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とその生物地理

フィリップ・ブシェ・ギド・ポッペ
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with a Discussion on Biogeography

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Abstract: *Alcithoe aillaudorum* n. sp. is the first *Alcithoe* known outside New Zealand waters; it is however not considered a Gondwanian vicariant relict but is probably a recent immigrant that dispersed from New Zealand to New Caledonia via the Norfolk ridge. *Lyria exorata* n. sp. is known from Capel and Kelso Banks, two submerged flat plateaus surrounded by abyssal depths in the Coral Sea. *L. habeii* Okutani, 1979 is a new record for New Caledonia. Records of other *Lyria* are reviewed and summarized. Although the distribution of *Lyria* in the Western Pacific corresponds rather well with the limits of the Pacific plate, this distribution appears to be a result of constraints in larval biology rather than a reflection of the plate tectonic history of the area.

Introduction

Deep water dredgings, conducted in 1985-86 in the New Caledonian region, have revealed a rich gastropod fauna with many undescribed species. The present paper reports on the family Volutidae, which is represented in New Caledonia by three shallow water species (Weaver and DuPont, 1970), and in the Chesterfield area, a New Caledonian dependency, by two species (Weaver and DuPont, 1970; Cernohorsky, 1980). Several species in the genus *Teramachia* will be dealt with in a separate paper.

The material was collected by the senior author during several oceanographic

cruises: BIOCAL under the direction of Prof. C. Lévi, MUSORSTOM 4 and 5, and CHALCAL 2 under the direction of Dr B. Richer de Forges. A popular account of the BIOCAL and MUSORSTOM 4 cruises has been presented in the journal of the Association Conchyliologique de Nouvelle-Calédonie (Bouchet 1986), and mimeographed reports of the MUSORSTOM 4, MUSORSTOM 5, CHALCAL 1 and CHALCAL 2 cruises have been published by ORSTOM (Richer de Forges, 1986; Richer de Forges et al., 1986, 1987).

Alcithoe aillaudorum n. sp.

(Figs. 1-5, 17)

Type material: Holotype and 10 paratypes in MNHN; one paratype each in AMS, NMNZ, AMNH, Natal Museum and BMNH.

Type locality: Off SW New Caledonia: 22°52'S, 167°13'E, 415 m (Cruise SMIB 1, St DW2); collected by G. Bargibant and P. Tirard, Feb. 5, 1986, aboard R.V. "Vauban".

Material examined: Cruise BIOCAL: St DW43, 22°46'S, 167°15'E, 400 m, 2 spms juv.; St DW44, 22°47'S, 167°14'E, 440-450 m, 3 spms, 3 juv.; St CP45, 22°47'S, 167°15'E, 430-465 m, 2 spms; St DW46, 22°53'S, 167°17'E, 570-610 m, 15 spms, 4 juv.; St DW51, 23°05'S, 167°45'E, 680-700 m, 1 fragment.

Cruise MUSORSTOM 4: St DW221, 22°59'S, 167°37'E, 535-560 m, 4 spms; St DW222, 22°58'S, 167°33'E, 410-440 m, 3 spms; St DW223, 22°57'S, 167°30'E, 545-560 m, 4 spms; St DW229, 22°52'S, 167°14'E, 445-460 m, 13 spms; St DW230, 22°53'S, 167°12'E, 390-420 m, 3 spms.

Cruise SMIB 1: St DW2, 22°52'S, 167°13'E, 415 m, 10 spms; St DW7, 22°56'S, 167°16'E, 500 m, 3 spms; St DW9, 22°55'S, 167°15'E, 450 m, 3 spms; SMIB 3: St DW12, 23°38'S, 167°42'E, 470 m, 1 spm; St DW13, 23°38'S, 167°42'E, 448 m, 2 spms; St DW21, 22°59'S, 167°19'E, 525 m, 5 spms; St DW22, 23°03'S, 167°19'E, 503 m, 3 spms; St DW24, 22°59'S, 167°21'E, 535 m, 5 spms; St DW26, 22°55'S, 167°16'E, 450 m, 3 spms.

Distribution: *A. aillaudorum* is known from a small area in the SW of New Caledonia, where it is common at depths between 400 and 700 m.

Description: Shell large, solid, heavy, elongate fusiform, consisting of 3 protoconch and 5.5 teleoconch whorls. Protoconch large, bulbous, with a small initial nucleus, smooth convex whorls. Protoconch/teleoconch transition indistinct; it is not clear if the earliest axial ribs belong to the protoconch or to the teleoconch. Teleoconch spire whorls convex, suture rather shallow; body whorl cylindrical, occupying 70% of total shell height. First whorl sculptured by 19 closely set prosocline axial ribs; on the second whorl the ribs become stronger at the periphery of the whorl, and the subsutural part of the whorl becomes concavely shouldered. Other teleoconch whorls with a series (12 per whorl, 13 on the penultimate whorl) of axially elongated knobs. Shoulder and knobs become

