Memoirs of the Queensland Museum | **Nature 62**

Queensland Museum Network respectfully acknowledges the Traditional Owners and Custodians of the lands, seas and regions across the state of Queensland.

PO Box 3300, South Brisbane 4101, Australia
Phone 06 7 3840 7555
Fax 06 7 3846 1226
Email qmlib@qm.qld.gov.au
Website www.qm.qld.gov.au

National Library of Australia card number
ISSN 0079-8835 Print
ISSN 2204-1478 Online

NOTE

A Guide to Authors is displayed at the Queensland Museum web site www.qm.qld.gov.au

A Queensland Government Project
Typeset at the Queensland Museum

A new species of *Amoria* (Gastropoda, Volutidae, Amoriinae) from the mid-east coast of Australia

John M. HEALY

Biodiversity and Geosciences Program, Queensland Museum, PO Box 3300, South Brisbane Queensland 4101, Australia. Email: john.healy@qm.qld.gov.au; Biological Sciences Faculty, University of Queensland; Integrative Biology Department, Field Museum of Natural History, Chicago USA.

https://doi.org/10.17082/j.2204-1478.62.2020.2019-02

LCID urn:lsid:zoobank.org:pub:9DE97BAB-E4C4-4B97-8567-9BCDFE6A6C58

Citation: Healy, J.M. 2019. A new species of *Amoria* (Gastropoda, Volutidae, Amoriinae) from the mid-east coast of Australia. *Memoirs of the Queensland Museum – Nature* 62: 1–10. ISSN 2204-1478 (Online), ISSN 0079-8835 (Print). Accepted: 30 October 2019. First published online: 10 January 2020.

ABSTRACT

A new species of *Amoria* Gray, 1855 (Gastropoda, Volutidae) is described from shells dredged off the Australian mid-east coast (Cape Moreton, Queensland and Tweed Heads, New South Wales). *Amoria thorae* sp. nov. shows a number of similarities in shell form and/or colour pattern to two other small *Amoria*, *A. necopinata* Darragh, 1983 and *A. benthalis* McMichael, 1964 and to the much larger *A. undulata* (Lamarck, 1804) but can be readily distinguished from these and all other members of the genus by the combination of small shell size, fusiform shape, high spire, equal-sized thick columellar plaits and a single, large undulation of the axial lines.

❑ *Amoria, Volutidae, systematics, new species, eastern Australia.*

In their monograph of the genus *Amoria* Gray, 1855, Bail, Limpus & Poppe (2001) included a small unnamed species ('*Amoria* (*Amoria*) sp.') dredged off Cape Moreton (south-east Queensland) and off Wooli (northern New South Wales) and known only from two specimens held in private collections. Limpus (1996) had previously reported on the Wooli specimen, referring to it as '*Amoria* cf *necopinata*' and noting that it had been 'trawled in 125+ metres'. Bail *et al*., (2001) also pointed out similarities to *A. necopinata* Darragh, 1983, a Capricorn Channel and southern Swains species, and to the more widely distributed, but much larger and chiefly southern Australian species *A. undulata* (Lamarck, 1804) but, due to a lack of specimens, refrained from naming the species. Neither Bail *et al*. (2001) nor Limpus (1996) made any comparison with *A. benthalis* McMichael, 1964, which partly resembles the unnamed species and has a similar geographic range. When photographing the Thora Whitehead shell collection prior to its acquisition by the Queensland Museum, the author located two specimens of the unnamed species (labelled as *A. necopinata*), and subsequent searching by Alison Miller (Australian Museum, Sydney) produced two further shells (also labelled as *A. necopinata*). In this paper I take the opportunity to name the species in honour of Thora Whitehead, who has, for over 50 years, made a major contribution to Australian malacology.

MATERIAL AND METHODS

Specimens used in the description derive from the molluscan collections of the Australian Museum and the Queensland Museum (those from the latter, originally from the Thora Whitehead Collection, Brisbane). For comparison with other species of *Amoria*, shells of *Amoria necopinata* Darragh, 1983, *A. benthalis* McMichael, 1964 and *A. undulata*

(Lamarck, 1804) from these collections and from the Thora Whitehead Collection were also examined. Shell measurements were made using Vernier callipers, with precision of 0.1 mm. The deep-focus images of the holotype (Fig. 1) and paratype 3 (Fig. 4A) were focus-stacked with Zerene Stacker software from source images taken with a Canon 5DS camera on a Dun Inc. BK-Plus imaging system. Specimens shown in Figs 3-4 were photographed using a Panasonic Lumix DFC-MZ8 camera with a Leica optical zoom lens and built-in flash. Specimens shown in Fig. 6 were photographed using a Nikon D810 camera with a 70 mm Sigma Art macro lens with studio flash.

