stn 20, 0°18.41'S, 121°58.45'E, 12-16 m, 4 lv (FLMNH 280199, BSULA 52). — CCW 1999, stn 21, 0°11.39'S, 122°11.02'E, 4-32 m, 1 rv (FLMNH 280350, BSULA 53).

DISTRIBUTION. — Widespread in the tropical West Pacific from Mariana and Caroline Islands to Indonesia (Sulawesi), Papua New Guinea, New Caledonia and Niue Island.

DESCRIPTION

Shell small (H = 10-20 mm), inequilateral, with posterior slope straight to slightly concave, markedly depressed and separated from the median area by a strong keel; medio-posterior slope rather variable rounded to moderately pointed, anterior margin rounded.

Lunular area narrow, with raised margin; lunule present but extremely small, situated just behind the anterior cardinal in the right valve (see Fig. 2F).

Exterior grey-white to beige with irregularly disposed, concentrically arranged maroon-brown spots; on the posterior slope spots larger and more regularly disposed. Interior always with several maroon coloured zones, with a ray along the medio-posterior angle, a spot on the part of the lunular area close to the small lunule and a ray along the ventral margin of the hinge below the ligament.

Anterior laterals slightly closer to cardinals than to posterior laterals. Second posterior lateral tooth in the right valve rarely observed.

Ribs 39-45; 10-12 on the posterior slope.

Posterior ribs slightly trapezoid to square-sided, tops flatly rounded and much wider than the finely-striated interstices. Close, thin, arched threads on tops of ribs, at irregular intervals along the rib, some

threads becoming broader, higher and longer, with pointed extremities overhanging interstices. These broader transverse nodes are irregularly distributed, touching to slightly separated by a variable number (up to 10) of thin threads. Anterior rib ornaments similar to posterior ones.

MICROHABITAT

Ctenocardia gustavi n. sp. has been recovered from depths of 1 to 54 m. It has been collected live by one of us (LK) in Papua New Guinea at a depth of 40 m, where it was shallowly buried on a narrow coral rubble rock ledge.

REMARKS

Ctenocardia gustavi n. sp. resembles the American *Ctenocardia (Americardia) media* (Linnaeus, 1758) and the American fossil species *Trigonocardia decidua* (Vokes, 1977) from the Oligo-Miocene Chipola Formation of Florida in several characters, including shape, hinge and rib morphology. In the tropical west Pacific, *C. gustavi* n. sp. is found sympatrically with six recognized conspecifics: *C. fornicata* (Sowerby, 1841), *C. victor* (Angas, 1872), *C. translatum*, *C. symbolica* Iredale, 1929, *C. perornata* Iredale, 1929 and *C. fijianum* n. sp. Although these taxa are similar in gross shell shape, rib number and distribution, they differ significantly in aspects of rib morphology.

Ctenocardia (Microfragum) subfestivum n. sp. (Fig. 5H-J; Table 8)

TYPE MATERIAL. — Holotype: 1 cv, 10.3 × 10.6 × 7.6 mm (ex Vidal coll. ex Boutet, MNHN). Paratypes (3): 1 cv, 9.1 × 9.0 × 7.2 mm; 1 cv, 8.5 × 8.8 × 7.6 mm; 1 rv, 10.1 × 10.3 × (8.0) mm.

TYPE LOCALITY. — French Polynesia, Tahiti, Afaahiti, 50 m.

ETYMOLOGY. — In reference to the species *C. (M.) festivum*, a species it has been previously confused with.

