

Five new species of the genus *Lienardia* (Conidae: Gastropoda) from the shallow waters of central Philippines

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ABSTRACT. Minute turriform conoideans comprise a considerable fraction of the taxonomically undescribed diversity of marine mollusks. Species of the genus *Lienardia* Jousseaume, 1884, extremely diverse in shallow water tropical marine communities, have long been overlooked by taxonomists and a high proportion of them remain undescribed to date. Development of a specialized collection technique, based on deployment of lumun-lumun nets have provided a vast amount of material on this group and enabled several new species to be distinguished. Examination of material from the Philippines and other regions of tropical Indo-Pacific revealed five new species of the genus *Lienardia*, which are being described as *L. acrolineata*, *L. grandiradula*, *L. multicolor*, *L. roseangulata*, and *L. tagaroae*. Examination of radulae in described species of the genus *Lienardia* showed unexpected morphologic diversity. It suggests that either rapid morphological specialization of *Lienardia* species had taken place in the evolution of the genus, or similarity of shells in *Lienardia* species is possibly convergent.

Introduction

Recent studies of Indo-Pacific marine biodiversity, focused on mollusks, has demonstrated that diversity of some molluscan taxa has been notably underestimated [Bouchet, *et al.*, 2002]. The main reasons are extreme diversity and general taxonomic complicity of these taxa combined with the small size of their members. In this respect four families have been mentioned specifically, namely Pyramidellidae, Triphoridae, Eulimidae and Turridae [Bouchet, *et al.*, 2009; Bouchet, *et al.*, 2002]. Among these, “Turridae”, being a paraphyletic taxon [Puillandre, *et al.*, 2008], is the only group of free living mollusks. Its members are specialized predators remarkable in their feeding strategies, similar to cone snails, their close relatives [Taylor, *et al.*, 1993]. Their often small size and low abundance combined with taxonomic complicity have made micro-turrids an extremely unpopular group for taxonomists. To assess the magnitude of turrid species richness in the shallow waters of central Philippines, specialized collecting technique, called *lu-*

mun-lumun, has recently been established [Seronay, *et al.*, 2010]. The author of the current paper participated in *lumun-lumun* activities in the Philippines, including sorting and identifying the catch.

The single *lumun-lumun* net has brought 36 turrid species, of which at least 13 belong to the subfamily Clathurellinae (family Conidae *sensu* Taylor, *et al.*, 1993) with an unexpectedly high proportion of undescribed species, mainly from the *Clathurella* / *Lienardia* genus complex. Many of these and similar, still undescribed species of the same group inhabit shallow water coral communities all over the Indo-Pacific area, from Philippines and Vanuatu archipelago to New Caledonia [Bouchet, 2008; our unpublished data].

Genera *Clathurella* Carpenter, 1857 and *Lienardia* Jousseaume, 1884 include morphologically similar forms, and are possibly synonymous, however, the former was established primarily for American species [Powell, 1966], while the latter contains Indo-Pacific species exclusively. Criteria, which would allow reliable delimitation of these two genera and clarification of their relationship, are still to be worked out. However, at this point descriptions of new species can go ahead without the taxonomic revision of genera. For simplicity, all species treated here are assigned to the genus *Lienardia*.

The present paper aims at the description of some of the new species of genus *Lienardia* and provides data on radular morphology of species described. Their relationships with other Indo-Pacific members of the *Clathurella* / *Lienardia* generic complex are discussed.

Materials and methods

Material for the present study was obtained from several sources:

1. Multiple specimens of the *Clathurella* / *Lienardia* complex were collected by the author and Philippine colleagues with lumun-lumun nets off Balicasag Island in 2008 - early 2011. Lately collected specimens were used for examination of radular morphology.

2. Some material, used in the present study was collected during different cruises and shore based expeditions in central Indo-Pacific and Pacific regions, undertaken by Muséum National d'Histoire Naturelle, Paris, France (MNHN).

3. Additional dry material, originated from different localities in Philippine archipelago was kindly donated by Mr. Guido Poppe (Conchology Inc., Lapu-Lapu City, Cebu, Philippines).

Shells of specimens for radulae examinations were photographed and bored with a micro-drill; the soft bodies were extracted and dissected. The radular sacs were dissected out and treated with 5% solution of potassium hypochlorite until the soft tissues were completely dissolved. In minute specimens entire buccal complexes were dissolved. Radulae then were cleaned in several shifts of distilled water, air-dried and mounted for SEM analysis.

Abbreviations of museums and depositories:

MNHN – Muséum National d'Histoire Naturelle, Paris, France

PBRC – Philippine Biodiversity Resource Center, Metro Manila, Philippines

ANSP – Academy of Natural Science, Philadelphia, USA

Conchology Inc. – Private collection of Conchology Inc., Lapu-Lapu City, Cebu, Philippines

Results

Taxonomy

Family Conidae Fleming, 1822

Subfamily Clathurellinae H. et A. Adams, 1858

Genus *Lienardia* Jousseaume, 1884

Type species: *Clavatula rubida* Hinds, 1843, by original designation.

Lienardia acrolineata sp. nov.

(Fig. 1, 6 C-E)

Holotype: 6.4 x 2.5 mm, 50–100 m, lumun-lumun net, Balicasag Is, Bohol, Philippines (PBRC) (Fig. 1 A-C).

Paratypes: Paratype 1, 6.1 x 2.6 mm, Maribojok Is, Bohol, Philippines, 10–15 m, (MNHN 24441) (Fig. 1 D, E); Paratype 2, 5.9 x 2.4 mm, lumun-lumun net, Siquijor Is, Philippines, 80 m, (ANSP 426056) (Fig. 1 F, G); Paratype 3, 5.8 x 2.3 mm, Maribojok Is, Bohol, Philippines, 10–15 m, (Conchology Inc.).

Other material examined: SL 5.4 mm, Loyalty Islands, Lifou, Atelier LIFOU, Stn. 1453: 20°54.6'S, 167°02.1'E, 21-30 m; SL 5.2 mm, MNHN; Stn. 1424: 20°54.9'S, 167°03.0'E, 4 m, MNHN; SL 4.3 mm, SL 4 mm, Stn. 1429: 20°47.5'S, 167°07.1'E, 8-18 m, MNHN; 5.5 x 2.2 mm, 50–100 m, lumun-lumun net, Balicasag Is, Bohol, Philippines; 5.1 x 2.2 mm,

80 m, lumun-lumun net, Siquijor Is, Philippines, juvenile; 4.4 x 2 mm, 40–50 m, lumun-lumun net, Balicasag Is, Bohol, Philippines; 4.6 x 2 mm, 40–50 m, lumun-lumun net, Balicasag Is, Bohol, Philippines.

Type locality: Philippines, Balicasag Is.

Description. Shell small, elongate fusiform (proportion of shell width to its length 0.4-0.42, body whorl to shell length – 0.57-0.59), with high spire. Teleoconch of 5 evenly convex whorls. Suture indistinct. Axial sculpture of strong rounded ribs (10-12 per whorl). Spiral sculpture of two fine threads in subsutural region followed by four strong spiral cords. Spiral cords wavy, strongest when intersect axial ribs, there they form spirally elongate nodules; body whorl with five such spiral cords. Four spiral cords, interrupted between axial ribs on shell base, followed by three spiral threads on siphonal canal. Fasciole moderately pronounced. Shell surface mat, sculptured by dense micro-tubercles.

Siphonal canal distinct, strongly notched. Aperture narrow, outer lip convex, inner lip straight. Outer lip moderately thickened and slightly inwardly curved, with five tubercles, two upper strongest. Varix well developed behind aperture outer lip. Inner lip with four tubercles of subequal size. Anal sinus deep, tear-shaped, separated from aperture by strong “subsutural tubercle”.

