

**Studies in *Canarium urceus* (Linné, 1758) Part 2:
Strombus anatellus Duclos, 1844, *Strombus crassilabrum* Anton, 1839,
Strombus incisus Wood, 1828 and *Strombus ustulatus* form *laevis*
 Dodge, 1946 (Neostromboidae: Strombidae)**

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ABSTRACT Many valid species can hide buried within prior taxonomic revisions. These need to be examined before the taxonomist embarks on the challenging task of naming new taxa. In this study we re-examine the synonyms compiled by Abbott (1960) under *Canarium urceus* (Linné, 1758), examining each taxon for morphological clarity and distinctiveness. After considering the written descriptions and type material in light of prior revisions, we suggest that there are three valid species buried within the *C. urceus* synonymy of Abbott. All three species can be differentiated from *C. urceus* in general form, being less equi-triangular and lacking the strong shoulder knobbing of that species. In addition, all three species are distinguishable by their distinctive aperture colouration. *Canarium urceus* possesses a typically black aperture, *Canarium anatellum* (Duclos, 1844) can be differentiated by its typically uniformly red/orange aperture, while *Canarium incisum* (Wood, 1828) is recognisable by the typically orange columella and outer lip, and a more triangular form. *Strombus ustulatus* form *laevis* Dodge, 1946 is the classical well-known form from the Philippines and elsewhere that is recognisable by its white columella. As the name *laevis* was preoccupied, we have renamed the species *Canarium esculentum nomen novem*. We assessed *Strombus crassilabrum* Anton, 1839 to be a *nomen dubium*. Further, our revision provides an improved hypothetical framework for the evolution and radiation of this most adaptable and variable of organisms, through increased clarity, and the re-circumscription of hitherto described taxa with distinctive morphotypes and separate biogeographical ranges.

KEY WORDS *Canarium urceus*, *C. anatellum*, *C. incisum*, *C. esculentum*, *C. crassilabrum*, phenotype, synonymy, taxonomy

INTRODUCTION

In the first part of these studies on the *Canarium urceus* of Abbott (1960), Maxwell *et al.* (2020) appropriately redefined *Canarium urceus* (Linné, 1758), tying the species morphology with a determinate population, thus providing a definitive diagnosis for *Canarium urceus*. The delimitation of *Canarium urceus* provided the

basis upon which to undertake a revision of the synonymy offered by Abbott (1960) for that species. The known synonyms are compared to the recircumscribed *Canarium urceus* to test the assessment of Abbott (1960). It has been previously demonstrated that Abbott (1960) tended to underestimate the number of species, lumping valid taxa into groups on broad morphological similarity (Dekkers and Maxwell

2018; Maxwell *et al.* 2019a; Dekkers and Maxwell 2020).

The current revision identifies the discrete sampling locations that are hidden in the historical literature and synonymised under *Canarium urceus* (Linné, 1758) of Abbott (1960), and re-circumscribing them. In revisiting these samples, no *a priori* taxonomic judgment is made as to their cladistic relationships, and at this time discrimination is based on stability of shell characters.

METHODS

This synonymic revision involved two primary steps. The first step aimed to identify the *Canarium urceus* synonymies contained within Abbott (1960). To do this we obtained images of the type material for each of the identified taxa, and use the morphology of type specimens and iconotypes to determine potential species. Once identified, the second step involved examining each taxon for morphological clarity and distinctiveness from other members of the *Canarium urceus* of Abbott (1960). Where a taxon was clearly a synonym, it was listed under the species hypothesis with precedence. Plated examples are provided for all species that were recircumscribed.

SYSTEMATICS

Three taxa were recircumscribed. *Canarium insisum* (Wood, 1828) was shifted to an Indonesian location and form, correcting the error in assignment (Man in 't Veld 1988). *Canarium anatellum* (Duclos, 1844) was reinstated, and *Canarium esculentum*, *nomen novem*, was introduced to replace the preoccupied *Strombus ustulatus* form *laevis* (Dodge, 1946) (not *Strombus laevis* Perry, 1811 (= *Euprotomus bulla* (Röding, 1798))).