MATERIAL EXAMINED. — **New Caledonia.** LAGON, Huon Atoll, stn 436, 18°06'S, 162°50'E, 45 m, 1 cv. — Yate, SE Lagoon, stn 634, 21°56.5'S, 166°46.5'E, 36-42 m, 1 cv (second paratype). — Grand Récif Mangalia, NE Lagoon, stn 853, 20°41'S, 165°07'E, 27 m, 1 rv. — Îles Belep, N

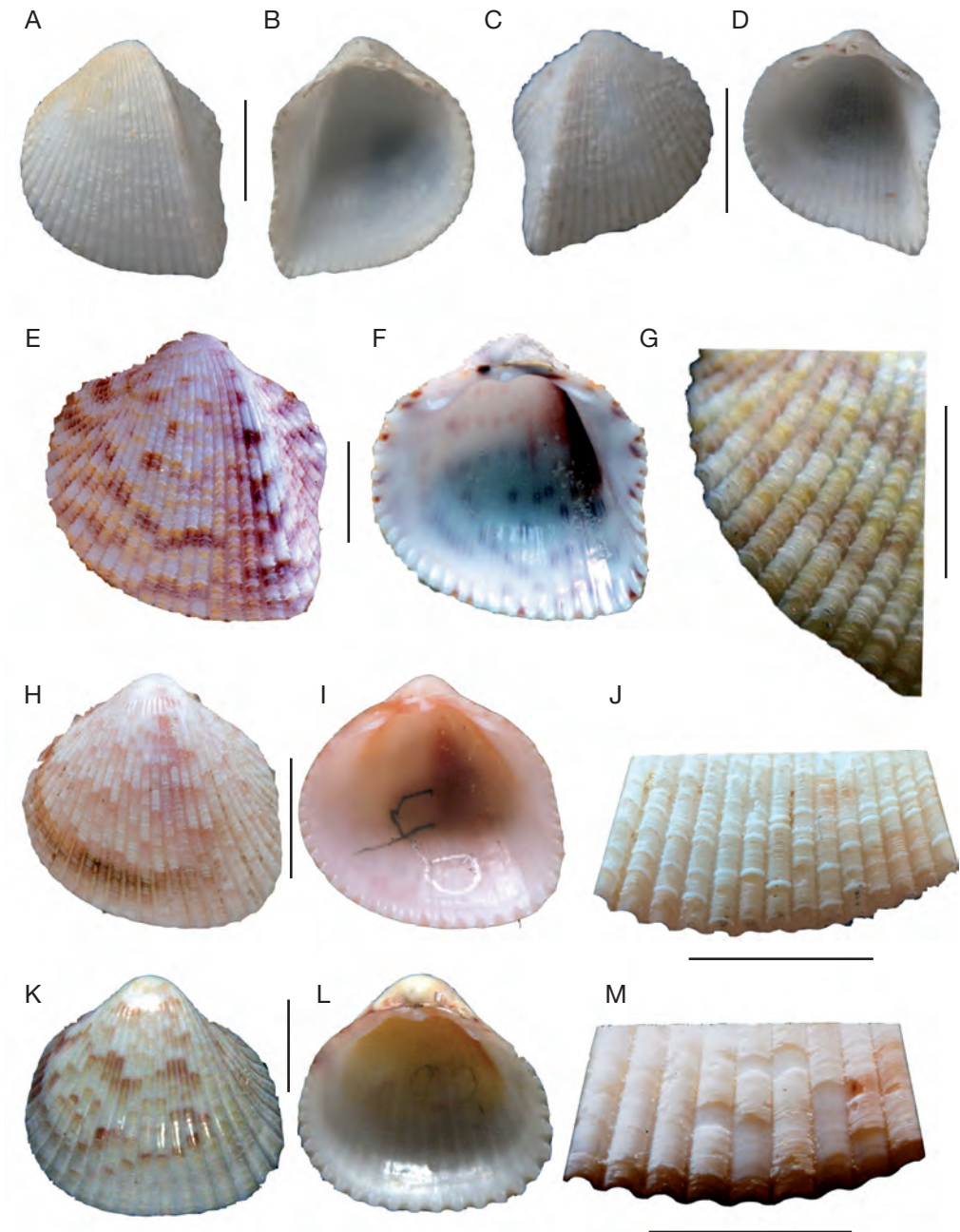


FIG. 5. — **A-D**, *Ctenocardia fijianum* n. sp.; **E-G**, *C. gustavi* n. sp., detail of lamellae on medio-anterior zone; **H-J**, *C. (Microfragum) subfestivum* n. sp., detail of lamellae in median zone; **K-M**, *C. (M.) festivum* (Deshayes, 1855), detail of lamellae in median zone. Scale bars: 5 mm.