ABBREVIATIONS

AMC, Australian Museum molluscs collection (Sydney, New South Wales); NSW New South Wales; QLD, Queensland; RC, Reserve Collection (dry shell collection); SA, South Australia; SE South-east; VIC, Victoria; QMMO, Queensland Museum molluscan collection (Brisbane, Queensland).

SYSTEMATICS

Class GASTROPODA Cuvier, 1795

Order NEOGASTROPODA Wenz, 1938

Family VOLUTIDAE Rafinesque, 1815

Subfamily AMORIINAE Gray, 1857

Genus *Amoria Gray, 1855*

Type species. *Voluta turneri* Gray (= Gray in Griffith & Pidgeon, 1834) (by subsequent designation, Harris (1897)).

Amoria thorae sp. nov.
(Figs 1, 2, 3, 4, 5A, E, 6A-D)

Amoria cf *necopinata* Darragh, 1983. Limpus (1996), pp 1 & 3.
Amoria (*Amoria*) sp. Bail, Limpus & Poppe (2001), p. 45, Pl 56, Figs 1,2; pl 84; pl 85, Fig.2

Material examined. HOLOTYPE: AMC.75849, (RC) dredged off Cape Moreton, QLD (no depth recorded) 27° 2′S, 153° 36′E, 1970, presenter O. Rippingale. PARATYPES: QMMO.85858, (paratype 1), RC, 1, trawled at 110 m off Cape Moreton, SE QLD, (no date recorded), presenter T. Whitehead. QMMO.85859, (paratype 2), RC, 1, same data as paratype 1. AMC.364620, RC, 1, (paratype 3), #9056B, off Tweed Heads, NSW 28° 14′ – 28° 19′S, 153° 50′E , depth 128-137 m, by FRV "Kapala", 2 June, 1978. Station: K78-09-09/10. Collector: K.J. Graham, ex AMC.114257. *Amoria thorae* sp. nov. LSID reference urn:lsid:zoobank.org:act:9741B918-3092-4D8F-B855-204EE11C4E64

Etymology. Named for Thora Whitehead for her many years of dedication to the study of molluscs and for her generous assistance to numerous individuals and societies throughout the world malacological community.

Diagnosis. The combination of small shell size and fusiform shape, high spire, equal-sized, thick columellar plaits and a colour pattern dominated by a single large undulation of the axial lines (overlying four rows of diffuse brown blotches) distinguishes this species from all other *Amoria* spp.

Description. Shell small for *Amoria* (adults 24.8-31.6 mm total length), moderately solid, narrow, high-spired and fusiform. Aside from growth lines, sculpture lacking and surface smooth. Protoconch conical of about two and a half whorls but transition to teleoconch very subtle; nucleus almost flat. Teleoconch of two to two and a half whorls; body whorl weakly concave toward suture, strongly convex at shoulder and very slightly convex to almost straight thereafter; suture impressed; aperture long and narrow; columella slightly curved, bearing four thick equal-sized plaits, the posterior two sometimes associated with low, weakly-developed secondary plaits; outer lip curved and solid, thickest posteriorly; anterior fasciole raised and well-defined; siphonal notch well-developed; anal notch moderately well-developed. Protoconch colour cream. Teleoconch base colour cream to tan, with overlying parallel, brown, axial lines; body whorl with 14-25 (average 18) axial lines which show one undulation peak directed towards the aperture (when viewed dorsally); underlying the axial lines of body whorl are four indistinct rows of light brown blotches, one row below the suture, two mid-whorl (best developed) and one close to anterior fasciole;

TABLE 1. Dimensions of the type series.

Specimen designation	Registration Number	Shell length	Length of aperture	Maximum shell width
Holotype	AMC.75849	24.8 mm	17.8 mm	10.9 mm
Paratype 1	QMMO.85858	27.8 mm	20.7 mm	12.4 mm
Paratype 2	QMMO.85859	24.3 mm	17.8 mm	10.4 mm
Paratype 3	AMC.364620	31.6 mm	22.7 mm	13.6 mm

fasciole with 5-8 axial lines. Animal presently unknown.

Distribution. Cape Moreton, SE QLD to Wooli, northern NSW (approximately 300 km); known bathymetric range 110-137 m (dead shells only) (see Fig. 2).