Superfamily: Stromboidea Rafinesque, 1815
Epifamily (Clade): Neostromboidae Maxwell, Dekkers, Rymer & Congdon, 2019b
Family: Strombidae Rafinesque, 1815
Genus: *Canarium* Schumacher, 1817
Type species: *Strombus urceus* Linné, 1758

Canarium anatellum (Duclos, 1844)

Type Material. *Strombus anatellus* Duclos, 1844 (Muséum National d'Histoire Naturelle, Paris (France) Collection: Molluscs (IM) MNHN-IM-2000-32467 (Figure 1).

Type Locality. The Kangean Islands, Indonesia, designated herein.

Original Description. Duclos (1844) provided no original description, with the name being introduced on plate 4, figures 11 and 12, and plate 21, figures 8 and 9, based on the Chenu (1859) plate sets (Sherborn and Smith 1911). The combination of illustration and binominal name is considered valid at the time of publication (ICZN 1999).

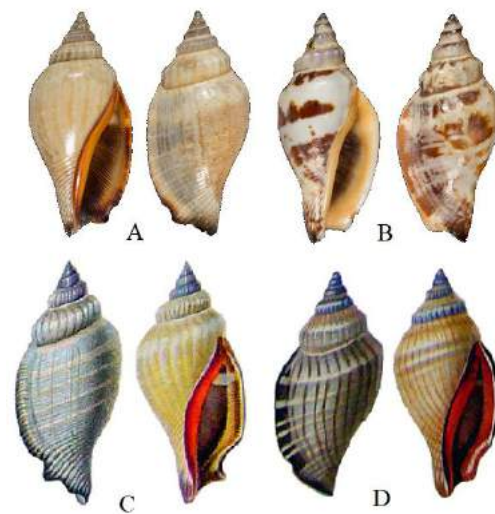


Figure 1. Syntypes of *Canarium anatellum* (Duclos, 1844) (Muséum National d'Histoire Naturelle, Paris (France) Collection: Molluscs (IM) two specimens **A** and **B**= MNHN-IM-2000-32467 illustrated- Duclos collection). Images from Duclos, 1844: **C**= pl. 4, figs. 11 and 12; **D**= pl. 21, figs. 8 and 9.