Lagoon, stn 1139, 19°24'S, 163°47'E, 39 m, 2 rv. — Îles Belep, stn 1158, 19°10'S, 163°07'E, 48 m, 1 cv + 3 lv. CHALCAL 1, Bellona Reef, Coral Sea, stn DC 60,

21°48.65'S, 159°27.95'E, 45 m, 2 rv + 2 lv. — Chesterfield Atoll, stn DC 15, 19°23.30'S, 158°38.60'E, 65 m, 1 rv. — Same region, stn DC 26, 19°10.72'S,

TABLE 8. — *Ctenocardia* (*Microfragum*) *subfestivum* n. sp., measurements (mm) and rib number (N) of type material and six additional exemplary specimens.

Repository	Type and locality	H	L	W	L/H	W/L	N
MNHN	Holotype, French Polynesia, Tahiti	10.3	10.6	7.6	1.03	0.72	40
MNHN	Paratype 1, Coral Sea, Chesterfield Atoll	9.1	9.0	7.2	1.00	0.80	40
MNHN	Paratype 2, New Caledonia, SE Lagoon	8.5	8.8	7.6	1.04	0.86	41
MNHN	Paratype 3, Wallis & Futuna Islands	10.1	10.3	(8.0)	1.02	0.78	40
MNHN	New Caledonia, Lifou, Baie du Santal	8.6	8.5	(6.0)	0.99	0.71	39
MNHN	New Caledonia, Atoll de Huon	8.8	9.2	6.8	1.05	0.74	42
MNHN	Tonga Islands, Ha'apai Group	8.0	8.0	(6.0)	1.00	0.75	38
MNHN	French Polynesia, Moorea	8.3	8.5	6.6	1.02	0.77	37
MNHN	French Polynesia, Austral Ridge, stn DW 1934, Président Thiers Banc	10.1	10.2	(7.2)	1.01	0.71	41
MNHN	French Polynesia, Austral Ridge, stn DW 2005, Rimatara Island	12.4	12.1	(9.4)	0.98	0.78	41

158°34.95'E, 48 m, 1 cv. — Same region, stn DC 39, 20°28.90'S, 158°48.70'E, 40 m, 3 cv.

MUSORSTOM 4, Grand-Passage, near Pelotas Atoll (N external zone), stn DW 162, 18°35'S, 163°10'E, 525 m, 1 rv + 1 lv.