Habitat. Unknown.

Comments on the type series. Of the four specimens comprising the type series of *A. thorae* sp. nov. (all dead-taken shells), the holotype, a small adult, is the most structurally intact and although somewhat faded still retains most of the colour pattern (Figs 1, 3A, E, 5A, E, 6A). Paratype 1, a slightly damaged adult with partial apertural encrusting by serpulid polychaetes, best shows the intensity of the colour pattern (Figs 3B, F, 4B, C, 6B). Paratype 2 is a juvenile, very damaged on the apertural side (Figs 3C, G, 4C, 6C), and paratype 3, a faded and partially bryozoan-encrusted adult but with the best preserved protoconch, is the largest of the series and also the largest known specimen (Figs 3D, H, 4A,C, 6D). Secondary columellar plaits (weakly-developed) are only evident in the holotype and paratype 1 (Fig. 4B). The marked difference in size between the holotype and paratype 3, both conchologically 'mature' specimens, raises the possibility of sexual dimorphism in the species, although this can only be determined once mature living animals - and statistically-analysable numbers of them - are found. Predation drill holes, likely of muricid and octopodan origin, are present in the three paratypes (paratype 1 - one on protoconch, one near anterior extremity of fasciole; paratype 2 - one on protoconch, one on early teleloconch; paratype 3 - one on protoconch) (Fig. 4C).

Comparison with other species of *Amoria*

Amoria thorae sp. nov. can be compared with several other *Amoria* spp. with axially-lined shells (see Plate 84 of Bail *et al*., 2001), but three stand out as showing the strongest conchological similarities: *A. necopinata* Darragh, 1983, *A. benthalis* McMichael, 1964 and *A. undulata* (Lamarck, 1804) (see Figs 5, 6 for comparative photographs). The following summarises the principal differences of these three species from *A. thorae* sp. nov.

Amoria necopinata (Figs 5B, F; 6E-J) differs from *A. thorae* sp. nov. in having: a thinner shell; a more expansive, convex aperture; thinner, more widely spaced columellar plaits; a deeper anal notch; an ivory-white shell background with a colour pattern devoid of underlying blotches and featuring fewer axial lines on the body whorl (13-14) – the lines forming two undulation peaks. Additionally, a brown spiral line is usually visible, running around the suture between the last protoconch whorl and first teleoconch whorl. The anterior fasciole has only one to three axial lines.

Amoria benthalis (Figs 5C, G; 6K-O) differs from *A. thorae* sp. nov. in having: a broader and generally larger shell; a noticeably shorter spire; a larger, broader protoconch, often with a distinct glaze; larger columellar plaits (the posterior being largest); a weakly defined anterior fasciole; a deeper anal notch; a colour pattern featuring a greater number of axial lines on the body whorl (25-32) – the lines showing either two or no undulation peaks.

Amoria undulata (Figs 5D, H; 6P-T) differs from *A. thorae* sp. nov. in having: a much larger shell (typically 60-80 mm); a larger, broader protoconch of 3 ½ -4 whorls; a deeper

FIG. 1. Holotype of *Amoria thorae* sp. nov. AMC.75849, dredged off Cape Moreton, SE QLD; **A,** Dorsal view; **B**, Ventral (apertural) view; **C**, Lateral view; **D**, View looking down on spire showing detail of protoconch.

anal notch; a colour pattern in which the axial lines usually exhibit two or more undulation peaks. Juveniles of *A. undulata* of the same size range as *A. thorae* sp. nov. are, by comparison with the new species, stocky with a wide, distinctly angulate shoulder (Fig. 6 P-T).

Two other species of *Amoria* whose geographic ranges partially overlap that of *A. thorae* sp. nov. are *A. zebra* (Leach, 1814) (Northern New South Wales to Northern Queensland, an exclusively shallow water species) and *A. canaliculata* (McCoy, 1869) (Cape Moreton to Swain Reefs, Queensland). These species very occasionally fall into the shell-size range of *A. thorae* sp. nov., but neither could be confused with it (*A. zebra*: pupiform protoconch, shell very thick and broad, shorter spire, very thick columellar plaits, no axial line undulation; *A. canaliculata*: shell very thick and broad, shorter and deeply channelled spire, very thick columellar plaits, no axial line undulation) (see Abbotsmith 1969; Weaver & DuPont 1970; Poppe & Goto 1992; Wilson 1994; Bail *et al*. 2001).