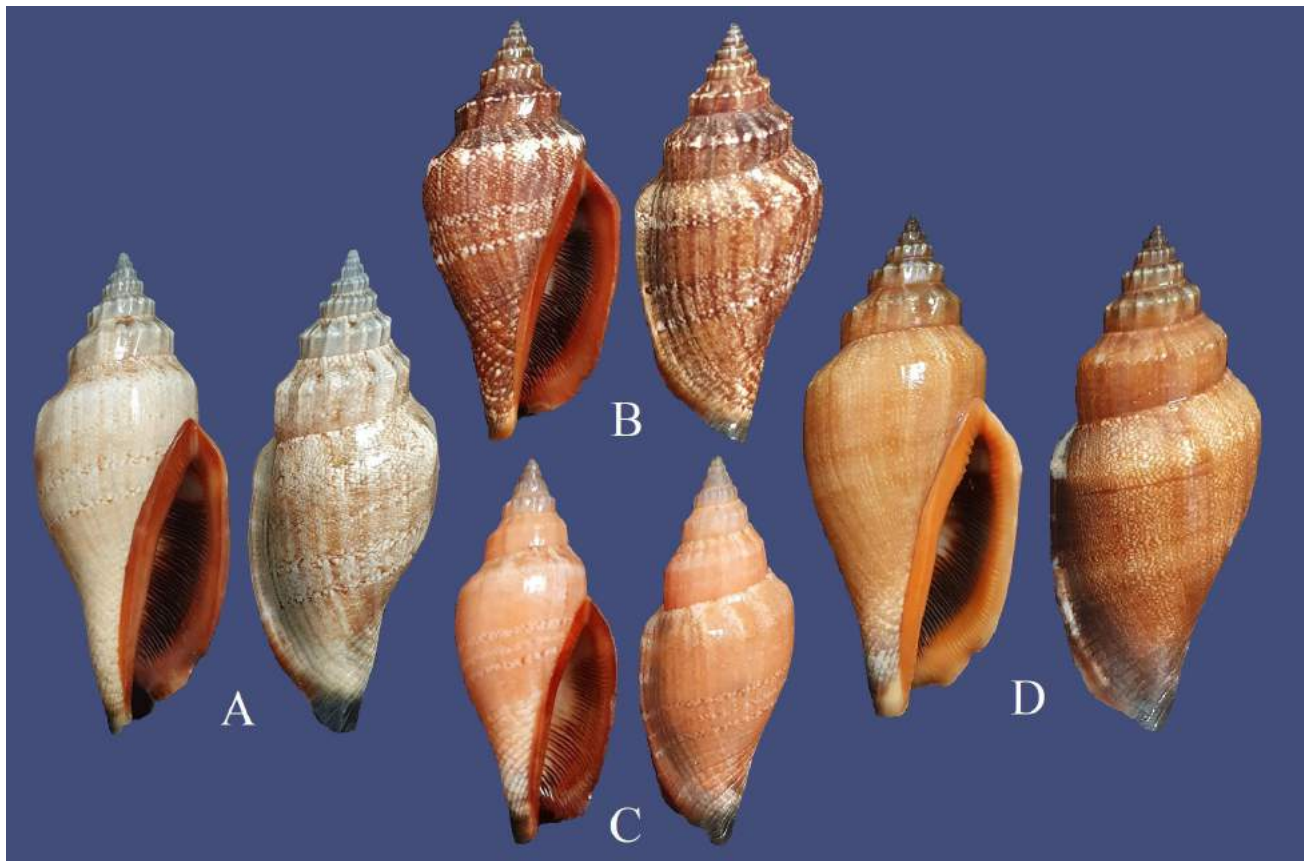


Figure 2. *Canarium anatellum* (Duclos, 1844) showing the red-orange columella, Kangean Islands, Indonesia, fisherman taken 2020: **A**= 52 mm (SMC 19b-006da); **B**= 45 mm (SMC 19b-006db); **C**= 36 mm (SMC 19b-006dc); **D**= 52 mm (SMC 19b-006dd).

Diagnosis. Key diagnostic feature is the uniformly red-orange toned columella and outer lip in combination with a slender shell with rounded shoulder (Figure 2).

Description. This ovate species has both a uniformly red-orange toned columella and outer lip. The shell is solid and smooth. The body whorl has axially aligned knobs on the shoulder. The columella is always smooth and, inside the labrum, it is red-orange with mostly dark coloured lirae entering deep inside the aperture; the last 4-5 mm towards the rim lose the brown colour. The outside colour is variable, with brown, green, cream, tan, yellow, orange, etc., and is mostly mottled. The anterior canal is almost always tipped with black within and on

the outside. The whorls are rounded, with a weakly angled shoulder. The spire whorls have up to 17 axial shoulder knobs, which may be weak or obsolete. The base of the shell has 8 – 10 incised lines giving rise to flat cords. The aperture is elongated with a small but sharp posterior canal just ending under the shoulder.

Synonymy.

1844 *Strombus anatellus* Duclos, pl. 4, figs. 11 and 12, pl. 21, figs. 8 and 9. Tryon 1885, p. 118. Adam and Leloup 1938, p. 113. Dodge 1956, p. 285. Abbott 1960, pp. 65 and 66. Cernohorsky 1972, p. 74. Wagner and Abbott 1978, p. 09-652. Walls 1980, p. 188.

Discussion. This ovately fusiform, medium-sized species is characterised by the red-orange columella and labrum. It has similar apertural colours to *Canarium incisum*, but *Canarium anatellum* differs in the form of the shell, *Canarium incisum* is also more triangulate and with a thicker and more quadrate aperture. *Canarium esculentum* is larger, with an actuate sinus at the upper aperture, with a predominantly white columella and a typical white labrum. *Canarium urceus* is a larger more fusiform species than *Canarium esculentum*, *Canarium urceus* differing in having a black coloured aperture with traces of deep plum.

Strombus crassilabrum Anton, 1839
nomen dubium

Type Material. Unknown.

Type Locality. Unknown.

Synonymy.

1839 *Strombus crassilabrum* Anton,
*Verzeichniss der Conchylien Welche Sich
in der Sammlung*, p. 87, no. 2820 (Figure
3).