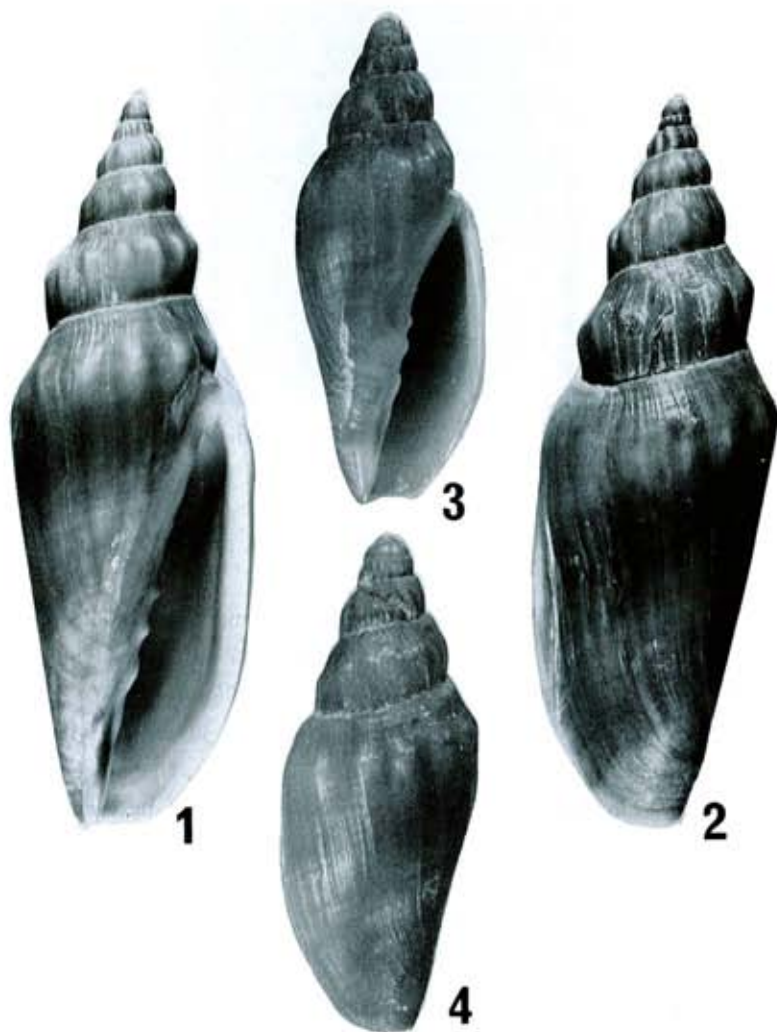


Fig. 1-4. *Alcithoe aillaudorum*. 1-2, holotype; 3-4, small sized adult paratype.

obsolete in the part of the body whorl behind the outer lip. In addition to the knobs, the sculpture consists of strong incremental lines, and weak and indistinct spiral scratches only visible on the body whorl. Aperture high, narrow, with an adapical callous projection adherent to the body whorl. Columella with 3 strong and 2 weaker plait; there is a thin and transparent glaze covering the columellar and parietal regions. Outer lip thick, smooth, straight. Siphonal canal broadly open, short. Siphonal fasciole present but indistinct.

Background colour of the shell dark beige to light brown, with a broad darker spiral band on the body whorl.

Head-foot white with small reddish-pink blotches; siphon pink.



Fig. 5. *Alcithoe aillaudorum*, radula,
Scale line: 50 μ m.

Radula with only three-cusped rachidian tooth present; base very broad, arched.

Dimensions of the shell (holotype): height 83 mm, breadth 28 mm; height of the body whorl 58 mm; height of the aperture 47 mm, breadth 9.5 mm.

Taxonomical remarks: The adult size of *Alcithoe aillaudorum* (with thickened outer lip) varies between 30.5 and 83 mm. The largest juvenile (with thin outer lip) is 64 mm high. Most adult shells are 35–50 mm high, there are only 5 shells over 60 mm high. There does not appear to be any distinct pattern of size variation: the intrapopulation adult size variation is large, from 35 to 83 mm, in some populations (SMIB 1 St DW2), and small, from 30.5 to 36 mm, in other (BIOCAL St DW46); there is no correlation with depth.

On the basis of general shell morphology, Powell (1979) distinguished three species groups in *Alcithoe*:

Group 1: large shells with a broad free-edged columellar callus-plate;

Group 2: large shells with a straight columella, tapered to a sharp point, and without a free-edged callus-plate;

Group 3: small subcylindrical shells with 4 pillar plaits, but without a columellar callus plate.

He only partly reflected this grouping in nomenclature, by using *Alcithoe* s.s. for groups 1 and 2, and *A. (Leporemax)* for group 3; he also placed several species in *Pachymelon* Marwick, 1926 and *Palomelon* Finlay, 1927, merged by Dell (1978) in the synonymy of *Alcithoe*.

We conclude from Weaver and DuPont (1970), Dell (1978) and Powell (1979) that supraspecific groupings within *Alcithoe* are still unstable, and consequently we will not assign *A. aillaudorum* to a subgenus.

At the specific level, because many taxa live at bathyal depths and are known only from scattered populations (Dell 1978), it is also a matter of opinion