Background color light olive in fresh specimens or yellowish in faded ones. Pale brown spots on subsutural area in interspaces between axial ribs. Smaller spots on spiral elements of shell base. Interspaces between spiral cords marked with fine brown lines. Fasciole with dark band, spreading to inner lip.

Protoconch orthoconoid, of four whorls. Protoconch I dark brown to black, with evenly convex whorls, bearing one spiral keel. Protoconch II light-yellowish, of strongly angular whorls, bearing two gemmate spiral keels, one marking whorl periphery, second situated right above the suture.

[Диагноз.] Раковина небольшая, удлинённо-веретено-видная (отношение высоты раковины к её ширине 0,4-0,42, отношение высоты последнего оборота к высоте раковины – 0,57-0,59), с высоким завитком. Телеоконх образован пятью равномерно закруглёнными оборотами. Шов плохо заметен. Осевая скульптура представлена мощными скруглёнными складками (10-12 на каждом обороте). Спиральная скульптура из двух тонких линий в пришовной области оборота и четырёх мощных широких рёбер. Спиральные рёбра волнистые, лучше развиты на пересечениях с осевыми складками, где они формируют спирально вытянутые бугорки. Последний оборот с пятью спиральными рёбрами; основание раковины с четырьмя спиральными рёбрами прерывающимися в интервалах между осевыми складками.

Сифональный канал хорошо выражен, с заметной вырезкой. Фасциола не развита. Устье узкое, внешняя губа равномерно закруглена, внутренняя губа прямая. Внешняя губа утолщена и слегка загнута внутрь, с пятью бугорками на внутренней поверхности. Варикс хо-

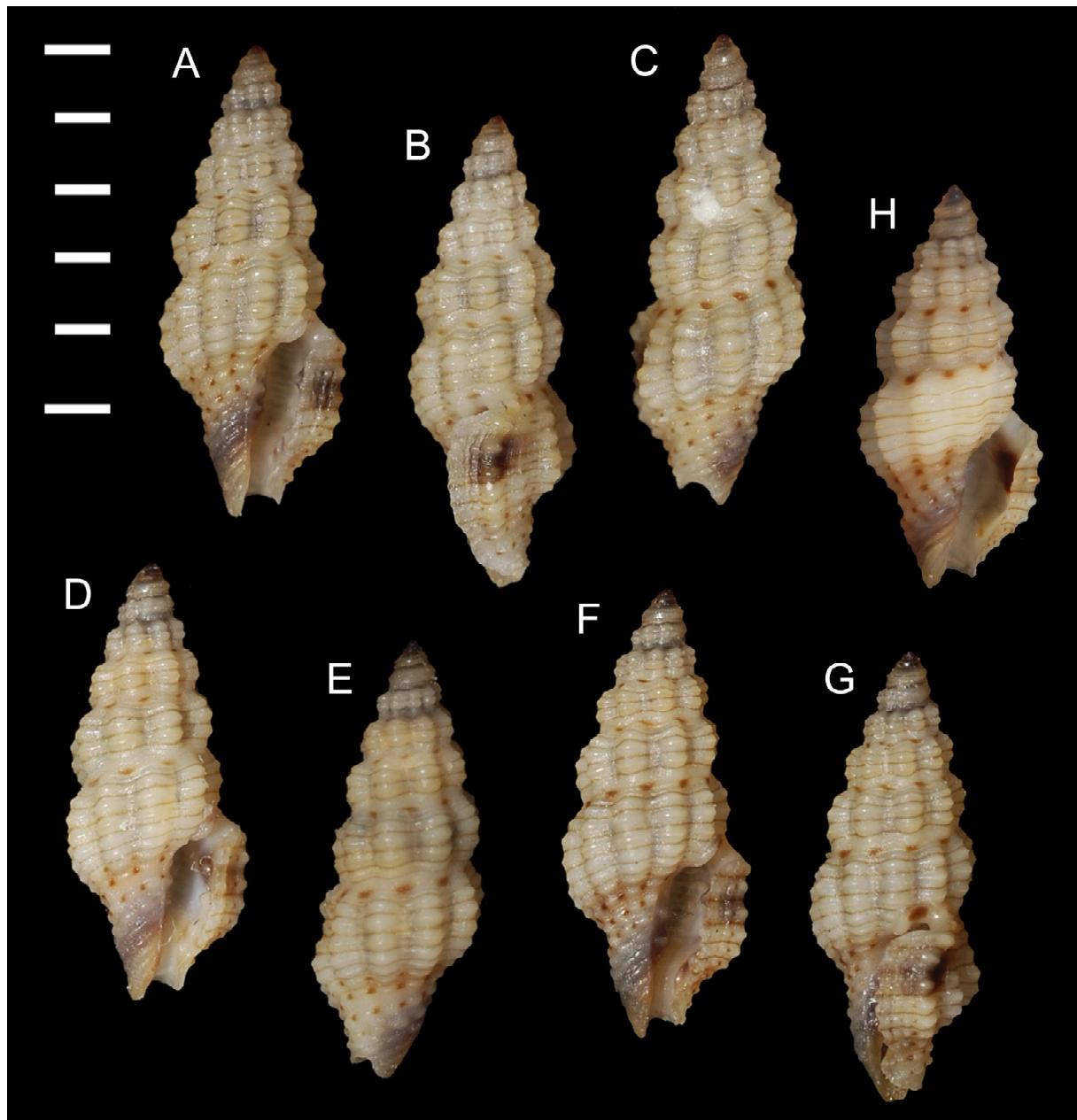


FIG. 1. *Lienardia acrolineata* sp.nov.; **A-C** – Holotype, PBRC (details in text); **D, E** – Paratype 1, MHN 24441; **F, G** – Paratype 2, ANSP 426056; **H** – Loyalty Islands, expedition Atelier LIFOU, Stn. 1453: 20°54.6'S, 167°02.1'E, 21-30m, 5.4 mm, voucher shell for radular study

РИС. 1. *Lienardia acrolineata* sp.nov.; **A-C** – Голотип, PBRC (см. Текст); **D, E** – Паратип 1, MHN 24441; **F, G** – Паратип 2, ANSP 426056; **H** – острова Лойалти, экспедиция Atelier LIFOU, Ст. 1453: 20°54.6'S, 167°02.1'E, 21-30м, 5,4 мм, экземпляр, использованный для исследования радулы.

орошо развит, позади внешней губы. Внутренняя губа с четырьмя бугорками. Анальный синус глубокий, воронковидный.

Раковина светло-оливковая с отчёлтыми коричневыми пятнами на пришовных частях оборотов и сифоногальном канале и тонкими коричневыми линиями в промежутках между спиральными рёбрами. Сифональный канал и варикс частично окрашены коричневым. Поверхность раковины матовая, скульптурирована многочисленными микроскопическими бугорками.

Протоконх ортоконойдный из 4x оборотов. Протоконх

I тёмно-коричневый до чёрного с равномерно закруглёнными оборотами и одним спиральным килем. Обратоконх II жёлтый с угловатыми оборотами, несущими 2 спиральных киля, на периферии оборота и над швом.]

Remarks: *Lienardia acrolineata* sp. nov. is similar to *Lienardia michelsi* Iredale et Tomlin, 1917, from which it could be differentiated due to its characteristic color pattern with fine brown lines and contrasting dots, marking suture.

Radula. Short, consists of *ca.* 15 pairs of hypodermic marginal teeth. Single tooth (Fig. 6 C, D) is 250–260 μm in length, with two opposite well pronounced terminal barbs, of which one larger and notably shifted down. Canal pore opens terminally, right sideway from lower barb (Fig. 6 E).

Etymology. akron- (Greek) – peak, summit; linea- (Latin) – line. The species name refers to multiple brown spiral lines, characteristic for this species.

Distribution: Philippines to Vanuatu and New Caledonia, shallow waters to 100 m depth.