2820. 1. crassilabrum mihi, spitz-oval, Gewinde ziemlich niedrig, 6 convexe Windungen, letzte grösser als die übrigen zusammen, mit 3 kielartigen, äusserst flachen Reifen, sonst quergestreift, Mundsaum und Basis gefurcht; Naht gerandet, obersten Windungen mit kleinen Tuberkeln besetzt; blassgelb; Mündung schmal, oben sehr spitz zugehend, quergestreift, innen roth, aussen weiss; Spindel mit dickem Wulst, oben und unten gestreift, Mitte glatt, innen roth, äusserer Saum weiss; Mundsaum sehr stark, nicht geflügelt. Br. 7''' H. 1'' 1'''. Die convexe glatte vorletzte Windung und die gesäumten Nähte nähern sie dem *St. gibberulus*, die dicke, in der Mitte glatte Spindel dem *St. urceus*, das wenig hohe Gewinde dem *St. floridus*. Ein Verbindungsglied obiger drei Arten.

Figure 3. Anton (1839 p. 87) original text for *Strombus crassilabrum*

Original Description. “2820. 1. *crassilabrum* in my collection, pointed oval, spire fairly low,

6 convex whorls, the last larger than the others together, with 3 keel-like, extremely flat spirals, otherwise with axials, aperture and base grooved; suture with band, uppermost whorls with small tubercles; pale yellow; Aperture narrow, pointed towards the top, striated across, red on the inside, white on the outside; Columella with thick callus, lirae at the top and bottom, smooth centre, outer edge white; apertural rim very strong, not winged. Br. 7''' H. 1'' 1'''. The convex, smooth penultimate whorl and the banded suture approach *St. gibberulus*, the thick, smooth columella in the middle *St. urceus*, the low spire *St. floridus*. A connecting link of the three species above.” (Anton 1839, p. 87: translated AMD).

Discussion. *Strombus crassilabrum* is considered a *nomen dubium*. There are two taxa that have been linked to this name: *Canarium erythrinum* (Dillwyn, 1817) and *Canarium esculentum*. The two-toned colour of the aperture, particularly with the red inner and white outer surfaces, is not dissimilar in colour distribution to the aperture of *Canarium esculentum*, but that species is not known by the authors to have red on the columella. The form of the columella is well defined and lirate top and bottom, which is not uncommon in either species it has been associated with. Within the literature, it is placed within the general synonymy of *Strombus urceus* (Abbott, 1960). However, it is not that species (Maxwell *et al.* 2020); the Anton (1939, no 2816) description for *Strombus urceus* Linné, 1758 is based on Martini's (1777) figures 803-806 (see Maxwell *et al.* 2020 for discussion on Martini) and its colour forms indicating that a different taxon to *Canarium urceus* was in his hands. WoRMS (2020) places it within the *Canarium erythrinum* complex without written justification.

Canarium esculentum Maxwell, Rymer,
Congdon & Dekkers, *nomen novem*
(Figure 5)

Type Material. The type is deposited in the American Museum of Natural History no. 12927 as the holotype of *Strombus ustulatus* form *laevis* Dodge, 1946, p.3. figs. 1 and 5 (Figure 4).

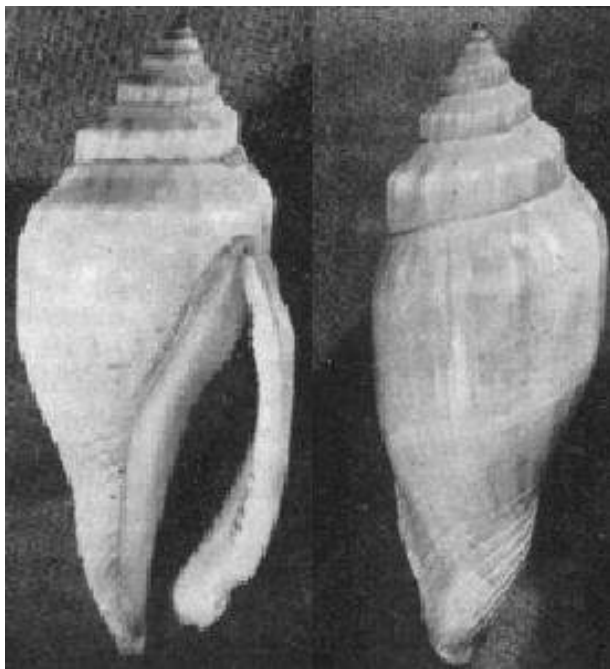


Figure 4. The holotype of *Strombus ustulatus* form *laevis* Dodge, 1946, p. 3, figs. 1 and 5 (American Museum of Natural History No. 12927).