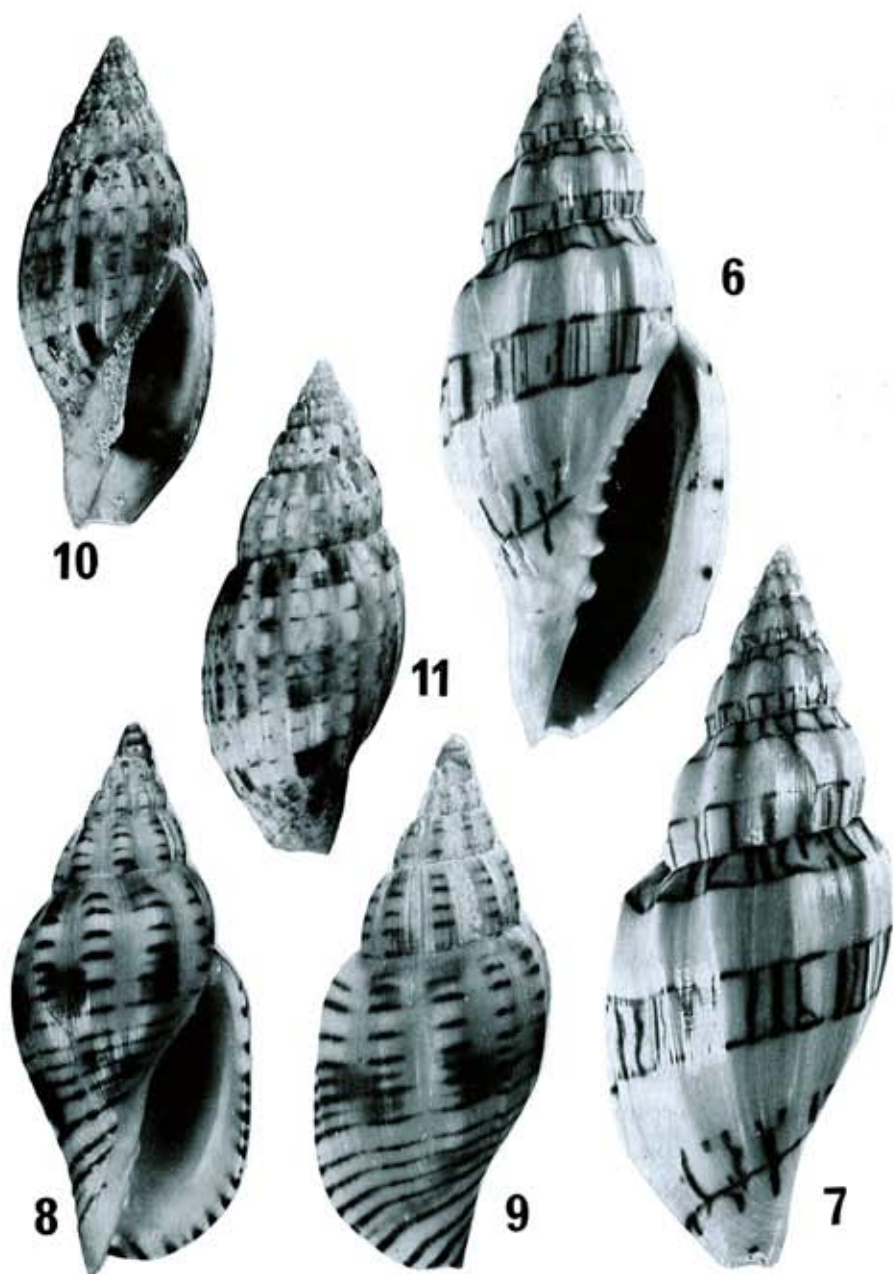


Fig. 6-11. New Caledonian deep water *Lyria*.

6-7. *L. exorata*, holotype; 8-9. *L. kuniene*, CHALCAL 2 St. DW82
(Azteque Bank); 10-11. *L. habei*, MUSORSTOM 4 St. DW205.

whether some of the named *Alcithoe* are considered as species, subspecies or morphs.

A. aillaudorum shows conchological similarities with three taxa. It most closely resembles *A. wilsonae* (Powell, 1933), from which it differs by the very high, cylindrical body-whorl giving to the whole teleoconch more slender proportions. *A. fusus* (Quoy and Gaimard, 1833) is not so closely related, but may be a source of confusion; its body whorl has a colour pattern, it is much more convex, with an expanded outer lip, and its protoconch is much smaller and more pointed. Finally, *A. hedleyi* (Murdoch and Suter, 1906), possibly a form or subspecies of *A. fusus*, shows some resemblance to *A. aillaudorum*; its protoconch, although large for the *A. fusus*-group, is always much smaller than in *A. aillaudorum*; its spire is lower, the siphonal notch is deeper, and the columellar plaits are not covered by a callus as they usually are in *A. aillaudorum*.

Alcithoe aillaudorum is named after Christiane and Jean-Pierre Aillaud, president and founder of the Association Conchyliologique de Nouvelle-Calédonie, and patrons of New Caledonian malacology.

Lyria exorata n. sp.

(Figs. 6-7, 12)

Type material: Holotype and one paratype in MNHN.

Type locality: Cruise MUSORSTOM 5, St DW282, 24°12'S, 159°32'E, 225-230 m (Kelso Bank); collected by P. Bouchet, B. Métivier and B. Richer de Forges aboard R.V. "Coriolis", Oct. 10, 1986.

Material examined: The holotype and one paratype from MUSORSTOM 5, St DW261, 25°27'S, 159°46'E, 300 m (Capel Bank); collected by P. Bouchet, B. Métivier and B. Richer de Forges aboard R.V. "Coriolis", Oct. 8, 1986. Both holotype and paratype were live taken.

Distribution: Only known from Capel and Kelso banks in the Coral Sea.

Description: Shell large, solid, fusiform, polished, consisting of 1.5 protoconch and 7.5 teleoconch whorls. Protoconch whorls convex, smooth; protoconch/teleoconch transition sharp. Teleoconch whorls convex with a moderately deep, impressed suture; body whorl occupying 68% of total shell height. Sculpture consists of broad, strong axial ribs, that are slightly but distinctly shouldered below the suture, and incremental lines. There are 12 ribs on the first two teleoconch whorls, 10 on subsequent whorls and 11 on the body- and penultimate whorls. No spiral sculpture except for a few very faint and indistinct furrows on the body whorl. Aperture high, narrow, with a thick callus where it joins the body whorl. Columella with a very thin callus; columellar plaits as follows: abapical one small, next 4 plaits very strong and equidistant, followed by two smaller and more closely set plaits; finally 4 closely set parietal lirae are situated adapically. Outer lip thick, smooth (abapical portion chipped). Siphonal canal

short, broad.

Background colour of the shell beige cream, with 3 rows of chocolate brown marks on the body-whorl (two on the spire whorls); the adapical row consists of a series of short and narrow flammules extending axially between the suture and a spiral line of the same colour. The second band consists of similar axial flammules extending between two spiral lines; this band is situated at the periphery of the body whorl, and is partly covered by the next whorl on the spire whorls. The abapical band consists of similar axial flammules but this time extending across a single chocolate spiral line. Aperture beige cream.