Lienardia grandiradula sp. nov.
(Fig. 2, 6 F, G)

Holotype: 10.0 x 4.0 mm, Philippines, Panglao Is., 9°37.6'N, 123°47.3'E, 20 m, MNHN 24439 (Fig. 2 A, B).

Paratypes: Paratype 1: 10.4 x 4.2 mm, lumun-lumun net, Philippines (PBRC) (Fig. 2 C, D); Paratype 2, 9.4 x 3.8 mm, Balicasag Is, Philippines (PBRC) (Fig. 2 E, F); Paratype 3, 9.0 x 3.9 mm, Balicasag Is, Philippines (ANSP 426057) (Fig. 2, G, H); Paratype 4, 8.2 x 3.3 mm, Balicasag Is, Philippines (ANSP 426057); Paratype 5, 10.2 x 4.3 mm, Is, Philippines (Conchology Inc).

Type locality: Philippines, Panglao Island.

Description. Shell fusiform (proportion of shell width to length 0.41–0.43, body whorl to shell length – 0.61). Teleoconch of 5.5–6 evenly convex whorls without distinct shoulder. Suture indistinct, subsutural ramp weakly pronounced. Shells sculpture of regular rounded axial ribs (13 on body whorl), intersected with fine widely spaced spiral cords. Subsutural ramp with two fine spiral threads, succeeded with three-four spiral cords on earlier spire whorls and five on penultimate one. Interspaces between 3rd, 4th and 5th spiral cords with minute vanishing riblets. Body whorl with eight spiral cords.

Siphonal canal relatively long, slightly recurved at its tip, clearly notched. Fasciole absent. Sculpture of siphonal canal of nine spiral cords, separated from spiral elements of body whorl base by wide interspace. Last spiral cord of body whorl and three first cords of siphonal canal formed by spirally elongate nodules.

Aperture narrow, outer lip thickened with 4–6 denticles of equal or subequal size, opposed by four denticles on straight inner lip. Varix well pronounced positioned behind outer lip. Anal sinus relatively wide, funnel-shaped.

Background coloration light-orange to light-olive with darker subsutural ramps. Body whorl with two rather indistinct darker bands, one on periphery and another, marking shell base.

Protoconch orthoconoid, of 2.5 convex whorls, brown. Later whorls with two distinct keels – one on whorl periphery, another immediately above suture.

[Диагноз.] Раковина веретеновидная (отношение высоты раковины к её ширине 0,41–0,43, отношение высоты последнего оборота к высоте раковины – 0,61). Телооконч из 5,5–6-ти равномерно выпуклых оборотов. Шов плохо заметен. Скульптура из регулярных осевых складок (13 на последнем обороте), пересекаемых тонкими, широко расставленными спиральными ребрами. Пришовные области оборотов с двумя тонкими линиями; ранние обороты завитка с тремя-четырьмя; предпоследний оборот с пятью спиральными ребрами. Интервалы между 3-м, 4-м и 5-м спиральными ребрами с мелкими промежуточными ребрышками. Последний оборот с восьмью спиральными ребрами.

Сифональный канал относительно длинный со слегка отогнутым кончиком. Фасциола не выражена. Сифональный канал с девятью спиральными косыми ребрами, отделенными от спиральных элементов последнего оборота широким интервалом.

Устье узкое, внешняя губа утолщена с 4–6 зубчиками равного или почти равного размера на внутренней поверхности, внешняя губа прямая с четырьмя зубчиками. Варик хорошо выражен позади внешней губы. Аналльный канал глубокий и широкий, воронковидный.

Раковина светло-оранжевая до оливковой, с более тёмными пришовными частями оборотов. Последний оборот с двумя спиральными тёмными полосами – на периферии оборота и в основании раковины.

Протоконх ортоconoидный, из 2,5 оборотов, коричневый. Поздние обороты протоконха с двумя ясными кильями, на периферии раковины и прямо над швом.]

Remarks: *Lienardia grandiradula* sp. nov. conchologically close to *Lienardia michelsi* Iredale et Tomlin, 1917 and has similar color pattern. However, the species differs in having 1) larger and wider shell with rather biconical outline; 2) a characteristic spiral dark band, marking periphery of the body whorl.

Radula. Radula remarkably large, of few pairs of hypodermic marginals. Each marginal tooth slightly curved near its base and attains length of *ca.* 550 μm (Fig. 6 F, G). Teeth tips with no barbs, but bear two opposite weakly developed blades.

Etymology. The species name refers to unusually large radular teeth found in this species.

Distribution. Philippines, Cebu-Bohol area, shallow waters.

Lienardia multicolor sp. nov.
(Fig. 3)

Holotype. 6.6 x 2.9 mm, lumun-lumun net, Balicasag Is, Bohol, Philippines (PBRC) (Fig. 3 A-C).

Paratypes. Paratype 1, 6.4 x 2.7 mm, Siquijor Is, Philippines, lumun-lumun net, 80 m (MNHN 24442) (Fig. 3 D, E); Paratype 2, 5.1 x 2.4 mm, Siquijor Is, Philippines, lumun-lumun net, 80 m (ANSP 426059) (Fig. 3 F, G).

Type locality: Philippines, Siquijor Island.

Description. Shell small, fusiform (proportion of shell width to its length 0.42–0.44, body whorl to shell length – 0.6), of 5.5 strongly convex teleo-