CORAIL 2, Banc Fairway, Chesterfield, stn DW 02, 20°50.48'S, 161°37.25'E, 62 m, 2 cv + 1 lv. — Same region, stn DW 03, 20°50.42'S, 161°34.19'E, 58 m, 1 lv. — Same region, stn DW 04, 20°52.38'S, 161°36.56'E, 3 rv. — Same region, stn DW 08, 20°52.07'S, 161°38.21'E, 63 m, 1 cv + 3 rv + 2 lv. — Same region, stn DW 09, 20°53.00'S, 161°35.32'E, 62 m, 1 cv + 1 rv. — Same region, stn DW 10, 20°52.49'S, 161°41.02'E, 60 m, 3 rv + 2 lv. — Chesterfield Lagoon, stn DW 31, 19°24.86'S, 158°45.03'E, 57 m, 1 cv. — Same region, stn DW 42, 19°21.53'S, 158°28.83'E, 45 m, 1 cv. — Same region, stn DW 46, 19°18.54'S, 158°20.00'E, 21 m, 2 cv. — Same region, stn DW 72, 19°15.30'S, 158°20.89'E, 32 m, 1 cv. — Same region, stn DW 87, 19°06.14'S, 158°59.94'E, 31 m, 2 rv + 3 lv. — Same region, stn DW 88, 19°05.98'S, 158°55.85'E, 32 m, 5 valves. — Same region, stn DW 96, 19°06.00'S, 158°41.92'E, 41 m, 1 rv. — Same region, stn DW 122, 19°28.17'S, 158°17.06'E, 32 m, 1 cv. — Same region, stn DW 128, 19°27.89'S, 158°30.44'E, 38 m, 1 rv. — Same region, stn DW 135, 19°31.37'S, 158°19.14'E, 46 m, 1 cv. — Same region, stn DW 137, 19°34.00'S, 158°14.60'E, 32 m, 2 cv. — Same region, stn DW 143, 19°37.40'S, 158°25.16'E, 45 m, 2 cv. — Same region, stn DW 144, 19°27.73'S, 158°23.28'E, 50 m, 1 rv. — Same region, stn DW 156, 19°48.95'S, 158°21.03'E, 42 m, 1 cv (first paratype).

Atelier LIFOU 2000, Baie du Santal, near Pointe Easo, stn 1430, 20°47.5'S, 167°07.1'E, 20-25 m, reefal environment, 1 rv + 1 lv. — Cap Aimé Martin, stn 1442, 20°46.4'S, 167°02.0'E, 47 m, on bottom of wall, 3 rv + 1 lv.

French Polynesia. Moorea-Tiahura, external slope, 32 m, 1 valve (ex Falconetti coll., MNHN).

Wallis and Futuna. MUSORSTOM 7, Banc Waterwitch, stn DW 537, 12°30'S, 176°41'W, 325-400 m, 1 rv (third paratype). — Same region, stn 538, 12°31'S, 176°40'W, 275-295 m, 1 rv. — Same region, stn DW 529, 12°31'S, 176°40'W, 500 m, 2 rv + 4 lv. — Banc Combe, stn CP 552, 12°16'S, 177°28'W, 786-800 m, 1 rv. — Wallis, stn DW 601, 13°19'S, 176°17'W, 350 m, 1 rv.

Tonga. BORDAU 2, Haa'apai Group, stn DW 1602, 20°49.19'S, 174°57.08'W, 263-320 m, 1 lv.

Austral Islands. BENTHAUS 2002, Banc Président Thiers, stn DW 1934, 24°40.6'S, 145°57.4'W, 560-1150 m, 1 lv. — Banc Président Thiers, stn DW 1926, 24°38.2'S, 146°00.8'W, 50-90 m, 1 lv. — Rimatara, stn DW 2015, 22°38.2'S, 152°49.5'W, 250-280 m, 1 rv. — Banc Président Thiers, stn DW 1927, 24°39'S, 146°01.6'W, 95-100 m, 1 rv + 2 lv. — Tubuai, stn DW 1958, 23°19.6'S, 149°30.3'W, 80-150 m, 1 cv + 8 rv + 3 lv. — Banc Président Thiers, stn DW 1932, 24°40.8'S, 146°01.5'W, 500-800 m, 1 rv. — Tubuai, stn DW 1955, 23°18.5'S, 149°25.7'W, 750-800 m, 1 rv. — E Coast of Rurutu, stn DW 2003, 22°27.6'S, 151°18.9'W, 250-330 m, 5 rv + 6 lv. — Tubuai, stn DW 1961, 23°20.9'S, 149°33.5'W, 470-800 m, 1 rv. — Tubuai, stn DW 1959, 23°19.8'S, 149°30.4'W, 95-380 m, 2 rv + 3 lv. — Tubuai, stn DW 1962, 23°20.8'S, 149°33.4'W, 470-800 m, numerous valves. — E Coast of Rurutu, stn DW 2004, 22°27.7'S, 151°18.7'W, 430-850 m, 1 rv. — Port of Rurutu, stn DW 2002, 22°26.7'S, 151°20.1'W, 247-250 m, 1 rv.