The head-foot is light beige with a reticulation of radiating reddish lines; siphon and tentacles cross striped with reddish lines. Eyes present.

Dimensions of the holotype: height 90.5 mm, breadth 35.5 mm; height of the body whorl 62 mm; aperture height 50 mm, breadth 14 mm.

Remarks: The paratype is 65.5 mm high and has a thickened outer lip. It conforms well with the holotype in shape and sculpture; it has 6 instead of 7 columellar plaits. The background colour is darker cream and the spiral chocolate lines are almost absent.

The shell and colour pattern of *L. exorata* are so distinctive that confusion with other living species of the genus is excluded. Related *Lyria* in the SW Pacific are *L. planicostata* and *L. kuniene*. Apart from the colour pattern it differs from *L. planicostata* by its shouldered whorls and fewer axial ribs. The protoconch of *L. kuniene* is bigger and more bulbous (Figs. 12, 15–16); its teleoconch is more slender and the aperture is white, not beige cream as in *L. exorata*. *Geographical and geological remarks*: Kelso and Capel banks are part of the chain of guyots stretching from the Chesterfield-Bellona Plateau to Lord Howe in the northern part of the Tasman Sea. The age of the volcanic structures supporting the guyots varies from 28 MY (upper Oligocene) in the North (Chesterfield—Bellona) to 6.5 MY in the South (Ball's Pyramid, off Lord Howe) (Missegue et al. 1987). An age of 15–20 MY is probable for Kelso and Capel banks, which cover an area of 1000 and 3000 km² respectively (Launay et al. 1979). Such an age and surface are sufficient for the existence of endemic species. However, the banks are separated by only short distances from Argo and Nova Banks, and from the Chesterfield—Bellona Plateau. Although no specimen of *L. exorata* has been collected on those banks, it is probable that its distribution is not just limited to Kelso and Capel Banks.

Lyria habe Okutani, 1979

(Figs. 10–11, 14)

Lyria habe Okutani, 1979, p. 5, fig 1.

Type locality: Hirase Banks, south of Kyushu, Japan (30°06'N, 130°06'E, 110 m).

Synonyms: *Lyria vicdani* Kosuge, 1981 and *Lyria reinai* Angioy and Biraghi, 1981 (see Poppe, 1982); *Lyria dondani* Angioy and Biraghi, 1982: 21, figs. (see Poppe, 1987).

Material examined: Cruise MUSORSTOM 4, St DW205, 22°38'S, 167°07'E, 140–160 m, 1 shell, collected by P. Bouchet and B. Richer de Forges aboard R.V. "Vauban", Sept. 27, 1985.

Remarks: The almost simultaneous discovery of *Lyria habei* in southern Japan and the Philippines, together with a lack of appreciation of intraspecific variation, has led to the publication of 4 names for the same species in less than 3 years. The synonymy of *L. vicdani* and *L. reinai* with *L. habei* was discussed by Poppe (1982). Specimens corresponding with the name *vicdani* have an unusual appearance due to the sculpture of axial ribs extending on to the body whorl of adult specimens, which is smooth in the holotype of *habei*. These axially ribbed specimens sometimes have a higher spire, and are then a little more slender than smooth forms. *L. vicdani* and *L. habei* have the same protoconch and apical teleoconch whorls, the same apertural characters, and their colour patterns are identical. Both forms can be found in the Philippines, where intermediate specimens, with broad and axially ribbed shells, have recently been collected. The existence of specimens with smooth and broad shells beside specimens with more slender and axially ribbed shells is also known in *L. mitraeformis* (Lamarck, 1811) (Weaver and DuPont, 1970).

Examination of material recently collected in the Philippines (coll. Poppe) also revealed that *L. dondani* simply corresponds with very large specimens of *L. habei* (Poppe 1987).

All these forms are "macrosympatric" in the Philippines; all known material is made available through the shell trade, and it is at present impossible to assess what is intrapopulation variation (without taxonomical status), and what may represent discrete geographical variation (which might deserve taxonomical recognition at subspecific or infrasubspecific levels). We recommend that the term "form" should be used to identify such variants.

The single empty shell dredged in New Caledonia is a young, low spired specimen, with axial ribbing extending on to the body whorl; the colour pattern is characteristic for the species.

This shell represents a considerable extension of the known distribution area of *L. habei*, hitherto known only from Southern Japan and the Philippines.

Lyria planicostata (Sowerby, 1903)

(Fig. 13)

Voluta planicostata Sowerby, 1903, p. 75, pl. 5, fig. 7.

Type locality: No data.