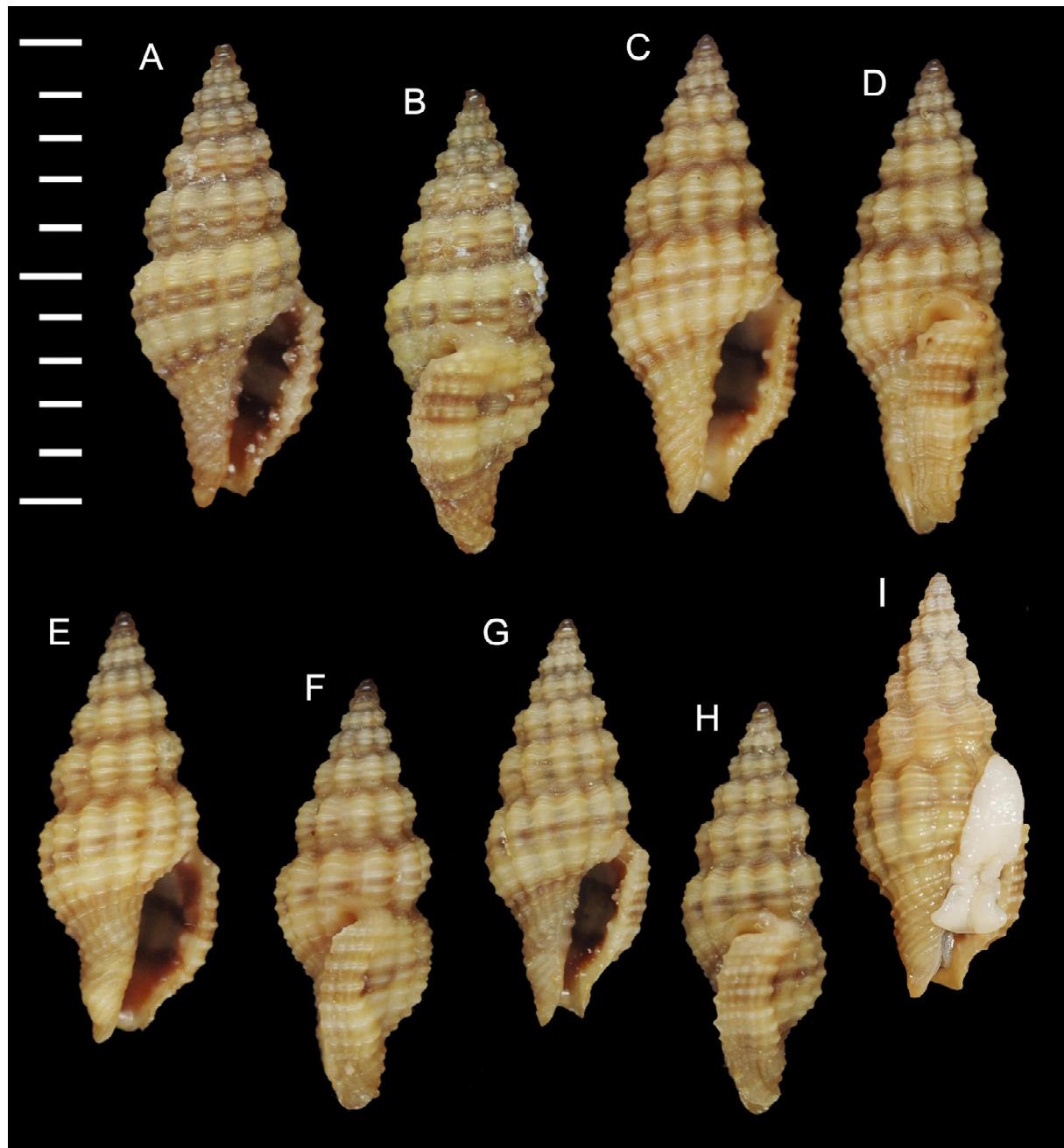


FIG. 2. *Lienardia grandiradula* sp. nov.; A, B – Holotype, MNHN 24439 (details in text); C, D – Paratype 1, PBRC; E, F – Paratype 2, PBRC; G, H – Paratype 3, ANSP 426057; I – Balicasag Is, Bohol, Philippines, lumun-lumun net, 35–50 m, 9.3 mm, voucher shell for radular study

РИС. 2. *Lienardia grandiradula* sp. nov.; А, В – Голотип, MNHN 24439 (см. текст); С, Д – Паратип 1, PBRC; Е, Ф – Паратип 2, PBRC; Г, Х – Паратип 3, ANSP 426057; И – о-в Баликасаг, Бохол, Филиппины, лумун-лумун, 35–50 м, 9,3 мм, экземпляр, использованный для исследования радулы.

conch whorls. Suture indistinct; subsutural region slightly concave, with three weak wavy spiral threads. Axial sculpture of strong prominent broadly rounded ribs (10 per whorl). Axial ribs intersected with spiral cords that form glossy spirally elongated nodules. Spire whorls with three to five such spiral cords, of which 2nd, 3rd and 4th, closest to whorl periphery strongest. Base of body whorl with 4 spiral cords, similar to those on whorl periphery,

succeeded by 6 spiral cords on siphonal canal. Shell surface mat, with fine micro-sculpture of dense micro-tubercles.

Siphonal canal well defined, straight, shallowly notched; fasciole moderately developed. Aperture elongate, narrow. Outer lip slightly thickened, with 4 subequal denticles inside. Varix well developed, situated behind outer lip. Inner aperture lip with three indistinct denticles. Anal sinus deep, tear-

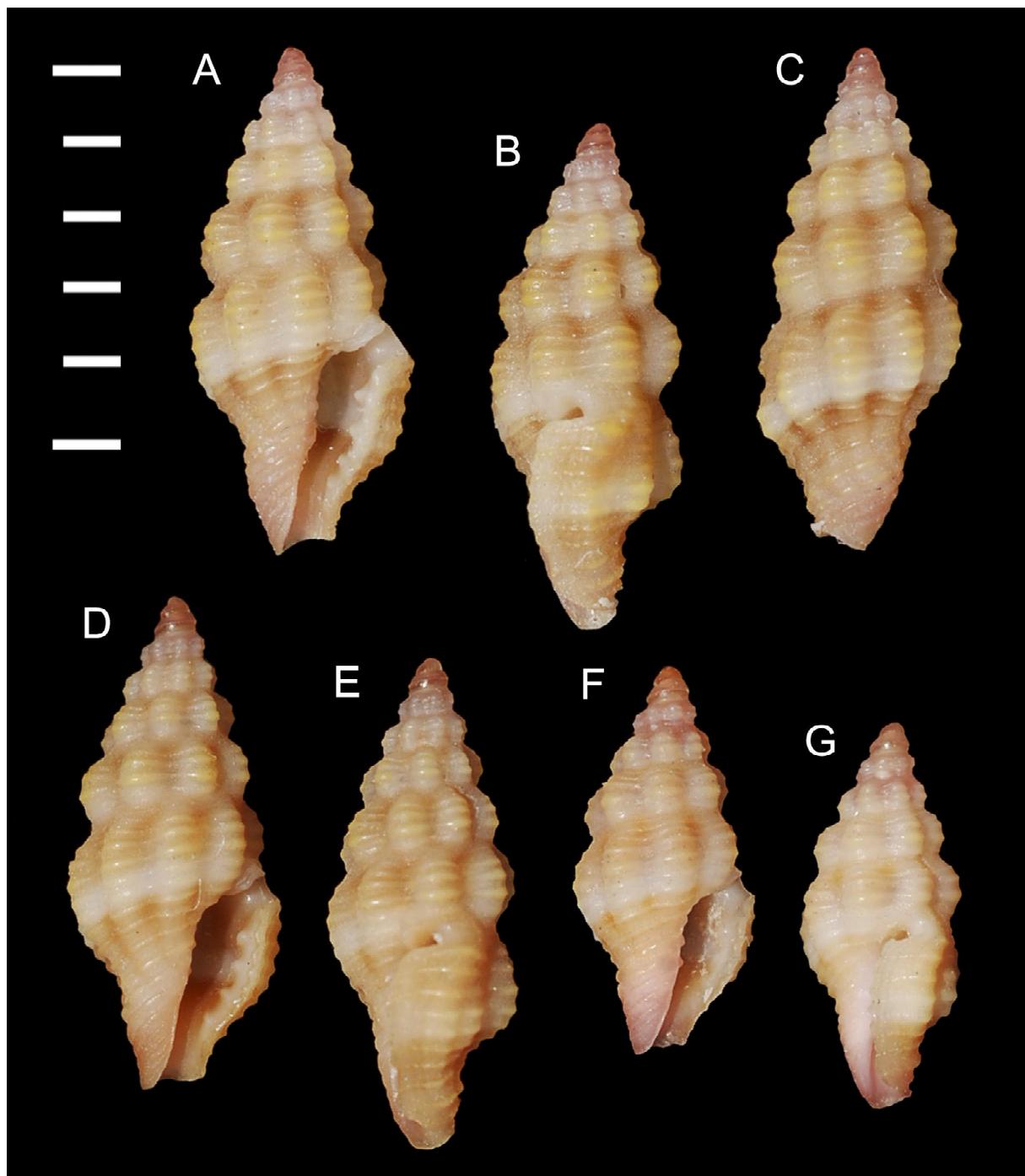


FIG. 3. *Lienardia multicolor* sp. nov.; **A-C** – Holotype, PBRC (details in text); **D, E** – Paratype 1, MNHN 24442; **F, G** – Paratype 2, ANSP 426059.

РИС. 3. *Lienardia multicolor* sp. nov.; **A-C** – Голотип, PBRC (см. Текст); **D, E** – Паратип 1, MNHN 24442; **F, G** – Паратип 2, ANSP 426059.

shaped, restricted by prominent subsutural tubercle.

Background coloration tan with subsutural regions darkened, spiral ribs yellow. Shell base marked with white spiral band, protoconch and siphonal canal pink.

Protoconch: bluntly orthoconoid, of 2.5 whorls, pink, glossy, with two distinct keels on later whorls.