Type Locality. We designate Olango Island, Philippines. Dodge (1946) gave no locality for his specimen.

Original Description. "I here propose for the extremely smooth form of *ustulatus* the name form *laevis*" (Dodge 1946, p. 3).

Diagnosis. The outer aperture is bordered with white, and the columella is two-toned, being white and pink (Figure 5).

Description. This species has both a uniformly white toned columella and rather slender fusiform to ovate appearance. The shell is medium sized, solid, smooth and relatively broad. Larger shells tend to be more slender. The body whorl has axially aligned knobs on the shoulder. The early whorls have mostly white varices, and a blueish black protoconch. The white columella is predominantly white, and is always smooth in the mid part; the posterior has ca. 10 lirae; and the anterior part 5-6 lirae. Inside labrum is yellowish-orange, with mostly dark coloured lirae entering deep in the aperture, the last 3-4 mm towards the rim has a pure white colour. Outside colour is variable with brown, green, cream, tan, yellow, orange, lilac, purple, etc., uniformly or mottled. The end of the anterior canal is almost always tipped with black within and on the outside. The body whorl is rounded, earlier whorls have a sharp angled shoulder diminishing in acuteness with growth. The penultimate whorls have 12-14 axial knobs at the shoulder, which may be obsolete. The base of the shell has 10 – 12 incised lines that gradually become less strong; the remainder of the body whorl covered with very thin spiral lines. The aperture is elongated with a small but sharp posterior canal just ending under the shoulder. The labrum is rather straight and not significantly thickened.

Synonymy.

Strombus ustulatus form *laevis* Dodge, 1946, p.3. figures 1 and 5. (not *Strombus laevis* Perry, 1811 (= *Euprotomus bulla* Röding, 1798 (Abbott, 1960)).

Discussion. This is the *Canarium* species that is abundant in souvenir shops and which is eaten by the thousands in the Philippines. Dodge (1946) described this species as *Strombus ustulatus* form *laevis* Dodge, 1946. This is, however, a junior synonym of *Strombus laevis* Perry, 1811 (= *Euprotomus bulla*). As *S. laevis*



Figure 5. *Canarium esculentum* Maxwell, Rymer, Congdon & Dekkers, *nomen novum* showing the bicoloured aperture, orange inside and with a white outline, Surigao, Philippines, Fisherman taken 2020: **A**= 39.5 mm (SMC U2-001k); **B**= 50 mm (SMC U2-001c); **C**= 34 mm (SMC U2-001e); **D**= 51 mm (SMC U2-001d).

was the first available name for this taxon, we had to rename the species. It is readily recognisable by the white columella in combination with the bicoloured aperture, orange inside and with a white outline. *Canarium urceus* has a black columella and aperture, whereas both *C. incisum* and *C. anatellum* have an orange columella.

Etymology. The species is named after the quantity of its consumption in the Philippines and the delicacy of its meat. The Latin word ‘*esculentus*’ means *e.g.* delicious, edible, eatable, ripe.

Canarium insisum (Wood, 1828)

Type Material. *Strombus incisus* Wood, 1828, p. 14 pl. 4 fig. 12 (Figure 6). The illustration of Wood’s *incisus* in the “Supplement to the Index

Testaceologicus or A Catalog of Shells, British and Foreign” is selected as the type. Size approximately 40 mm (Abbott, 1960).



Figure 6. Type figure of *Strombus incisus* Wood, 1828, p. 14, pl. 4 fig. 12 (no locality).

