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A morphometric analysis of the cowry *Cribrarula cumingii* (Gastropoda: Cypraeidae), with a revision of its synonyms

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Abstract

Traditionally, two formae are distinguished on the basis of this feature (*cumingii* and *cleopatra*). The taxonomic status of these forms is a long-debated subject. This study compares a series of more than 100 *Cribrarula cumingii* from various localities in Polynesia.

Material and methods

A series of 108 specimens in fresh condition from Tahiti: Arue, Papeete; Hitiaa; Tuamotu: Manihi, Rangiroa Atoll; Huahine: Tefaererii was compared using standard measuring procedures (length, width, height, and number of teeth (reduced, after SCHILDER & SCHILDER, 1938).

Also, the shell structure was compared using a Philips LX20 scanning electron microscope.

Shell dimensions and number of teeth

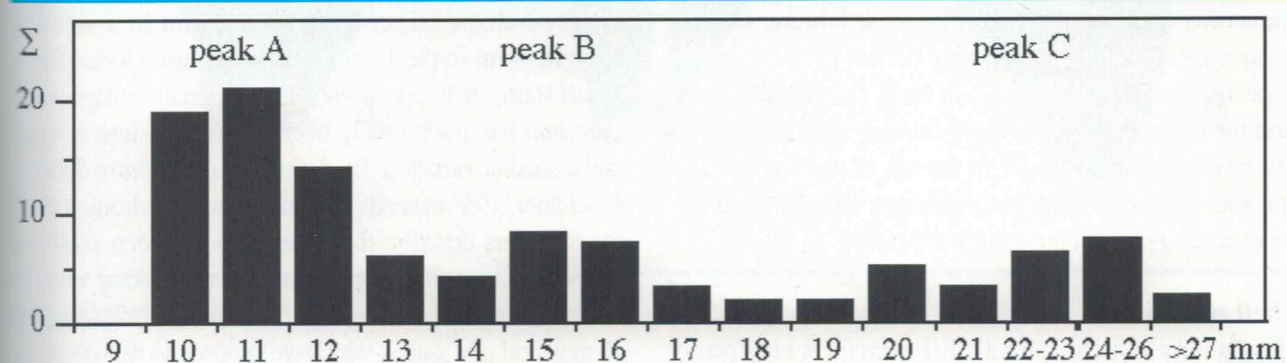
For the following comparisons, only undamaged, fully adult specimens were used.

Smallest shell: 9.67 mm, largest shell: 27.90 mm.

There are three peaks in size ranges, which means that certain shell lengths are more common than others (gaps). The peaks are roughly between lengths of 9.7 and 12.5 mm (peak A), 14.5 and 16.5 mm (peak B) and 19.5 to 25 mm (group C). Gaps are roughly: 12.5 to 14.5 mm (gap 1) and 16.5 to 18 mm (gap 2). There are only nine shells between 16 and 20 mm, which is less than ten percent of the material studied. The flatter but wider plateau of peak C is interpreted as an effect of the shells' larger sizes. Relative to the shells' length, the variability of the large set (peak C) is comparable to that of the smaller sets: the relative variability (standard deviation divided by average (s/ø), see LORENZ 1999) of small (<13 mm: s/ø = 0.082) and large shells (>20 mm: s/ø = 0.092) is about the same. The three peaks will in the following be called A (small shells), B (medium-sized shells), C (large shells). The width/length and height/length ratios were found to be constant throughout the entire size range. The three groups do not differ by the ratio of width to length: 0.54 for group A, and 0.55 for groups B and C.

However an interesting phenomenon is found when normalizing the number of labral teeth to a hypothetical shell of 25 mm length*. There is a consistent difference in dentition between the shells measuring 12 mm and less (A) and the larger specimens (B and C), whereas the difference between groups B and C is slight.

Table 1: Length of *Cribraria cumingii cumingii*



*The formula for the calculation is: 7 + (number of teeth counted-7) x √(25/length).

The shell formula (after SCHILDER, 1938) of the total set measured in this study is 16 (55) 34:32 The number sequence is as follows: average length (width/length in percentage) labral teeth: columellar teeth (both normalized).