[Диагноз. Раковина мелкая, веретеновидная (отношение высоты раковины к её ширине 0,42-0,44, отношение высоты последнего оборота к высоте раковины – 0,6). Телоокон из 5,5 сильно выпуклых оборотов. Шов плохо заметен. Пришовная область слегка вогнутая с тремя тонкими волнистыми спиральными линиями. Осевая скульптура из мощных широких складок (10 на последнем обороте). Осевые складки пересечены спиральными рёбрами, образующими в месте пересечения гладкие

спирально-вытянутые бугорки. Обороты завитка с 3-5 спиральными рёбрами такого же строения, наиболее мощные находятся на периферии оборота. Основание последнего оборота с 4-мя спиральными рёбрами.

Сифональный канал хорошо выражен, прямой, с неглубокой вырезкой, скульптурирован 6 спиральными рёбрами. Фасциола развита умеренно. Устье удлинённое, узкое. Внешняя губа незначительно утолщена с 4-мя бугорками на внутренней стороне; варикс хорошо выражен, позади внешней губы. Внутренняя губа устья с тремя небольшими бугорками. Аналый синус глубокий, воронковидный.

Раковина светло коричневая с более тёмными пришовными частями оборотов и жёлтыми спиральными рёбрами. Основание раковины со спиральной белой полосой, протоконх и, частично, сифональный канал розовые. Поверхность раковины матовая, густо скульптурирована микро-буторками.

Протоконх широко ортоконоидный, из 2.5 оборотов с двумя отчёлывыми килями на поздних оборотах.]

Remarks: *Lienardia multicolor* sp. nov. superficially resembles *L. crassicostata* (Pease, 1860), but could be easily differentiated due to its characteristic coloration.

Radula. No data.

Etymology. The name of this species was inspired by its characteristic color pattern.

Distribution. Central Philippines, depths 50-150 m.

Lienardia roseangulata sp. nov.

(Fig. 4, 6 H, I)

Holotype: 4.6 x 1.9 mm, Vanuatu, SANTO 2006, Stn. EP36, 15°33.2'S, 167°12.5'E, 20-60 m, MNHN 24440, IM-2009-18091 (Fig. 4 A, B)

Paratypes: Paratype 1, 5.7 x 2.45 mm, Balicasag Is, Bohol, Philippines, lumun-lumun net, 35-50 m, PBRC (Fig. 4 C, D); Paratype 2, 5.6 x 2.3 mm, same locality, Conchology Inc. (Fig. 4 E, F).

Other material examined: 5.8 x 2.65 mm, Loyalty Islands, Lifou, Atelier LIFOU, Stn. 1461, 20°54.0'S, 167°02.1'E, 100-200 m, MNHN.

Type locality: Philippines, Balicasag Island.

Description. Shell small, fusiform (proportion of shell width to length varies from 0.42 in smaller specimens to 0.46 in larger ones, due to notably recurved upper outer lip). Teleoconch of 5-5.5 strongly convex to angulated shouldered whorls. Suture indistinct, subsutural ramp sloping, with fine wavy threads. Axial sculpture of strongly elevated ribs (10 on body whorl), latest 4-5 ribs clearly angulated with the whorl periphery slightly shifted down. Axial ribs intersected by fine spiral cords, slightly widened in intersections. Spire whorls with 4-5 spiral cords, of which second marks shoulder. Body whorl with 8 spiral cords, succeeded with 6 spiral to obliquely-spiral cords on siphonal canal.

Siphonal canal relatively long, straight, slightly notched, fasciole absent. Aperture narrow, its outer

lip strongly thickened and inwardly curved. Inner margin of outer lip with 5 denticles. Uppermost margin of outer lip angulated and notably recurved due to well developed, wide anal sinus. Inner aperture lip almost straight with three closely spaced little denticles in its medial part.

Shell pink with periphery of body whorl bearing spiral light band, distinct in fresh shells.

Protoconch pink to brownish, of 2.5 convex whorls. Later whorls with two strong keels, of which upper marks whorl periphery, while lower runs immediately above suture.

[**Диагноз.** Раковина мелкая, веретеновидная (отношение высоты раковины к её ширине от 0,42 у более мелких экземпляров до 0,46 у более крупных за счёт значительно отогнутого верхнего края внешней губы). Телооконх из 5-5,5 сильно выпуклых до угловатых оборотов иногда с выраженным плечом. Шов плохо заметен, пришовная область крутая с тонкими спиральными линиями. Осевая скульптура из мощных складок (10 на последнем обороте), последние 4-5 складок отчёлово угловатые. Осевые складки пересечены тонкими спиральными рёбрами, слегка утолщеными в местах пересечений. Обороты завитка с 4-5 спиральными рёбрами. Последний оборот с 8 спиральными рёбрами.

Сифональный канал относительно длинный, прямой, с небольшой вырезкой, скульптурирован 6-ю осевыми до косых рёбрами. Фасциола не выражена. Устье узкое, внешняя губа устья сильно утолщена и загнута внутрь, несёт 5 зубчиков, обращённых к устью. Верхний край внешней губы значительно отстоит от основания последнего оборота за счёт широкого и глубокого анального синуса. Внешняя губа устья почти прямая с тремя мелкими зубчиками в средней части.

Раковина розовая, периферия последнего оборота со спиральной белой полосой.

Протоконх розовый до коричневатого из 2,5 выпуклых оборотов. Поздние обороты протоконха с двумя отчёлывающимися килями, на периферии раковины и прямо над швом.]

Remarks: *Lienardia roseangulata* sp. nov. similar to *Glyphostoma lamproideum* Hervier, 1896, but the latter species is not pink and has more numerous columella pleats. *Lienardia fallaciosa* Hedley, 1922, is also close in shape to the species described, but lacks the pink colour. *Lienardia roseangulata* sp. nov. also resembles *L. roseotincta* (Montrouzier, 1871), but differs in having a proportionally shorter siphonal canal and higher spire. Relatively higher spire and characteristic notably angulated axial ribs of body whorl distinguish this species from a complex of similarly colored, still undescribed *Lienardia* species, co-occurring with *Lienardia roseangulata* in Central Indo-Pacific.

Radula. Radula small, of 15-20 pairs of hypodermic marginal teeth, length 130-140 µm, some teeth slightly bent near tips (Fig. 6 H, I). Tooth tip with two well developed opposite barbs of equal size. Pore of canal opens subterminally right below barb, with minute projection below the lower margin of the pore.