All other species of *Amoria* with axially-lined shells have geographic ranges far removed from that of *A. thorae* sp. nov. and can be readily distinguished from it on shell features: *A. ellioti* (G.B. Sowerby II, 1864) (Western Australia), *A. jamrachi* Gray, 1864 (Western Australia), *A. turneri* (Gray in Griffith & Pidgeon 1834) (Western Australia to Torres Strait, Queensland) (all with much larger shells, shorter spires, axial line undulation peaks either absent or irregular), *A. macandrewi* (G.B. Sowerby III, 1887) (Western Australia) (larger shell, shorter spire, with 2-3 axial line undulation peaks), *A. dampieria* Weaver, 1960 (Western Australia) (shell small but very thick, with shorter spire, very thick columellar plaits, no axial line undulations) (see Abbotsmith 1969; Weaver & DuPont 1970; Poppe & Goto 1992; Wilson 1994; Bail *et al*. 2001). The Timor subspecies of *A. grayi*, *A. grayi kawamurai* Habe, 1975, does show a single large undulation peak of the body whorl axial lines but this peak, when viewed dorsally, faces the opposite direction to that of *A. thorae* sp. nov., and the shell is much larger and its facies show an obvious, strong affinity with Western Australian *Amoria* (see Poppe & Goto 1992; Wilson 1994; Bail *et al*. 2001).

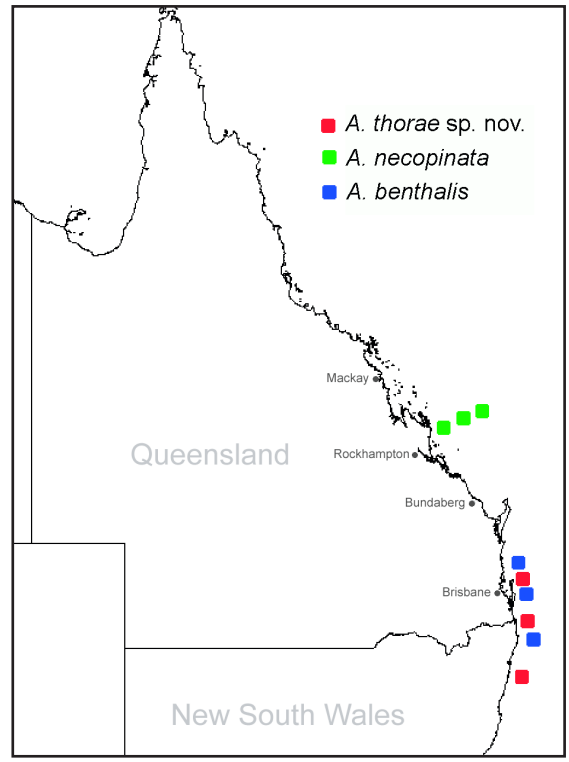

FIG. 2. Map contrasting known distributions of *Amoria thorae* sp. nov., *A. necopinata* Darragh, 1983 and *A. benthalis* McMichael, 1964.

Other Remarks. Although the holotype and paratypes of *Amoria thorae* sp. nov. are dead-taken specimens, they clearly belong to the same species illustrated by Bail *et al*., (2001) as '*Amoria* (*Amoria*) species' (their plate 56, figures 1 and 2: likewise a dead-taken specimen, albeit in fresher condition that the type series of *A. thorae* sp. nov.). The two specimens examined by Bail *et al*. (2001) were trawled off Cape Moreton (southern Queensland) and off Wooli (northern New South Wales – their illustrated specimen). Locality data for the type series of *A. thorae* sp. nov. not only confirm that the species occurs off Cape Moreton but importantly, with the existence of a Tweed Heads shell (paratype 3), help to bridge an apparent gap between Cape Moreton and Wooli, thereby giving a known

FIG. 3. Type series of *Amoria thorae* sp. nov. from dorsal view (A-D) and ventral/apertural view (E-H). **A, E,** holotype, AMC.75849, dredged off Cape Moreton, SE QLD; **B, F,** Paratype 1, QMMO.85858 110 m trawled off Cape Moreton, SE QLD; **C, G,** Paratype 2 (QMMO.85859; same data as Paratype 1); **D, H,** Paratype 3, AMC.364620, #9056B, 128-137 m off Tweed Heads, NSW.