A (specimens measuring 9.7 - 13.5 mm): 11 (54) 43:34
B (specimens measuring 13.6 - 16.0 mm): 15 (55) 31:31
C (specimens measuring 16.1 - 27.9 mm): 21 (55) 31:32

From this morphometric comparison it becomes apparent that most of the smaller shells (A) differ from the medium-sized to large shells mainly by much finer labral teeth and somewhat finer columellar teeth (normalized). B and C do not differ except in size.
There is one specimen whose size would place it into group A, but the color and shell structure (see below) identifies it as a dwarfed shell of group B.

Color and pattern

In all specimens examined the ground color is plain white to orange-gray. In the medium-sized to large shells (B and C), the darker coating is orange. The lacunae are small (average diameter/total shell length = 7.5%) and numerous (average number: 43 in B and 47 in C). The lacunae and the dorsal line are framed with darker orange. The dorsal line is situated in the labral fourth of the dorsal dome, so that viewed dorsally it is visible along the margin. In the medium-sized shells (B) the dorsal line is more conspicuous than in the large shells (C). In A the dorsum is extremely thin and translucent. The internal coiling can be seen through the shell. The darker coating of the small shells is pale cream. The lacunae are comparatively larger (average diameter/total shell length = 9.5%) and less numerous (average number: 31). They are framed by a barely darker ring. The dorsal line is narrow and situated in the labral third. From the dorsal view it appears to be closer to the shell's axis than the lines of B and C. The marginal spotting of the medium-sized and larger shells is dense and of variable size. There usually is a set of large spots above the labrum, and numerous smaller spots directly on the labrum. On the columellar side, the spotting may be less dense midway, especially in the large set (C). In both, the medium-sized and the large shells, the average number of labral spots is 19, of columellar spots 14. In the set of small shells (A) the spots are somewhat less numerous: labrally there are 13 on average, 11 on the columellar side.

Shell structure

Hardly any conchological differences were found between B and C. With the one above-mentioned exception, all small shells of peak A are consistently different from B and C by the following features (refer to Plate 1: scanning electron microscope photos of B (top) and A (bottom). Scale: 0.3 mm). In A the posterior extremity (Plate 1: a) is pronounced and rostrated, especially on the labral side. The spire is exposed and deeply umbilicate (Plate 1: c). In B and C the posterior extremity is more callused and shorter, partly covering the spire. The aperture in A is somewhat more curved to the left than in B and C. The labral teeth (Plate 1: b) of B and C are equally long throughout, the labrum is rather narrow. In A the teeth are very short midways, while becoming longer towards the extremities; the labrum is broader than in B and C, making the aperture narrower. In A the labrum is distinctly declivitous posteriorly, which is not the case in B and C. The columellar dentition in A is elevated, forming a callused ridge bordering the aperture (Plate 1: d). Such a callused ridge is not found in B and C. In A the terminal ridge is longer and wider than in B and C. No intergrades in any of the described differences could be found amongst the specimens examined.

Distribution and habitat

Since all shells were obtained from professional shell dealers, the evaluation of locality and habitat data requires a certain degree of skepticism.
The shells of B and C are reported from various localities in Huahine and Tahiti, whereas all specimens of A are labeled Tuamotu. Shells of B and C were collected from the intertidal zone to a depth of more than 30 m, mostly at night. The shells of A were mostly collected empty, in shell grit deposits at depths ranging from 1 to 5 m. One exception, which is already mentioned above, originating from Tahiti measures 9.9 mm and conchologically belongs to group B.

Discussion

LORENZ & HUBERT (1993) recognize two distinct geographical subspecies of *Cribrarula cumingii*, namely *c. cumingii* from Tahiti and Tuamotu and *c. astaryi* Schilder, 1971 from the Marquesas. Both subspecies are variable in size and shape. *C. c. astaryii* is found in a smaller, elongate form (typical) and a larger, callused form (forma *lefaiti* Martin & Poppe, 1989). The nominate subspecies *c. cumingii* has traditionally been subdivided into a larger and a smaller variation. By definition, *c. cleopatra* Schilder & Schilder, 1938 exceeds 20 mm. In their Prodrome (1938) the Schilders describe the differences between *cumingii* and *cleopatra* as follows: "There are two striking varieties in size: the typical *cumingii* (11.54.40.34) varying from 9 to 16 mm. and rare giants, which we propose to call *cleopatra* (22.52.28.32); we have never seen intermediate shells. Moreover *cleopatra* differs by the labial teeth, which are