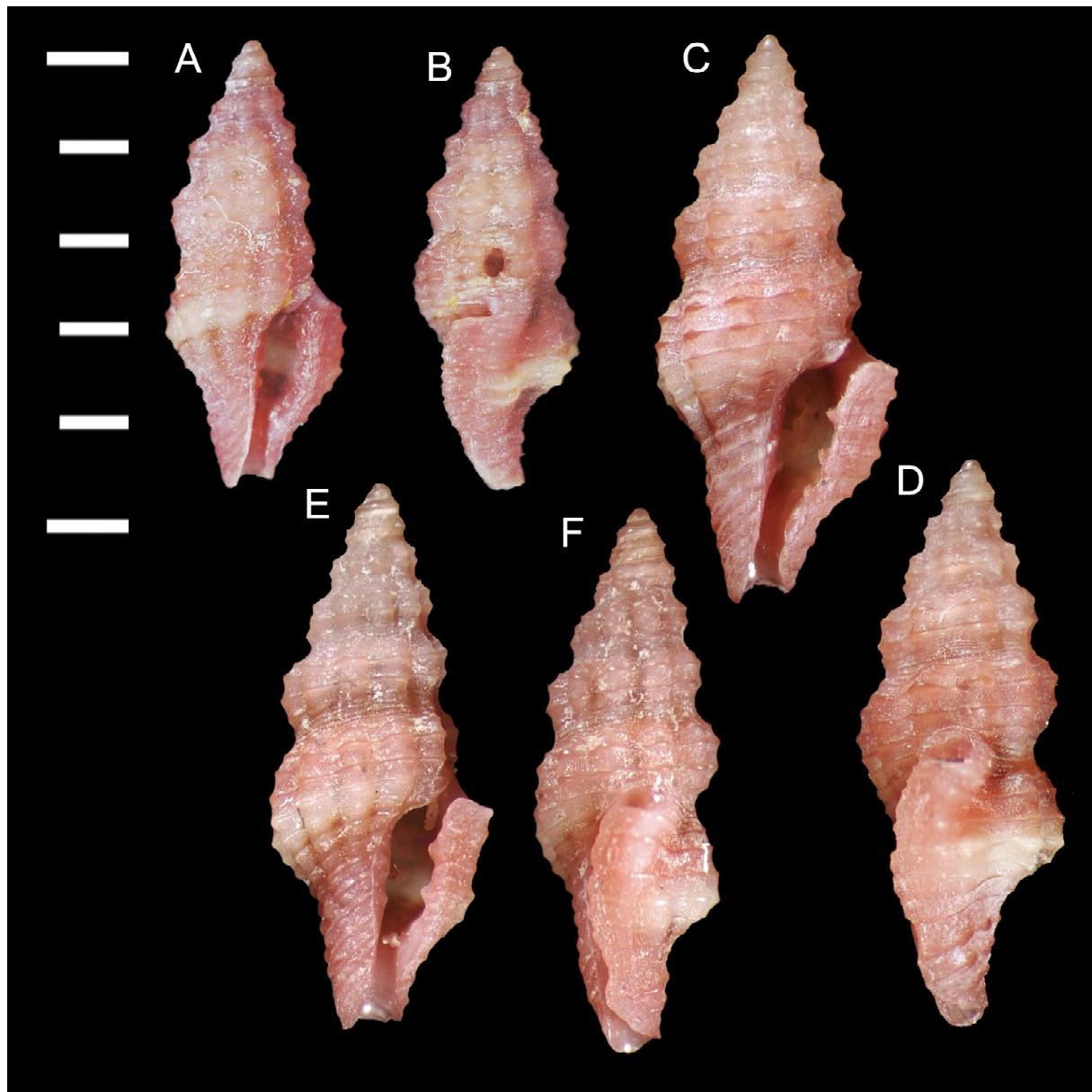


FIG. 4. *Lienardia roseangulata* sp. nov.; A, B – Holotype, MNHN 24440 (details in text); C, D – Paratype 1, PBRC; E, F – Paratype 2, Conchology Inc.

РИС. 4. *Lienardia roseangulata* sp. nov.; А, В – Голотип, MNHN 24440 (см. Текст); С, Д – Паратип 1, PBRC; Е, Ф – Паратип 2, Conchology Inc.

Etymology. The name of this species refers to the general coloration of the shell, which is colored pink and to the characteristic angulated axial ribs, marking the shell base.

Distribution. Philippines, Vanuatu and New Caledonia, 20-200 m.

Lienardia tagaroae sp. nov.
(Fig. 5, 6 J, K)

Holotype: 5.9 x 2.5 mm, Philippines, Balicasag Is., 9°30.9N, 123°41.2'E, 90-110 m (MNHN 24438) (Fig. 5 A, B)

Paratypes: Paratype 1, 8.3 x 3.5 mm, lumun-lumun net, off Punta Engano, Mactan Is, Philippines, 50-150 m, (PBRC) (Fig. 5 C, D); Paratype 2, 6.0 x 2.6 mm, Balicasag Is, Bohol, Philippines (PBRC) (Fig. 5 E, F); Paratype 3, 5.3 x 2.3 mm, Balicasag Is, Bohol, Philippines (ANSP 426060) (Fig. 5 G, H); Paratype 4, 6.5 x 2.8 mm, Balicasag Is, Bohol, Philippines (ANSP 426060) Paratype 5, 6.7 mm, Balicasag Is, Bohol, Philippines, lumun-lumun net, 35-50 m (Conchology Inc.).

Type locality: Philippines, Balicasag Island.

Description. Shell small, fusiform (proportion of shell width to its length 0.42-0.43, body whorl

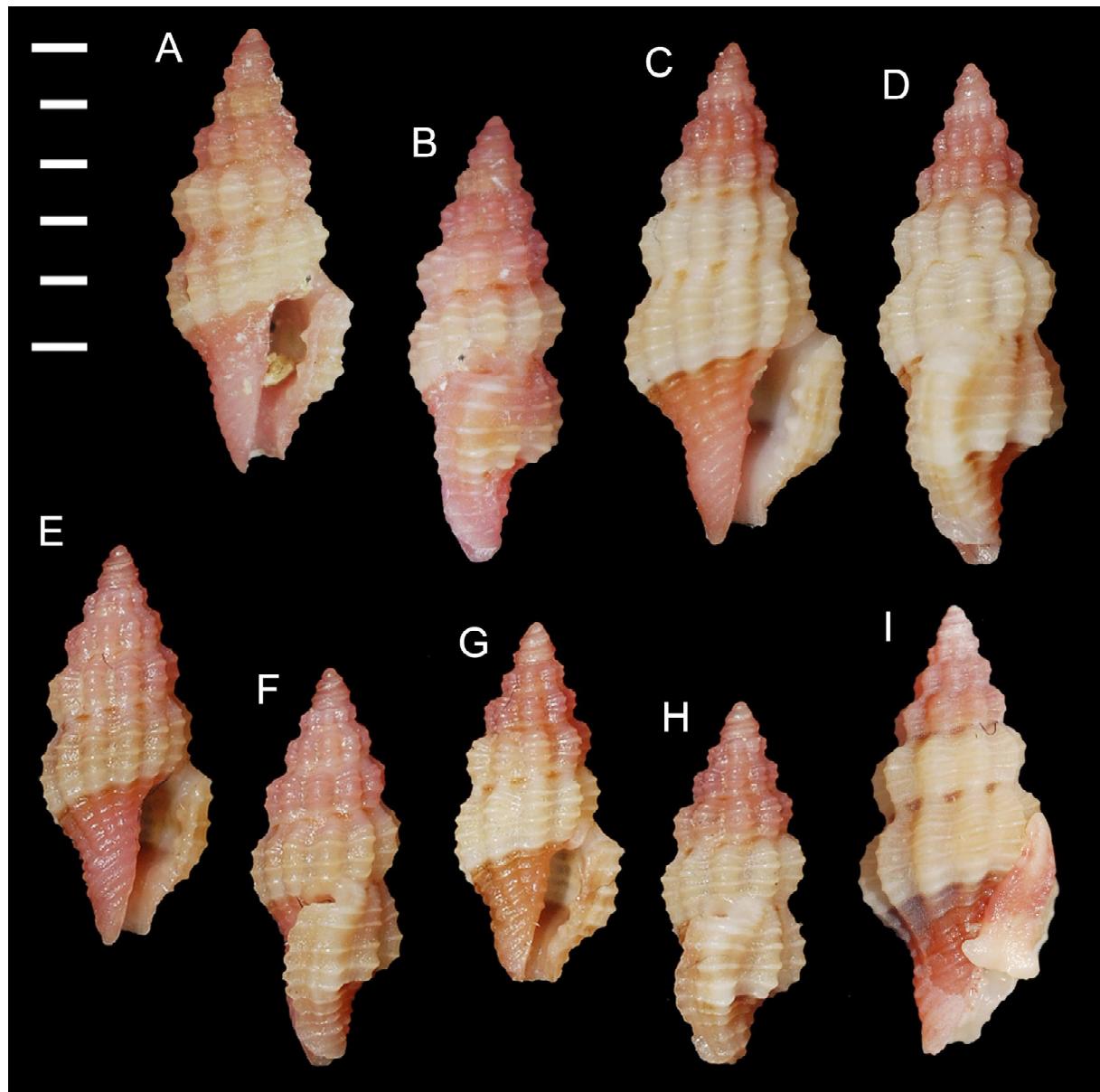


FIG. 5. *Lienardia tagaroae* sp. nov.; A, B – Holotype, MNHN 24438 (details in text); C, D – Paratype 1, PBRC; E, F – Paratype 2, PBRC; G, H – Paratype 3, ANSP 426060; I – Paratype 5, Conchology Inc., voucher shell for radular study.