Synonyms: *Lyria taiwanica* Lan, 1975; *Lyria kawamura* Habe, 1975; *Lyria*

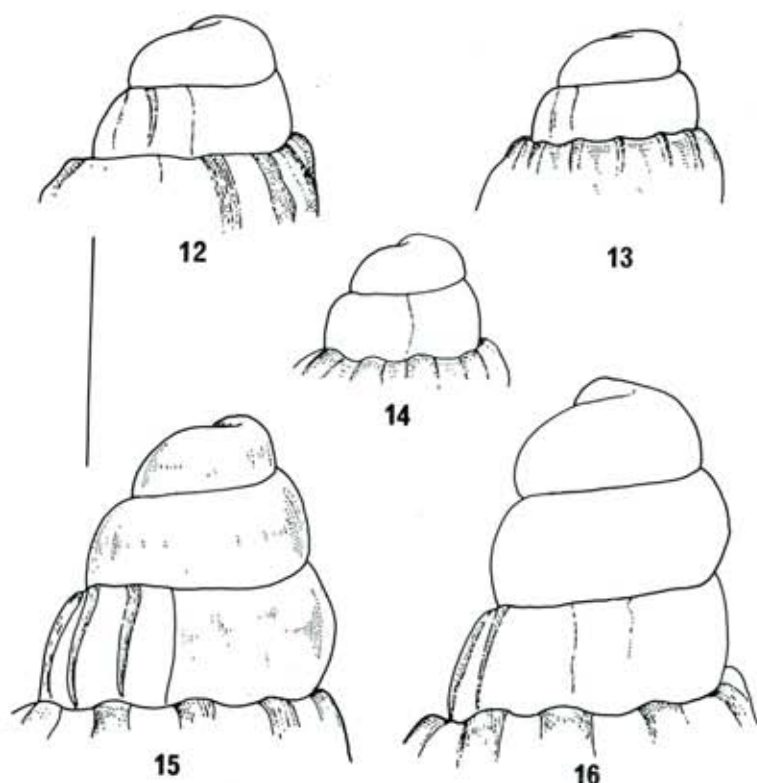


Fig. 12-16. Protoconchs of New Caledonian deep water *Lyria*.
 12. *L. exorata*, paratype from Capel Bank; 13. *L. planicostata* Dumbéa Pass, off Nouméa; 14. *L. habei*, MUSORSTOM 4 St DW205; 15. *L. kuniene*, CHALCAL 2 St DW82 (Azteque Bank); 16. *L. kuniene*, MUSORSTOM 4 St DW227. Scale line: 2mm.

santoensis Ladd, 1975; *Lyria taiwanica* forma *davaoensis* and forma *boholensis* Kosuge, 1980. (See Weaver, 1977; Kosuge, 1980; Cernohorsky, 1980; Pointier, 1985; Springsteen and Leobrera, 1986; Poppe, 1987).

Material examined: Dumbéa Pass, off Nouméa (22°22'S, 166°16'E), 290 m, one shell from crab trap.

Remarks: The present record of *L. planicostata* has already been published by Bouchet (1985); the shell is now in the private collection of M. Lecornet, Nouméa. The specimen is young and in good condition, and is the only one known from New Caledonia.

In the SW Pacific, *L. planicostata* is known from the Solomons (Cernohorsky, 1980; Poppe, 1987) and from the Pleistocene deposits of Espiritu Santo in Vanuatu (formerly New Hebrides: type locality of *santoensis*). Its known SE Asian range includes Taiwan, the Philippines and NW Borneo (Cernohorsky,

1980). Shells from Davao (S. Philippines), the Solomons and Vanuatu have a pattern of uninterrupted dense spiral lines, while shells from Taiwan, Bohol (S. Philippines) and New Caledonia have a pattern of widely spaced, interrupted spiral lines. We therefore regard the different colour forms as population variants and not as geographical subspecies.

***Lyria kuniene* Bouchet, 1979**

(Figs. 8-9, 15-16)

Lyria kuniene Bouchet, 1979, p. 49, figs. 1-3.

Type locality: 22°49'S, 167°12'E, 390-395 m (S. New Caledonia).

Material examined: the holotype; MUSORSTOM 4 St DW226, 22°47'S, 167°22'E, 390 m, 1 broken shell; St DW227, 22°46'S, 167°20'E, 300 m, 1 juv. spm and 2 fragments; St DW 234, 22°15'S, 167°08'E, 350-365 m, 1 broken shell; CHALCAL 2 St DW82, 23°14'S, 168°04'E, 305 m (Azteque Bank), 1 juv. shell + 1 fragment; ca. 22°40'S, 167°20'E, 250-350 m, 1 worn shell.

Distribution: Only known from the material examined, S. New Caledonia and northernmost Norfolk ridge, in 300-400 m.

Remarks: Despite intensive recent dredgings in the area, it is remarkable that only worn and fragmentary shells have been collected. A large fragment indicates that the species can probably reach more than 90 mm. The material from S. New Caledonia differs little from the holotype, and does not support the hypothesis (Cernohorsky, 1980) that *L. kuniene* is a synonym of *L. planicostata*: the ribs are sometimes less shouldered than in the holotype, but the protoconchs are the same. The differences from *L. planicostata* cannot be interpreted as geographical variation of that species since typical *planicostata* also occur in the area. In addition to the regular colour pattern, the juvenile and fragment from Azteque Bank have a spirally arranged series of brown blotches in the interspaces between the axial ribs.

Biogeographical Discussion

Protoconch morphology in all Recent and most fossil volutes indicates non-planktotrophic larval development. The protoconchs of several American Eocene Athletinae have been interpreted as indicating planktotrophic development (Fisher et al., 1964; Hansen, 1978). The protoconch of five Paleocene volutes figured by Glibert (1973) indicate non-planktotrophic development. From personal observations on Recent and fossil volutes, we conclude that, with the possible exception of Paleogene Athletinae, all members of the family, and at any rate all Neogene and Recent species, have non planktotrophic larval development. No volute larva has ever been taken in plankton nets.

Populations of Volutidae therefore do not exchange genetic material through a long lived planktonic veliger stage (Scheltema 1987), and make good material

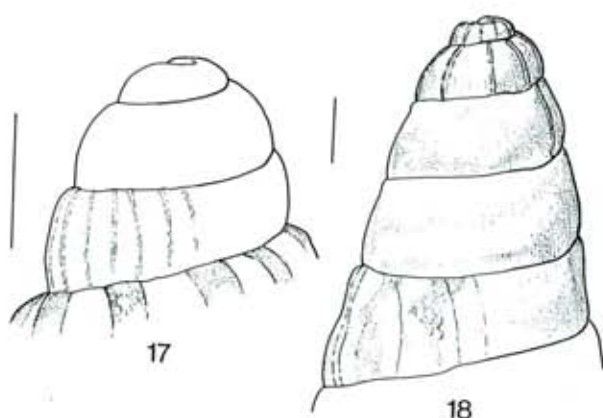


Fig. 17-18. Protoconchs of New Caledonian Volutes.
 17. *Alcithoe aillaudorum*, BIOCAL St. DW
 46; 18. *Cymbiolacca thatcheri*, Booby Reef,
 Chesterfield group. Scale lines: 2mm.

to test vicariant biogeographical hypotheses.