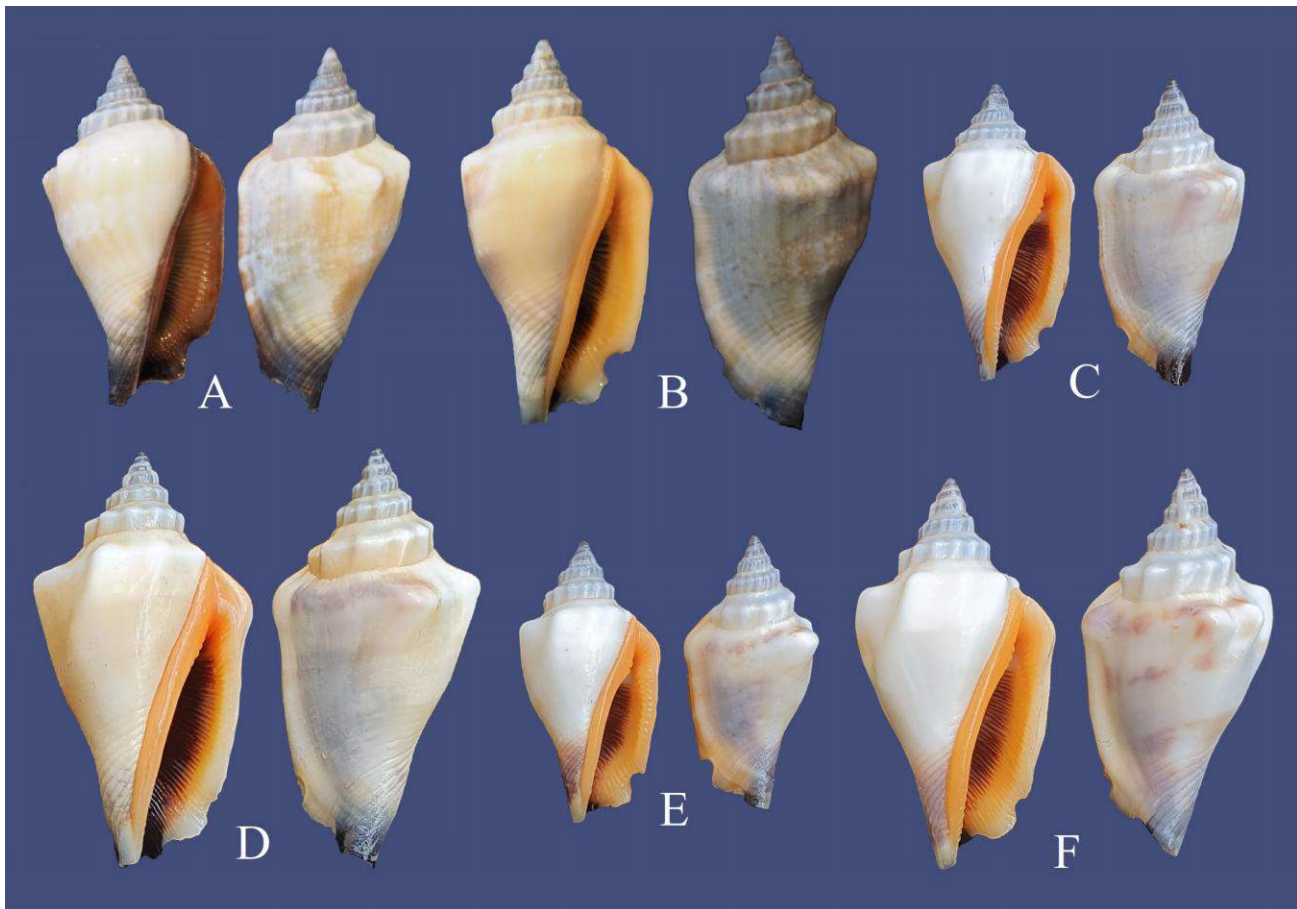


Figure 7. *Canarium incisum* (Wood, 1828): **A**= 29.5 mm, ex. coll. J.N.J. Post. Labuan Bajo, Binonko Beach, Flores, empty shell found on the beach at low tide. (AMD STR3271); **B**= 30 mm, ex. coll. J.N.J. Post. Labuan Bajo, Binonko Beach, Flores, empty shells found on the beach at low tide (AMD STR3271); **C**= 22 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003k); **D**= 33 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003m); **E**= 22 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003j); **F**= 31 mm Kangean Islands, Indonesia, fisherman taken 2020 (SMC 19d.003n).

Type Locality. We designate Labuan Bujo, Benonko Beach, Flores, Indonesia, based on the collecting data of Hans Post (shells now in coll. AMD and Hans Post). Wood (1828) gave no locality data. The selection of the type locality by Man in 'T Veld (1988, p. 8) is in error: there was confusion of the species of Wood (1928).

Original Description. No original description. The combination of illustration (Wood 1828, pl. 4 fig. 12) and binominal name (Wood 1828, p. 14) was valid at the time of publication (ICZN 1999).