Japan. Okinoshima, Kochi pref., 2 cv (NSMT 42313).

DISTRIBUTION. — Western Pacific from Japan to New Caledonia and Polynesia.

DESCRIPTION

Shell small (H = 7 to 10 mm), as long as high, inequilateral with posterior slope oblique, posterior margin slightly truncate and somewhat expanded and posterior angle well marked, rounded and not carinate.

TABLE 9. — Comparison of diagnostic characters for similar *Fulvia* (*Fulvia*), *F.* (*Laevifulvia*) and *Pseudofulvia* n. gen. taxa occurring sympatrically in the tropical west Pacific.

Taxon	L/H	W/L	N	Sublunule	Lunular heart	Ribbing posterior slope	Ribbing median part	Ribbing anterior slope	Periostracal insertions	Eyes
<i>Fulvia</i> (<i>Fulvia</i>) <i>colorata</i> n. sp.	0.85-0.89	0.71-0.78	45-55	Short and smooth	Large and cordiform	Ribs flatly rounded, larger interstices	Ribs flat, smooth, just discernible	Ribs flat, smooth, just discernible	Yes, everywhere	Yes
<i>F.</i> (<i>F.</i>) <i>vepris</i> n. sp.	c. 1.00	0.56-0.68	52-54	No	Long and narrow	Ribs flat-round large, with calc. tubercules	Ribs flatter and lower	Ribs flatter and larger	Yes, everywhere	?
<i>F.</i> (<i>F.</i>) <i>dulcis</i> Deshayes, 1863	c. 1.00	0.76-0.80	41-47	Long	Rather large	Granules. Ribbs rounded, wide and strong	Ribs hardly perceptible	Rare granules. Ribbs hardly perceptible	Yes, everywhere	Yes
<i>F.</i> (<i>F.</i>) <i>scalata</i> Vidal, 1994	c. > 1.00	0.70-0.77	36-44	Rather small	Very large, cordiform	Granules in interst. as rungs. Ribbs squared	Ribs well perceptible	Ribs well perceptible	Yes, everywhere	Yes
<i>Fulvia</i> (<i>Laevifulvia</i>) <i>subquadrata</i> n. sp.	c. 1.00	0.71-0.77	36-42	Short, flat	Small, well formed	Num. granules. Ribbs and interstices rounded	Num. granules. Ribbs narrower, flatter, less distinct	Num. granules. Ribbs flatter, less distinct	No	Yes
<i>F.</i> (<i>L.</i>) <i>imperfecta</i> n. sp.	c. 1.00	0.56	76	Short	Long and very narrow	Ribs in PT1 (6-7), no ribs in PT2	Ribs almost invisible. Internal serrat. clear	Ribs almost invisible, internal serrat. clear	No	?
<i>F.</i> (<i>L.</i>) <i>undatopicta</i> Pilsbry, 1904	0.94-0.96	0.68-0.72	46-53	Long	Rather small	Aligned conc. granules. Ribbs rounded to triangular	Ribs not easily discernible	Ribs of moderate development	No	Yes
<i>F.</i> (<i>L.</i>) <i>lineonotata</i> Vidal, 1994	0.80-0.90	0.60-0.68	53-55	Very long	No	Ribs flatly triangular, poorly marked on PT2	Ribs almost indiscernible, but int. crenul. well-marked	Ribs almost indiscernible, but int. crenul. well-marked	No	Yes
<i>F.</i> (<i>L.</i>) <i>hungerfordi</i> Sowerby, 1901	1.02-1.16		42-44	Variable length according to population	Small	Large rounded ribs on PT1, flattened on PT2	Ribbed to not ribbed according to population	Slightly but always ribbed	No	Yes
<i>F.</i> (<i>L.</i>) <i>prashadi</i> Vidal, 1994	c. 1.00	0.50-0.75	10 + 10	Medium length	Small	Large rounded ribs on PT1 and PT2	No ribs nor internal serrations	About 10 ribs and internal serrations	No	?
<i>Pseudofulvia</i> <i>caledonica</i> n. gen., n. sp.	0.91-0.97	0.60-0.74	c. 43	Extremely large, with pustules	Short and prismatic	Ribs large, wide, roundly triangular, asymmetrical	Ribs hardly perceptible, int. serrations discernible of this slope	Smooth sublunule on ½ of rest	Only on top of PT ribs (thin)	No
<i>P.</i> <i>arago</i> n. gen., n. sp.	0.86	0.75	80	No	Long and very narrow	Ribs large, wide, roundly triangular, asymmetrical	Ribs narrow, low, rounded, very numerous	Ribs narrow, low, rounded, very numerous	No	No