1. Distribution of *Alcithoe*:

The discovery of an *Alcithoe* in the New Caledonian region is biogeographically interesting, because its bathymetric distribution excludes the vast abyssal plains that isolate New Caledonia from other SW Pacific land masses. The genus was previously believed to be endemic to New Zealand, where its fossil record extends back to the lower Miocene (Marwick, 1926; Fleming, 1966) and its presence in Recent New Caledonia can tentatively be explained by three processes:

(a) New Caledonia, together with New Zealand was until the Cretaceous part of a Gondwanian block called Tasmantis (Coleman, 1980; Stevens, 1980), and the present disjunct distribution of *Alcithoe* could parallel similar vicariant distributions in land and freshwater taxa (Cracraft, 1980; Mildenhall, 1980 and references therein); however the breakup of this block happened before the genus *Alcithoe* (and its synonyms and subgenera) had evolved: 80 MY vs. 25 MY (Coleman, 1980; Fleming, 1966), so that *A. aillaudorum* cannot be considered a Gondwanian relict in New Caledonia.

(b) Although the general circulation of surface currents is not favourable (Pilot Charts, U.S. Hydrographic Office), New Caledonia can also be reached from New Zealand by planktonic veliger larvae. However, intracapsular metamorphosis in fossil and modern *Alcithoe* (Suter, 1919; Graham, 1941; Ponder, 1970, and Fig. 17), prohibits immigration of the larval phase from New Zealand to New Caledonia.

(c) The most likely dispersal route is by the Norfolk ridge, which provides a relative continuum of suitable bathyal depths between the two land masses

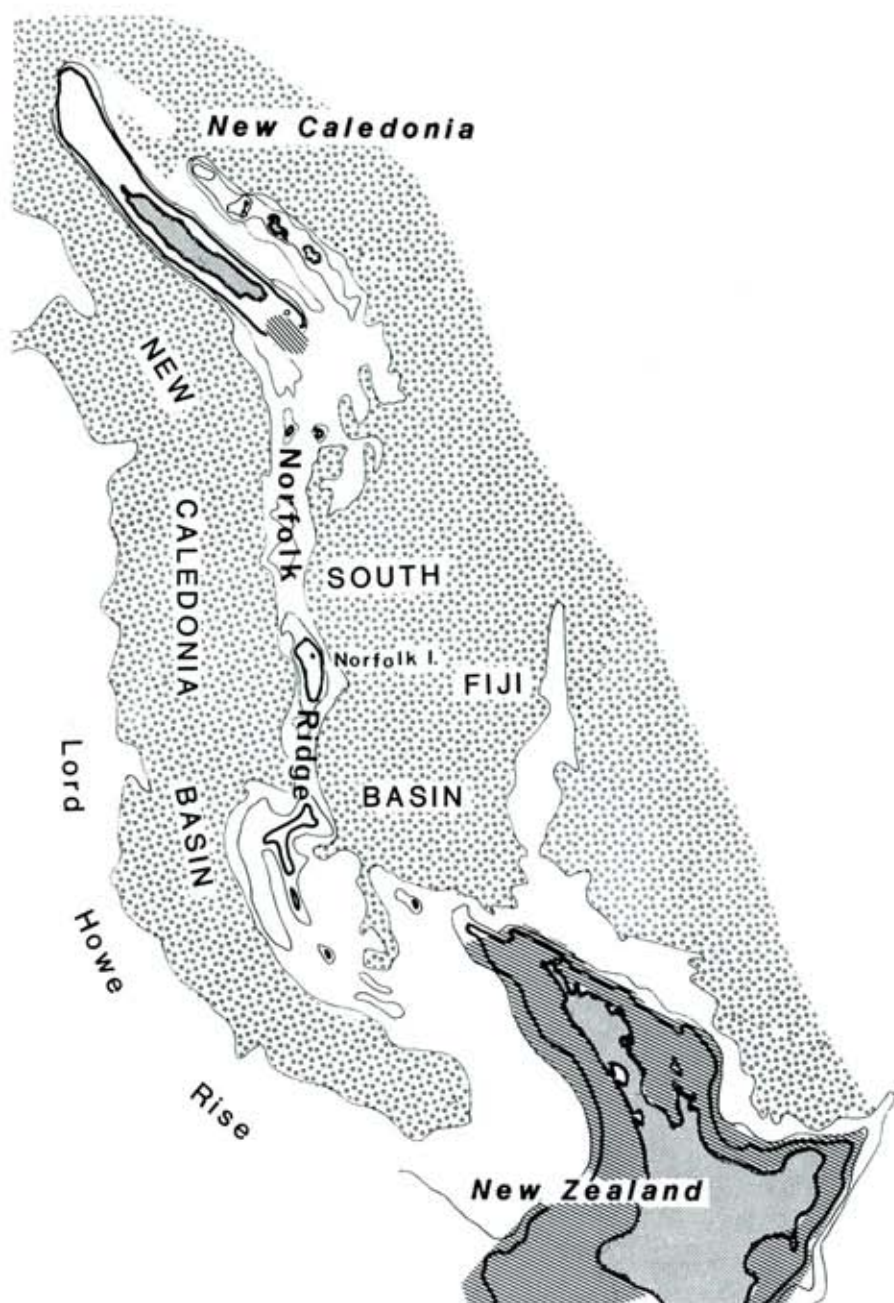


Fig. 19. Bathymetrical map of the SW Pacific, emphasizing Norfolk Ridge between New Zealand and New Caledonia. Depths contours: 500 m (thick line), 1000 m and over 2000 m. Hatched areas represent the disjunct distribution of *Alcithoe* species around New Zealand (all species pooled together) and South of New Caledonia. The New Caledonian Basin and Norfolk Basin (connected to South Fiji Basin) are both deeper than 3500m.