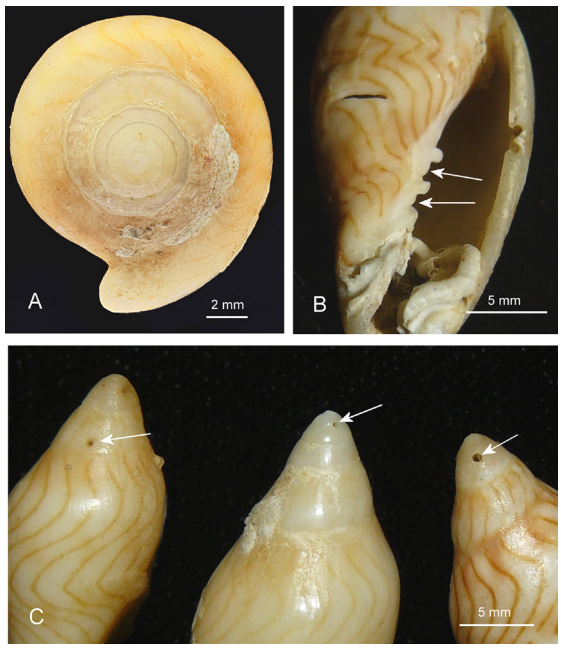

FIG. 4. *Amoria thorae* sp. nov. **A**, View looking down on spire showing detail of protoconch of paratype 3 (AMC.364620). **B**, Apertural view of paratype 1 (QMMO.85858) showing weakly developed secondary plates (arrows) between primary plates. **C**, Predation drill holes (arrows) in paratypes (left to right) paratype 2 (QMMO.85859, likely octopodan drill hole), paratype 3 (AMC.364620, likely muricid drill hole), paratype 1 (QMMO.85858, possible muricid drill hole).

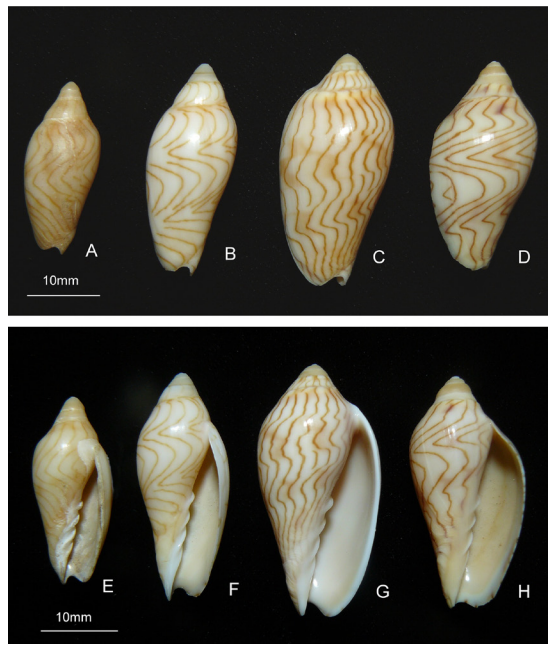

FIG. 5. *Amoria thorae* sp. nov. (**A, E,** holotype, AMC.75849, dredged off Cape Moreton, SE QLD) contrasted (from both dorsal and apertural perspective showing columellar plaits) with *A. necopinata* Darragh, 1983 (**B, F,** AMC.101845. 133.5 m, Capricorn Channel, off North Reef Lighthouse, Coral Sea, QLD), *A. benthalis* McMichael, 1964 (**C, G,** QMMO.83608, 170 m, off Moreton Island, SE QLD) and a typical juvenile *A. undulata* (Lamarck, 1804) (**D, H,** QMMO.30632, Hawks Nest, SA).

range of approximately 300 km for the species. This range substantially overlies that of *A. benthalis* (Mooloolaba, southern Queensland to Ballina, New South Wales) (see Fig 2) although, as the present paper has shown, that species can readily be differentiated on shell features from *A. thorae* sp. nov. Hopefully further collecting will determine the depth at which living *A. thorae* sp. nov. may be found. Possibly it is deeper than the recorded maximum for the type series (137 m) as extensive shallow-water (<100 m) trawling throughout the known range over many years by fishing vessels has not produced specimens, at least to the author's knowledge. Given that the terrain worked by commercial trawlers is of necessity (e.g. safety, potential damage to boat and gear – see Evans, 2000) very select, it is also possible that the new species lives near areas avoided by boats, such as coarse rubble and/or rocky reefs, but within the known bathymetric range, or shallower. However, Alison Miller (Australian Museum, Malacology Department) was able to supply the author with a list of 29 other molluscs species (5 bivalves, 24 gastropods) dredged together with paratype 3 of *A. thorae* sp. nov. from off Tweed Heads, New South Wales. Most if not all of these are associated with mud, sand or shell grit bottoms, and all four of the other volute species present (*Athleta studeri* (Von Martens, 1897), *Ericusa sericata* Thornley, 1951, *Cymbiolacca complexa* Iredale, 1924, *Nannamoria parabola* Garrard, 1960) live either on mud and/or sand (Coleman 1975; Poppe & Goto