Lunular area small with protruding but not raised margin; lunule itself very short, extending in right valve to just behind the anterior cardinal.

Exterior grey-white, light brown or pink, with some irregular darker zones; interior white, slightly pink in the umbonal cavity. Anterior part of hinge line pink.

Ribs 37-41.

Ribs rounded in cross-section, covered with thin, imbricated contacting lamellae, rather irregular in strength and size (Fig. 2M); they become more tubercular on anterior and posterior regions of the valve.

MICROHABITAT

Ctenocardia subfestivum n. sp. was recovered from 20-400 m. This is slightly deeper than the average

depth of *C. (M.) festivum*, a species with a similar distribution and very similar gross shell features. This observation is based on examination of a limited number of either live-collected or fresh-dead (ligament intact or valves found together with no subsequent encrustations) specimens of both species.

REMARKS

Ctenocardia (Microfragum) subfestivum n. sp. differs from *C. (M.) festivum* in gross shell shape by being more asymmetrical and oblique, with a more truncate posterior margin and a more marked posterior angle or keel. *Ctenocardia (M.) subfestivum* n. sp. also has more ribs, a characteristic pink hinge coloration and less numerous but more irregular lamellae compared with *C. (M.) festivum* (Fig. 5K-M). Moreover, on

the medio-posterior external shell region, ribs of the new species are more squared and interstices are wider (about half of the ribs), with limits between ribs and interstices sharper and less progressive than in *C. (M.) festivum* (Fig. 5K-M).

GENERAL DISCUSSION

Among the 10 new species here described, seven are members of the subfamily Cardiinae, from two well-known genera (*Fulvia* and *Acrosterigma*) and one newly described genus (*Pseudofulvia* n. gen.). These are *Acrosterigma capricorne* n. sp., *Fulvia (Fulvia) colorata* n. sp., *F. (F.) vepris* n. sp., *F. (Laevifulvia) subquadrata* n. sp., *F. (L.) imperfecta* n. sp., *Pseudofulvia caledonica* n. gen., n. sp. and *P. arago* n. gen., n. sp. *Acrosterigma capricorne* n. sp. and *P. arago* n. sp. are notably restricted in their distributions, known only from the Austral Islands in fairly deep water. As common in island-endemics, they are large bodied relative to sister-taxa/conspecifics. *Acrosterigma capricorne* n. sp. is allied with the *Acrosterigma uniornatum* species-complex (Vidal 1999), found in the western Pacific, while *P. arago* n. gen., n. sp. is most closely similar to *P. caledonica* n. gen., n. sp. However, *P. arago* n. gen., n. sp. is very distinct not only from all other *Fulvia* studied to date (Vidal 1994), but also from *P. caledonica* n. gen., n. sp. in a number of characters, including absence of exterior granulations, no sublunule, connected cardinals in the right valve and unconnected cardinals in the left valve, and absence of periostracal insertions. We refrain from describing it as a new genus, because of the limited material available (only one live-collected specimen is known). The remaining Cardiinae taxa provide further support for the distinction of two subgenera, *Fulvia* and *Laevifulvia*, within the genus *Fulvia* (Vidal 1994). Although these taxa, *Fulvia (Fulvia) colorata* n. sp., *F. (F.) vepris* n. sp., *F. (Laevifulvia) subquadrata* n. sp., *F. (L.) imperfecta* n. sp., are often represented by sparse material, they are easily distinguished from other species by a suite of morphological characters including length/height, width/length ratios, rib number, sublunule size and shape, nature of lunular heart and details of ribbing (see comparisons in