(Fig. 19). The Norfolk Ridge separates two deep water basins where *Alcithoe* cannot live: the Norfolk Trough to the West, and the South Fiji basin to the East. The Norfolk Ridge is an old structure, running for 2000 km from the NW of New Zealand to Norfolk, then to New Caledonia; its mean depth is between 1000 and 2000 m, but there are many banks and mountains that reach between 500 and 1000 m below sea-level (Dupont et al., 1975; Kroenke et al., 1983). Such banks can provide suitable habitats for *Alcithoe* and it is very likely that the ancestor to *A. aillaudorum* reached New Caledonia by hopping along this chain of submerged structures.

Exploration of the Norfolk Ridge will reveal if population of *Alcithoe* are present along the ridge, which will mean that dispersal is still an active process; or if the distributional area of *A. aillaudorum* is really disjunct from the area of all other *Alcithoe* together, which will mean that the dispersal process is an older phenomenon that left no modern trace along its pathway.

2. Discussion of distribution patterns in the genus *Lyria*:

The present paper brings the Volute fauna to 3 species in the Chesterfield and surrounding banks, and 7 species in New Caledonia. Of these, 6 are *Lyria*; their bathymetric range is from 10 m (*L. deliciosa* (Montrouzier, 1859) and *L. grangei* Cernohorsky, 1980) to ca. 500 m (*L. kuniene*, *L. planicostata*, *L. exorata* and *L. habeii*) and is incompatible with a continuous distribution across the floor of the Coral Sea. The diversity of this fauna contrasts with their total absence in modern faunas of Pacific archipelagos situated to the East of New Caledonia.

The genus *Lyria* is recorded since the upper Cretaceous (Cossmann, 1899), although the exact generic position of the Cretaceous and Paleocene fossils is a matter of discussion. No revision of Cenozoic West Pacific *Lyria* is available. The genus is known with certainty from the Tertiary of the Western Pacific (Fleming, 1966; Darragh, 1970; Masuda and Noda, 1976), and from the Pleistocene of Vanuatu (Ladd, 1975), but has not been recorded from the Cenozoic deposits of Tonga and Fiji described by Ladd (1982).

It is true that the Recent deep water faunas of the other tropical S. Pacific archipelagos are so totally unknown that the absence of Volutidae cannot be taken as significant: the two Pleistocene deep water *Lyria* reported by Ladd (1975) might very well be still living in Vanuatu. However, in view of the knowledge of shallow water faunas in Polynesia and the Central Pacific, their absence in the 0–100 m depth range is certainly significant: Volutes thus reach eastwards as far as the Melanesian archipelagos (Solomons, Vanuatu, New Caledonia), but are absent from Micronesia (Palau, Carolines, Marianas), Hawaii and Polynesia (Fiji, Tonga, Cook, Tuvalu, Kiribati, Society, Marquesas, Tuamotu, Easter) (Fig. 20).

This distribution is congruent with the limits of the Pacific Plate, but we

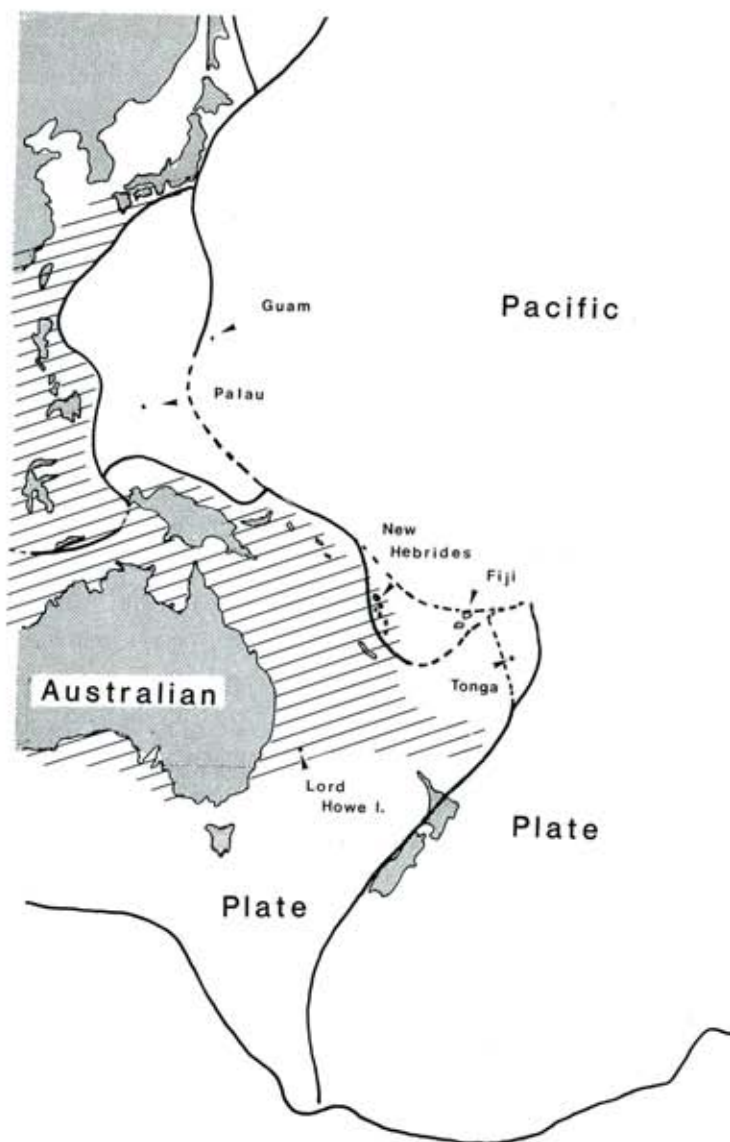


Fig. 20. Congruence between distribution of *Lyria* (all species together: hatched area) and limit of the Pacific Plate. Interrupted lines represent uncertain plate boundaries. Note the extension of *Lyria* across the New Hebrides trench onto the Pacific Plate. See text for discussion.

nevertheless believe that *Lyria* distribution cannot be convincingly explained in terms of vicariance.