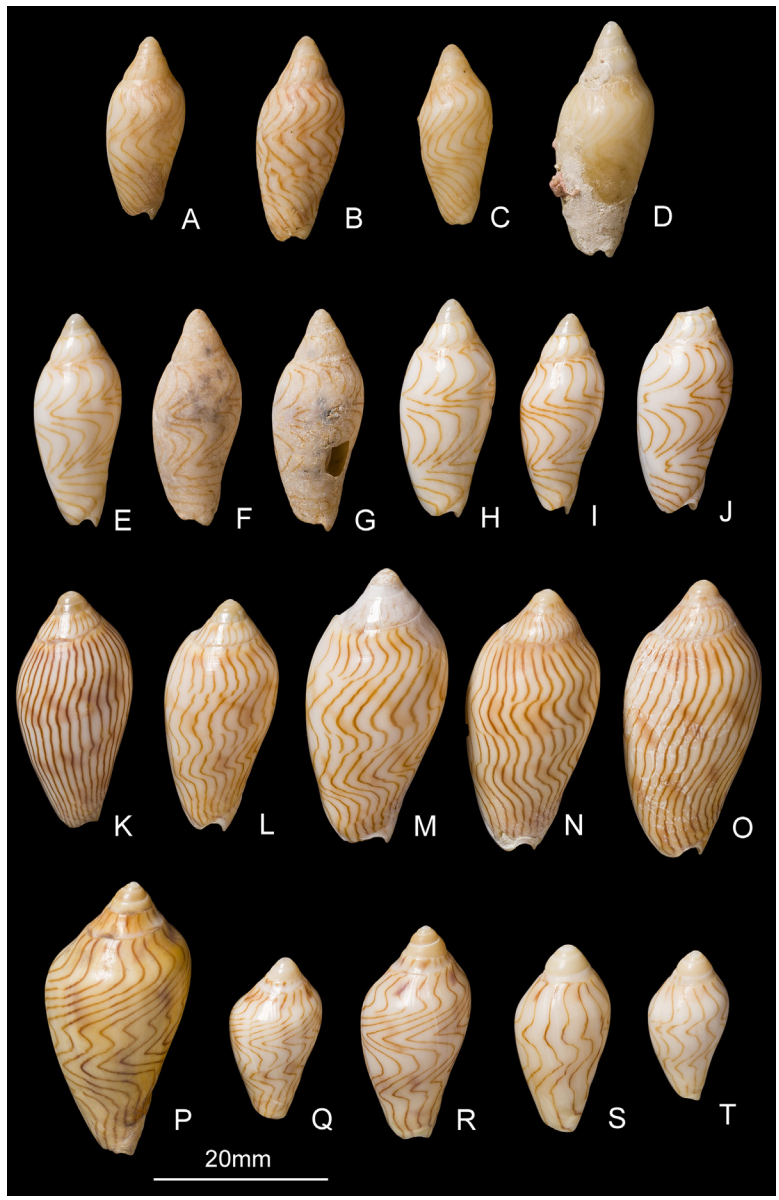

FIG. 6. Comparison of shell series of *Amoria thorae* sp. nov. with similar species of *Amoria*, showing general consistency of shape and colour pattern within each species. **A-D**. *Amoria thorae* sp. nov; **A,** Holotype (AMC.75849, Cape Moreton, SE QLD); **B, C,** Paratypes 1 (QMMO.85858) and 2 (QMMO.85859), both 110 m, off Cape Moreton, SE QLD. **D,** Paratype 3 (AMC.364620, 128-137 m off Tweed Heads, NE New South Wales); **E-J,** *A. necopinata* Darragh, 1983; **E-G**, AMC.101845, 133.5 m, Capricorn Channel, off North Reef Lighthouse, Coral Sea, QLD; **H, I,** QMMO.85878, Coral Sea, QLD; **J,** QMMO.83660, 140 m, Capricorn Channel, Coral Sea, QLD; **K-O,** *A. benthalis* McMichael, 1964; **K,** QMMO.63431, off Cape Moreton, SE QLD. **L, M,** QMMO.83608, 170 m, off Moreton Island, SE QLD; **N, O,** QMMO.85879, 200 m off Mooloolaba, SE QLD; **P-T,** Juvenile *A. undulata* (Lamarck, 1804); **P, Q,** QMMO.25166, Sorrento, VIC; **R,** QMMO.30632, Hawks Nest, SA; **S, T,** QMMO.85880, Eastern Cove, Kangaroo Is, SA).