Diagnosis. Key diagnosis is a uniformly orange columella and 45° high shouldered outer lip, giving the shell a quadrate form (Figure 7).

Description. This bi-pyramidal species has both a uniformly red toned columella and rather high-shouldered outer lip. The shell is around 40-45 mm in length, solid, smooth, relatively broad. The body whorl is axially aligned knobs on the shoulder. The aperture is elongated, with a small but sharp posterior canal just ending under the shoulder. The orange columella is always smooth in the mid part: the posterior part has ca. 10 lirae and the anterior part 5-6 lirae.

The inside labrum is orange with mostly dark coloured lirae entering deep in the aperture; the last 4-5 mm towards the rim lose the brown colour and take the orange colour. Outside colour variable with brown, green, cream, tan, yellow, orange, etc., mostly mottled with a dull white-greyish colour as the base colour. The anterior canal is almost always tipped with black within and on the outside. The body whorl has an angled shoulder, which may have axial knobs, with the largest being at the edge of the left dorsal shield and right ventral body whorl. Base of the shell has 8 – 10 incised lines giving rise to flat cords.

Synonymy.

1828 *Strombus incisus* Wood, p. 14 pl. 4 fig.

12a (no locality). Abbott 1960, p. 65

“Quadrate form”.

1988 *Strombus urceus incisus* Wood – Man in ‘t Veld p. 7, fig. 2. only (b/w drawing from Wood).

Discussion. This medium-sized species is characterised by the orange columella and inside of the labrum. Man in ‘t Veld (1988) confused the drawing of Wood (1828) with an undescribed species ranging from the Solomon Islands to the New Hebrides. These shells have a higher thicker callused outer lip and shoulder and a white aperture. There are uncoloured examples of Wood (1828) and one is in the library of the fourth author. Thus, the mistake is likely caused by the colour of the columella. A similar yellow-orange columella and aperture is found in ‘*urceus*’ from western Thailand. These Thailand populations are not connected to the Indonesian populations. The Thailand shells with orange columella are sturdy shells, growing larger on average than the Indonesian counter shells. The Thailand shells bear strong rounded knobs on the shoulder of the body whorl and the axials on the spire are fewer but stronger. Most of them also bear about 8-12

lirae on the posterior part of the columella and about 4-5 on the anterior part about the same as this species. The Thailand material will be addressed in Part 3 of this series. Similarly, *Canarium anatellum* lacks the shouldering of *Canarium incisum*, and has a red-orange aperture.

FUTURE RESEARCH

This paper is part 2 of a larger revision of the *Canarium urceus* (Linné, 1758) complex after Abbott (1960), reinstating species that were erroneously synonymized with *Canarium urceus*. The next steps deal with the circumscription of taxa historically considered as belonging to the *Canarium urceus* complex. The results of those analyses will then be used to aid in the development of a theory for the phylogeography of the *Canarium urceus* complex and the species contained within it.

ACKNOWLEDGEMENTS

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Strombidae, Cypraeidae, Pediculariidae, Ovulidae, Cassididae, Doliidae, pp. 1-64, pl. 1-12 (Terebridae), 65-98, pl. 1-7 (Cancellariidae), 99-152, pl. 1-12 (Strombidae), 153-240, pl. 1-23 (Cypraeidae, by S.R. Roberts), 241-256, 301-304, pl. 1-5 (Pediculariidae and Ovulidae), 257-267, 305-306, pl. 1-6 (Doliidae), 268-300, 307-309, pl. 1-10 (Cassididae). Philadelphia, published by the author.

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The image displays a variety of Strombidae shells, including several species shown in pairs (A, B) and individual views (C, D, E). A book cover titled "Jewels of the Everglades: The Fossil Cowries of Southern Florida" is shown in the top left. A stratigraphic chart is located in the bottom right corner, showing the geological time scale from the Paleozoic to the Cenozoic, with specific sub-periods and families of shells indicated.

Time Period	Age	Formation	Shell
Paleozoic	Carboniferous	Strombidae	Strombidae
		Strombidae	Strombidae
Mesozoic	Cretaceous	Strombidae	Strombidae
		Strombidae	Strombidae
Cenozoic	Tertiary	Strombidae	Strombidae
		Strombidae	Strombidae
Cenozoic	Quaternary	Strombidae	Strombidae
		Strombidae	Strombidae

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