РИС. 5. *Lienardia tagaroae* sp. nov.; А, В – Голотип, MNHN 24438 (см. Текст); С, Д – Паратип 1, PBRC; Е, Ф – Паратип 2, PBRC; Г, Н – Паратип 3, ANSP 426060; И – Паратип 5, Conchology Inc., экземпляр, использованный для исследования радулы.

length to shell length – 0.6), of 5.5 evenly convex teleoconch whorls. Suture indistinct; subsutural region sloping, slightly convex, with three fine wavy spiral threads. Axial sculpture of strong rounded ribs (12 per whorl), intersected by fine spiral cords. Later spire whorls with spiral threads of subsutural region succeeded by five strong wavy spiral cords. Periphery of body whorl with 6 wavy spiral cords, followed by 5 wavy cords on shell base and 6 spiral to oblique cords on siphonal canal. Shell surface mat, finely sculptured by dense micro-tubercles.

Siphonal canal well defined, straight, deeply notched, terminally slightly bent backward. Fasci-

ole moderately developed. Aperture elongate, narrow. Outer lip notably inwardly curved, thickened, with 5 subequal denticles on its inner side. Varix well defined situated behind outer lip. Straight inner aperture lip with three denticles with lower strongest. Anal sinus deep, tear-shaped, restricted by distinct subsutural tubercle.

Protoconch with earlier teleoconch whorls and siphonal canal of shell pink, peripheries of body whorl and penultimate whorl cream. Pink shell base separated from cream colored periphery of body whorl by fine brown line. Outer lip colored cream.

Protoconch: orthoconoid, of 3-3.5 glossy angu-

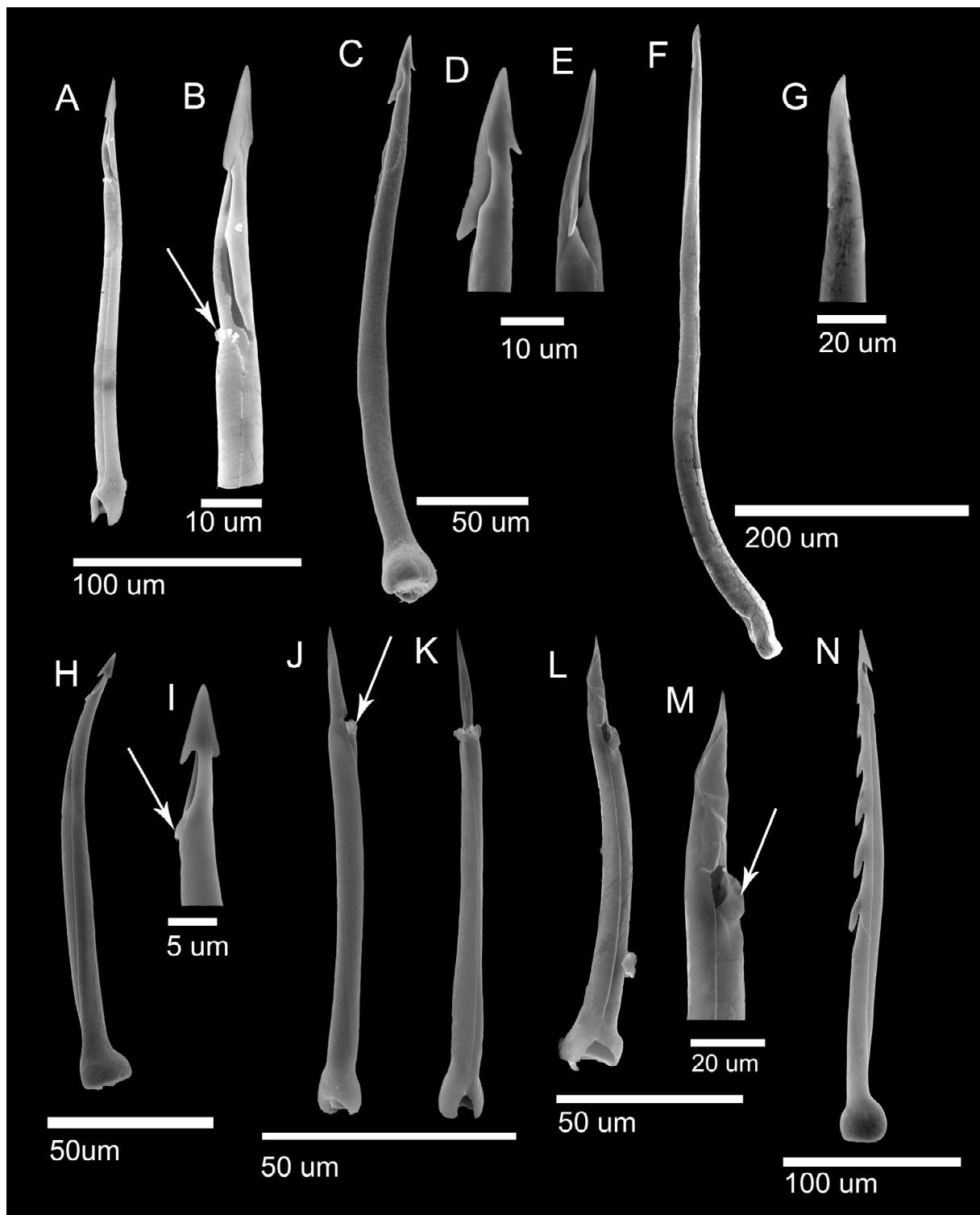


FIG. 6. Radular structure in some *Lienardia* species. A, B – *Lienardia* cf *rosella* Hedley, 1922; C-E – *Lienardia acrolineata* sp. nov.; F, G – *Lienardia grandiradula* sp. nov.; H, I – *Lienardia roseangulata* sp. nov.; J, K – *Lienardia tagaroae* sp. nov.; L, M – *Lienardia* sp.; N – *Lienardia gilberti* (Souverbie, 1874)

РИС. 6. Строение радул у некоторых видов рода *Lienardia*. A, B – *Lienardia* cf *rosella* Hedley, 1922; C-E – *Lienardia acrolineata* sp. nov.; F, G – *Lienardia grandiradula* sp. nov.; H, I – *Lienardia roseangulata* sp. nov.; J, K – *Lienardia tagaroae* sp. nov.; L, M – *Lienardia* sp.; N – *Lienardia gilberti* (Souverbie, 1874)

lar whorls, with two distinct spiral keels, on late whorls, one on periphery and second situated right above suture.