1992; Bail & Limpus 2015.). The three species here considered closest to *A. thorae* sp. nov. (*A. necopinata*, *A. benthalis*, *A. undulata*) are also associated with mud and/or sand (see Weaver & Dupont 1970; Poppe & Goto 1992; Limpus 1993; Bail *et al*. 2001), and on balance, such a substratum seems likely for the new species. Given the small shell size of *A. thorae* sp. nov., and the fact that modern trawling methods are designed to exclude unwanted benthic by-catch, locating living specimens may prove difficult, particularly if the species is genuinely uncommon or rare. The fact that all known specimens of *A. thorae* sp. nov. are dead-taken should not be misconstrued as evidence that the species is actually extinct (i.e. that the known shells are 'sub-fossils'). For example, the vast majority of *A. necopinata* and *A. benthalis* encountered are dead-taken shells (Coucom 1975a, b; Bail *et al*. 2001; Evans 2001), yet both species are unquestionably living ones as documented in colour photographs of the animals (Coucom 1975b; Bail *et al*. 2001; Healy 2015).

Concerning the precise relationship of *A. thorae* sp. nov. to other *Amoria* species, little can be said with any certainty until animals are available for study. Conchologically, the new species would appear to have closest connections with the similarly small-sized *A. necopinata* and *A. benthalis* and with the much larger and more widely distributed *A. undulata.* Bail *et al*. (2001), in their comments on *A. necopinata* (p. 34), hinted that the two specimens observed by them of '*Amoria* (*Amoria*) species' (= *A. thorae* sp. nov.) may actually be variants of *A. necopinata*, but later in the same study (p. 44) suggested that the same specimens may be closer to *A. undulata* based on range and colour pattern. The known distribution of *A. necopinata* is well separated from even the most northerly record of *A. thorae* sp. nov. (Fig. 2) and despite similarities in shell size and shape and a shared tendency towards possession of secondary columellar plaits, the two taxa are readily distinguished on other shell features. As also shown in this paper, *A. thorae* sp. nov. cannot be confused with *A. benthalis* nor with *A. undulata* of the same shell size (the latter specimens invariably being juvenile, broad-shouldered and angulate). Importantly, the known geographic range of *A. thorae* sp. nov. overlaps that of *A. benthalis* and the northern-most east coast limit of *A. undulata* (see Abbotsmith 1969; Bail *et al*. 2001) indicating that the new species is not an ecophenotype of either of these taxa. Indeed, judging from available bathymetric data, all three of these species could potentially be sympatric. Published photographs of living *A. necopinata*, *A. benthalis* and *A. undulata* (Coucom 1975b; Coleman 1975; Wilson 1994; Bail *et al*. 2001; Healy 2015) may provide clues as to the appearance of the animal of *A. thorae* sp. nov. Both *A. necopinata* and *A. benthalis* show alternating yellow/white and brown/orange transverse bands on the tentacles and reticulate markings on the siphon, whereas in *A. undulata* the tentacles and siphon are both longitudinally striped. Such information, aside from helping to confirm that *A. benthalis* is a valid species (and not, as suggested by Darragh (1983, 1988) an end-of-range dwarf form of *A. undulata*), also provides an anatomical link between *A. necopinata* and *A. benthalis*. It will be of interest to know if the markings of the cephalic tentacles and siphon of *A. thorae* sp. nov. are like those of *A. necopinata* and *A. benthalis*, or like those of *A. undulata*, or perhaps follow some other scheme. As *A. necopinata*, *A. benthalis*, and *A. undulata* all exhibit reticulate brown markings on the foot (contrasting with the radiating stripes of the foot seen in most other *Amoria* spp. – Weaver & DuPont 1970; Wilson 1994; Bail *et al*. 2001), it is likely that *A. thorae* sp. nov. also shares this feature. Finally, an examination of the radulae of *A. thorae* sp. nov., *A. necopinata* and *A. benthalis* is here considered important to confirm that these species possess the 'typical' *Amoria* Y-shaped rachidian teeth seen in *A. undulata* (see McMichael 1964).