Table 9). The recent expedition to the Philippines includes live-collected specimens subsampled for molecular analyses of the type species of the new genus (*P. caledonica* n. gen., n. sp.). This will allow an independent test of the distinctiveness of this new genus, relative to *Fulvia* and other sampled Cardiidae.

Three new species from the genus *Ctenocardia* in the subfamily Fraginae are described, *C. fijianum* n. sp., *Ctenocardia gustavi* n. sp. and *C. (Microfragum) subfestivum* n. sp. *Ctenocardia fijianum* n. sp. appears restricted in distribution, as it is presently only known from a few valves recovered from Viti Levu in Fiji. In contrast, the other two species are common, widely distributed taxa found at subtidal depths throughout the western Pacific. *Ctenocardia (M.) festivum*, as well as the new species *C. (M.) subfestivum* n. sp. are considered members of the genus *Ctenocardia*, with *Microfragum* retained as a subgenus. These two species are the only recognized members of this group at present. These taxa share several characters with members of *Ctenocardia*, most notably a similar, seemingly inductural deposition of lamellae on the exterior shell surface (Vokes 1977 as "intritacalx"; Schneider & Carter 2001). The disposition, placement and highly deciduous nature of the lamellae indicate that their composition may be similar to that described for *Ctenocardia*, although this assumption needs to be formally tested through analysis of *C. (M.) festivum* and *C. (M.) subfestivum* n. sp. shell microstructure. Molecular phylogenetic analyses of *C. gustavi* n. sp. and *C. (M.) subfestivum* n. sp. have confirmed their distinctiveness from other included conspecifics, providing further support of their species status (LK unpubl. data). They are confirmed aposymbiotic taxa of Fraginae, consistent with their relatively deep depth ranges, especially for tropical Pacific fragines (Ohno *et al.* 1995; LK unpubl. data). These two species fall in a well-supported clade that includes Indo-West Pacific *Ctenocardia*, as well as the American generic taxa *Americardia* and *Trigoniocardia*. Finally, although beyond the scope of this paper, the genus *Ctenocardia* is in need of revision, as is the entire subfamily Fraginae.

In summary, one new genus of cardiid and 10 new cardiid taxa from the western Pacific are de-

scribed. Many of the new species are distinct in detailed morphological features of hinge, dentition, rib number and ornamentation but also, often in a number of gross morphological attributes, such as coloration, shape and size. While many taxa are fairly conspicuous in coloration, large in size, and common throughout their relatively wide ranges in shallow waters (*Ctenocardia gustavi* n. sp. and *C. (M.) subfestivum* n. sp.), other taxa appear fairly restricted in their distribution and occur in relatively deep water (*Acrosterigma capricorne* n. sp. and *Pseudofulvia arago* n. gen., n. sp.). Earlier studies documenting additional new species of cardiids from the region (Vidal 1994, 1999, 2001, 2003), together with these 10 new species, and molecular support of some of these findings (LK unpubl. data), demonstrate that the discovery of new cardiid taxa is not at a plateau. Furthermore, this trend is not specific to cardiids and seems to be common (Bouchet *et al.* 2002), even for other supposedly well-known molluscan groups (e.g., cowries, Meyer 2003). The biodiversity of remote, little studied yet hyperdiverse corners of the world remains poorly known.

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