[Описание.] Раковина мелкая, веретеновидная (отношение высоты раковины к её ширине 0,42-0,43, отношение высоты последнего оборота к высоте раковины – 0,6),

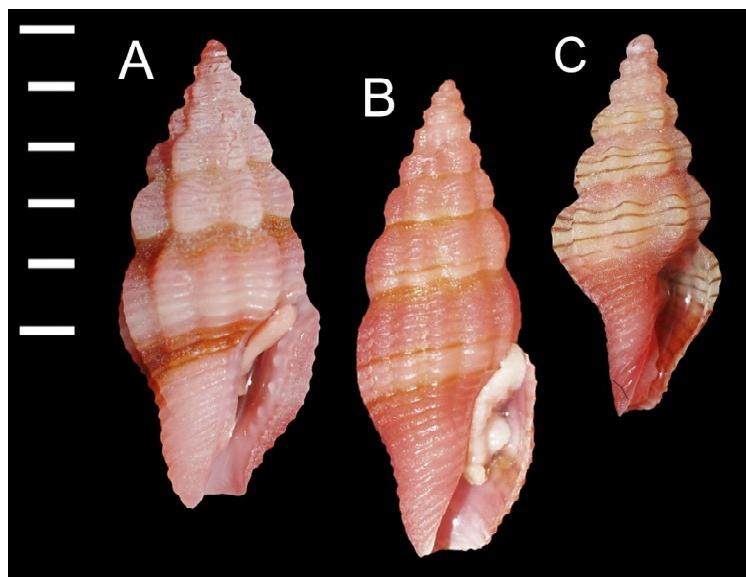


FIG. 7. Shells of some additional specimens of *Lienardia*, radulae of which were examined. **A** – *L. cf rosella* Hedley, 1922, Puerto-Engana, Mactan Is. Philippines, lumun-lumun net, 7.7 mm; **B** – *Lienardia gilberti* (Souverbie, 1874), Balicasag Is, Bohol, Philippines, lumun-lumun net, 35-50 m, 7.9 mm; **C** – *Lienardia* sp. Balicasag Is, Bohol, Philippines, lumun-lumun net, 35-50 m, 6.2 mm

РИС. 7. Раковины некоторых дополнительных экземпляров рода *Lienardia*, изученных на предмет морфологии радулы. **A** – *L. cf rosella* Hedley, 1922, Пунта-Энганья, Остров Мактан, Филиппины, лумун-лумун, 7,7 мм; **B** – *L. gilberti*, О-в Баликасаг, Бохол, Филиппины, лумун-лумун, 35-50 м, 7,9 мм; **C** – *Lienardia* sp. О-в Баликасаг, Бохол, Филиппины, лумун-лумун, 35-50 м, 6,2 мм

телеоконх из 5,5 равномерно выпуклых оборотов. Шов плохо заметен. Пришовная область слабо выпуклая, покатая, с тремя тонкими волнистыми спиральными линиями. Осевая скульптура из мощных закругленных сверху складок (12 на последнем обороте), пересечённых тонкими спиральными ребрами. Поздние обороты завитка с 5-ю отчётливыми спиральными ребрами. Периферия последнего оборота с 6 спиральными ребрами, основание раковины – с 6-ю.

Сифональный канал хорошо выражен, прямой, с глубокой вырезкой, несёт 6 ребер, спиральных до косых. Фасциола развита умеренно. Устье удлинённое, узкое. Внешняя губа устья заметно загнута внутрь, утолщена, несёт 5 зубчиков на внутренней поверхности. Варикс хорошо развит, позади внешней губы. Внутренняя губа с 3-мя зубчиками, из которых нижний выражен лучше остальных. Аналый синус глубокий, воронковидный, ограничен от устья крупным пришовным бугорком.

Протоконх, ранние обороты завитка и сифональный канал розовые, периферии последнего и предпоследнего оборота светлые. Граница периферии последнего оборота и основания раковины с отчётливой спиральной коричневой линией. Внешняя губа светлая.

Протоконх ортоконоидный из 3-3,5 оборотов, с двумя килями на поздних оборотах.]

Remarks: *Lienardia tagaroae* sp. nov. is close to *L. rubida* (Hinds, 1843), but could be easily recognized, on account of its peculiar color pattern.

Radula. Radular marginal teeth straight, slender, relatively short (tooth length about 90-100 µm – Fig. 6 L, M). Teeth tips with no barbs or blades, form awl-shaped terminal thorns, constituting about

fifth of teeth total length. Pore opens at base of thorn, with remarkable collar-shaped band of tubercles below its lower margin.

Etymology. This colorful and attractive species was named in honor of Sheila Tagaro, conchologist from Conchology Inc., who helped a lot in search for material for present paper.

Distribution. Central Philippines, Cebu-Bohol area, 50-150 m deep.

DISCUSSION

Studied species of the genus *Lienardia* are extremely close in shell morphology – they have the same sculptural pattern and are very similar in structure of aperture. All five studied species have protoconchs, which bear two keels which are very typical for subfamily Clathurellinae. Despite this, they could be easily separated by color patterns and proportions of shells. Since characters of this kind are generally accepted to be taxonomically insignificant, one could expect studied species to be closely related members of the same genus. However, taxonomically more important characters of radula could suggest the opposite, since all studied *Lienardia* species differ notably in radular morphology. All studied species possess radulae composed of few pairs of hypodermic type marginal teeth (type 4 – Kantor, Taylor, 2000), at the same

time, each described species has unique teeth morphology.

In different species marginal teeth bear a) symmetric opposing barbs – *L. cf rosella* (Figs. 6 A, B; 7 A), *L. roseangulata*, b) asymmetric opposite barbs – *L. acrolineata*, c) blades – *L. grandiradula*, d) no barbs or blades – *L. tagaroae*.

Internal canal of hypodermic tooth in different studied species can open a) below the barb – *L. cf rosella*, *L. roseangulata*; b) sideway from the barb – *L. acrolineata*.

The most characteristic feature, found in marginal teeth of most of described *Lienardia* species, is a projection (pointed out with arrows on Fig. 6 B, I, J, M), positioned below the upper opening of tooth canal. It can be a) single projection – *L. roseangulata*, or b) band of closely spaced projections, weakly developed in *L. cf rosella* or well pronounced in *L. tagaroae*.

In addition radulae teeth of studied species differ dramatically in size (tooth length varies from 95 to 550 µm).

In some cases conchologically very similar species of *Lienardia* demonstrate striking differences in radular structure. For instance, *L. gilberti* (Fig. 7 B), being conchologically close to both *L. cf rosella* and still undescribed species of the genus *Lienardia*, *L. sp.** (Fig. 7 C), possess radular teeth bearing multiple barbs on one side (Fig. 6 N), that differ from teeth of *L. cf rosella* and *L. sp.* (Fig. 6 L, M) as dramatically, as they differ from radulae of any other species, described here.

This has been shown, that within Conoidea morphologically very similar shells could often appear independently in unrelated taxa [Kantor, Taylor, 1994; Kantor, *et al.*, 2008]. On the other hand, it is believed that feeding specialization was a major mechanism of ecological radiation of turrids, which should have caused adaptive transformation of organs involved in feeding, including radula. These two statements give a raise to two opposite hypotheses of evolution of *Clathurella* / *Lienardia* generic complex. Either the species studied here are closely related, but have developed radulae of extremely diverse morphologies, reflecting their feeding specialization, or in other case, members of this group are less closely related, that is suggested from general similarity of their shells.

*This species is being currently described by G. Rosenberg and coauthors [Rosenberg, Stahlschmidt, 2011].

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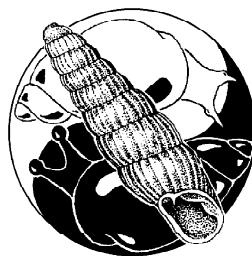
Пять новых видов рода *Lienardia* (Conidae: Gastropoda) из центральных Филиппин

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РЕФЕРАТ. Мелкие турриформные коноидеи составляют существенную часть таксономически

неописанного разнообразия морских моллюсков. Виды рода *Lienardia* Jousseaume, 1884, исключительно разнообразные в мелководных тропических морских сообществах не имелиенного успеха у таксономистов и значительная их часть остаётся на данный момент не описана. Использование специализированной техники сбора мелких моллюсков, с применением лумун-лумунов позволило собрать значительный материал по этой группе и выделить несколько новых видов. При исследовании материала с Филиппин и других регионов тропической Индо-Пацифики было выявлено 5 новых видов, описанных в данной статье как *L. acroleineata*, *L. grandiradula*, *L. multicolor*, *L. rose-angulata* и *L. tagaroae*. Изучение радул описываемых видов выявило неожиданное разнообразие их морфологий. Это предполагает либо быструю морфологическую специализацию, имевшую место при эволюции рода *Lienardia*, либо, вероятно, конвергентное сходство раковин его представителей.



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