ACKNOWLEDGMENTS

The author thanks Mrs Thora Whitehead for generously donating the specimens herein designated as paratypes 1 and 2 of *Amoria thorae* sp. nov. to the Queensland Museum and for donating specimens of *A. necopinata*, *A. benthalis*

and juvenile *A. undulata* for comparisons. Alison Miller of the Australian Museum (Malacology Department) is thanked for her considerable help in locating, within that institution's extensive collection, additional specimens of *A. thorae* sp. nov. (which have become the holotype and paratype 3) as well as material of *A. necopinata* and *A. undulata* for comparisons and for the list of other molluscs collected with paratype 3 by the "Kapala" (Ken Graham) from off Tweed Heads. Dr Mandy Reid (Collections Manager, Malacology Department, Australian Museum) kindly allowed me the opportunity to examine the Australian Museum material. Geoff Thompson (Collections Imager, Queensland Museum) took the high definition (image-stacked) photographs of the holotype (Fig. 1) and protoconch of paratype 3 (Fig. 4A); Peter Waddington (Photography, Queensland Museum) photographed specimens for Fig 6; all other photographs (Figs 3, 4B, C, 5) are by the author. Thanks are also due to Sarah Verschoore (Biodiversity and Geosciences Program, Queensland Museum) for her assistance with the map (Fig. 2) and the referees for their very helpful suggestions on the manuscript.

LITERATURE CITED

Abbotsmith, F. 1969. *Multiform Australian Volutes.* (Privately published) 108pp + later addenda.

Bail, P. & Limpus, A. 2015. The eastern Australian *Cymbiola* Swainson, 1831. New revision of the subgenus *Cymbiolacca* Iredale, 1929. The "pulchra complex" 1998 updated. *Visaya Supplement* **6** (Conchology Inc., Lapu-Lapu City) 95pp.

Bail, P., Limpus, A & Poppe, G. 2001. *A Conchological Iconography. The Genus Amoria*. (ConchBooks, Hackenheim), 50 pp, 92 pls.

Coleman, N. 1975. *What Shell Is That ?* (Hamlyn, Sydney) 308pp.

Coucom, C. 1975*A*. To be – or not to be. *Keppel Bay Tidings* **14**(2): 1 & 4.

1975b. Capricorn Channel volutes. *Keppel Bay Tidings* **14**(4): 1, 4 & 5.

Darragh, T.A. 1983. Volutidae (Mollusca: Gastropoda) from the Capricorn Channel, Central Queensland, Australia. *Journal of the Malacological Society of Australia* **6**(1-2): 83-87. https://doi.org/10.1080/00852988.1983.10673959.

1988. A revision of the Tertiary Volutidae (Mollusca: Gastropoda) of south-eastern Australia. *Memoirs of the Museum of Victoria* **49**(2): 195-307. https://doi.org/10.24199/j.mmv.1988.49.12.

Evans, R. 2000. Prawn trawling off the Sunshine Coast. The 60's & 70's. Part 1 (The grounds… deep and shallow and their shells). *Keppel Bay Tidings* **39**(1): 7.

2001. Prawn trawling off the Sunshine Coast, the 60's and 70's (The winter months …70-105 fathom deep-water grounds). *Keppel Bay Tidings* **40**(1) : 6-7.

Harris, G.F. 1897. *Catalogue of Tertiary Mollusca in the Department of Geology, British Museum (Natural History). Part I. The Australasian Tertiary Mollusca.* (British Museum [Natural History], London).

Healy, J.M. 2015. Colour images of deep water *Volutidae. Radula* (Spring): 3.

Limpus, A. 1993. *Amoria necopinata* Darragh, 1983. A welcome visitor. *Keppel Bay Tidings* **32**(2): 1 & 5.

1996. To be – or not to be. *Keppel Bay Tidings* **35**(3): 1 & 3.

McMichael, D. 1964. Notes on the genera *Amoria* Gray, 1855, and *Zebramoria* Iredale, 1924, (Gastropoda: Volutidae), with descriptions of new species. *Records of the Australian Museum* **26**(8): 265-274. https://doi.org/10.3853/j.0067-1975.26.1964.676.

Poppe, G.T. & Goto, Y. 1992. *Volutes*. (L'Informatore Piceno, Ancona), 348pp.

Weaver, C.S. & DuPont, J. 1970. *The Living Volutes.* (Delaware Museum, Greenville), i-xv + 375pp.

Wilson, B.R. 1994. *Australian Marine Shells. Prosobranch Gastropods. 2 (Neogastropoda).* (Odyssey Publishing: Kallaroo), 370pp.