There are three arguments that support this view:

(a) The presence of the non-endemic *Lyria planicostata* and *L. habeii* in the bathyal of New Caledonia evidences that some kind of dispersal is actively maintaining a gene pool between New Caledonia and surrounding land masses or submerged banks.

(b) The Coral Sea plateaus and banks of volcanic origin, have never been connected to any larger land mass and are surrounded by abyssal depths; the presence of two species of *Lyria* cannot be explained in terms of vicariance, but suggests that dispersal has taken place from Queensland and/or New Caledonia.

(c) Tonga and Fiji are on the Australian Plate, yet *Lyria* is not known from there. (The New Hebrides were formerly on the Indo-Australian Plate, and are now east of the subduction zone).

We instead propose to explain *Lyria* distribution by dispersal.

If one takes into consideration all isolated reefs and submerged banks in the Melanesian archipelagos and the Coral Sea area, the distance from one habitat to the nearest is never greater than 250 km (Fairway Reef to New Caledonia). Uncolonised islands and archipelagos to the East of Melanesia are isolated by greater distances: Conway Reef—Viti Levu (580 km), Lau group (Fiji)—Tonga seamounts (400 km); furthermore, the islands situated immediately to the East of the New Hebridean arc (Matthew, Hunter, Tikopia) are so recent (Pleistocene to Holocene) in age that they probably could not yet act as connecting bridges with Fiji. Like the Coral Sea guyots, the Polynesian archipelagos have never been connected to larger land masses during the last few million years. Distances are moderate between the islands of Fiji, Tonga and Cook; they become large, amounting to thousands of kilometers, in the Central Pacific (Marquesas, Easter, Hawaii).

Although the currents can certainly enhance or lessen these barriers, the vast abyssal plains and large stretches of open water obviously act as filters to potential colonizers (Scheltema and Williams, 1983; Scheltema, 1986): *Lyria* occur in such parts of the Pacific where barriers appear to be 300 km or shorter, they do not occur in the parts of the Pacific where barriers are larger than 300 km.

Exchange of genetic material must occur frequently enough to prevent subspeciation or speciation in such non-endemic species as *L. habeii* and *L. planicostata*. If we take their endemism as significant, *L. kuniense*, *L. grangei* and *L. exorata* would be the result of rare colonization events followed by genetic drift and speciation.

Protoconch sizes indicate that *Lyria* larvae are generally small (Figs. 12–16) compared to other Volute larvae: 1–2 mm in contrast with the 5–10 mm or more

hatching size of many Volutes (see for example *Cymbiolacca thatcheri* McCoy; Fig. 18). Such sizes may not be totally incompatible with a short demersal lecithotrophic free swimming stage; the duration of such a stage might be longer in cold bathyal depths, and be compatible with a 200–250 km journey between islands, banks and reefs in the Western Pacific. Even if *Lyria*, like other Volutes, undergo intracapsular metamorphosis, some kind of demersal dispersal of the young postlarvae must take place.

The conclusion of this analysis of distribution patterns in *Alcithoe* and *Lyria* is that dispersal, and not vicariance, appears to be the main explanatory factor. This is particularly noteworthy since Volutes are among the most holobenthic of all gastropods, and could therefore have been expected to exhibit distributional patterns resulting from vicariant events.

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要 約

Alcithoe aillaudorum, n. sp. はニュージールランド海域以外から初めて記載される *Alcithoe* 属で、ニューカレドニア南西の水深400~700mに比較的普通である。貝殻は大きく、重厚、紡錘形。最大殻長83mm。胎殻は大きい。体層は殻長の70%。縦肋は肩角上の結節となり、1階あたり12~13個。強い成長肋と弱い螺肋がある。殻口外唇は肥厚し直線的。内唇から軸唇にかけて滑層を塗り、軸褶は3。殻表は淡褐色で幅広い暗色螺帯がある。本種は *A. wilsonae* (Powell, 1933) に似るが、いっそう細高い。

Lyria exorata, n. sp. はサンゴ海のカベル・ケルソ両礁の水深225~300mから採集された。殻は紡錘形で大きく、殻長90.5mm。殻表には10~12本の幅広く強い縦肋がある螺状溝は極めて弱い。殻口には滑層が著しく発達し、軸唇には最下部の強い軸褶の上に4強褶、続いて2小褶、更に4褶がある。殻表はベージュクリーム色で、2本(体層では3本)の褐色螺状帯があるが、それは上下を繋ぐ火焰状縦帯の不規則な連結からなる。

ニューカレドニア産の *Lyria* スジボラ属には次の3種ある。すなわちハベスジボラ *L. habei* Okutani, 1979 (= *L. vicdani* Kosuge, 1981; *L. reinai* Angioy & Biraghi, 1981; *L. dondani* Angioy & Biraghi, 1982); アラスジボラ *L. planicostata* (Sowerby, 1903) (= *L. taiwanica* Lan, 1975; *L. kawamurai* Habe, 1975; *L. santoensis* Ladd, 1975) 及び *L. kuniene* Bouchet, 1979。

以上の発見から、ニューカレドニアの *Alcithoe* マオリガイ属は Gondwana の遺存種とするよりノーフォーク海嶺沿いの伝播と考えられる。またニューカレドニア付近の *Lyria* の分布はプレートテクトニクスと関連させて考えるより、幼生時代にいくらかの地理的分散があると考えられる。

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