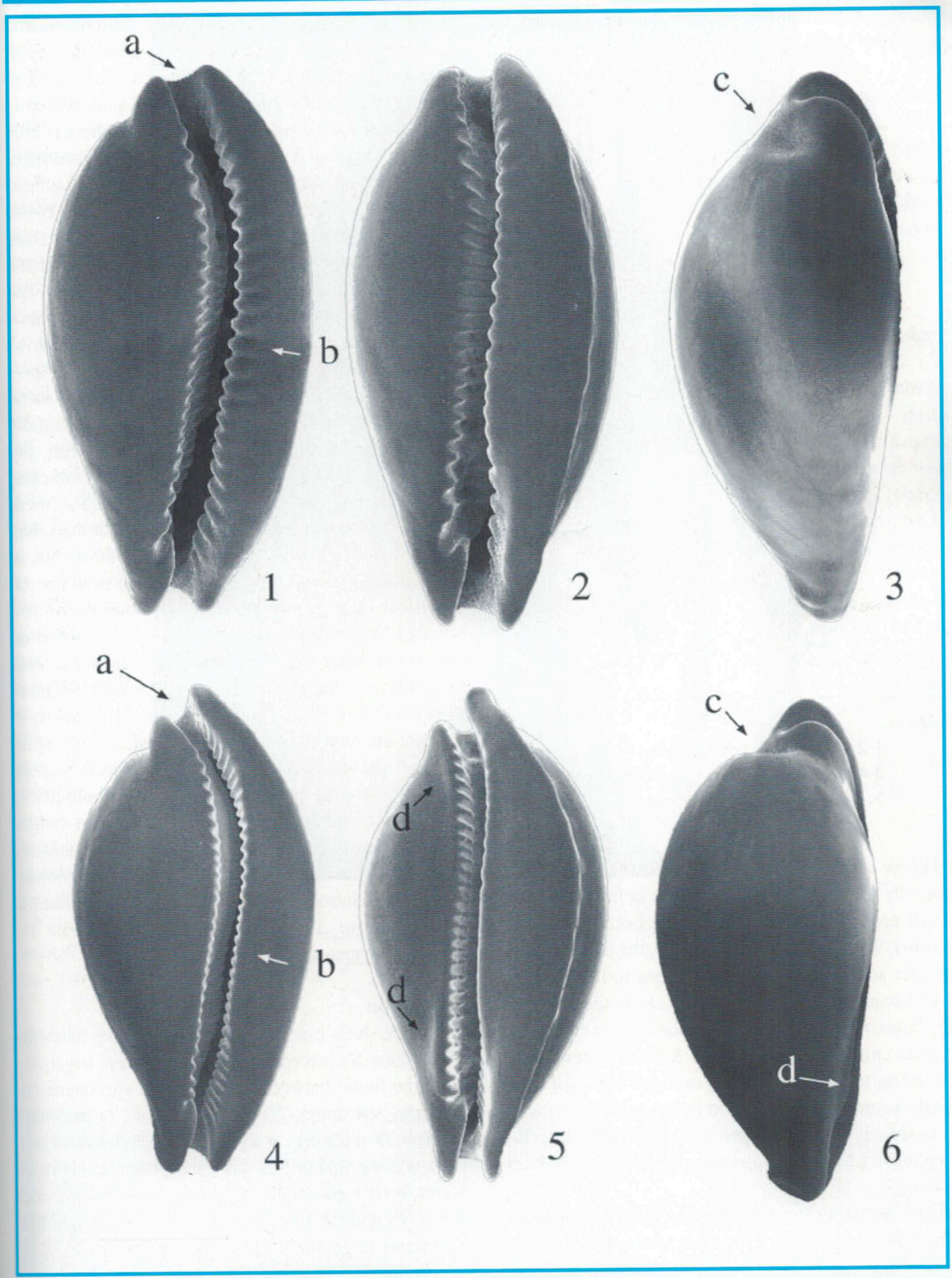


Table 1: SEM pictures.

1-3: C. *cumingii cumingii*

4-6: C. *cumingii compta*

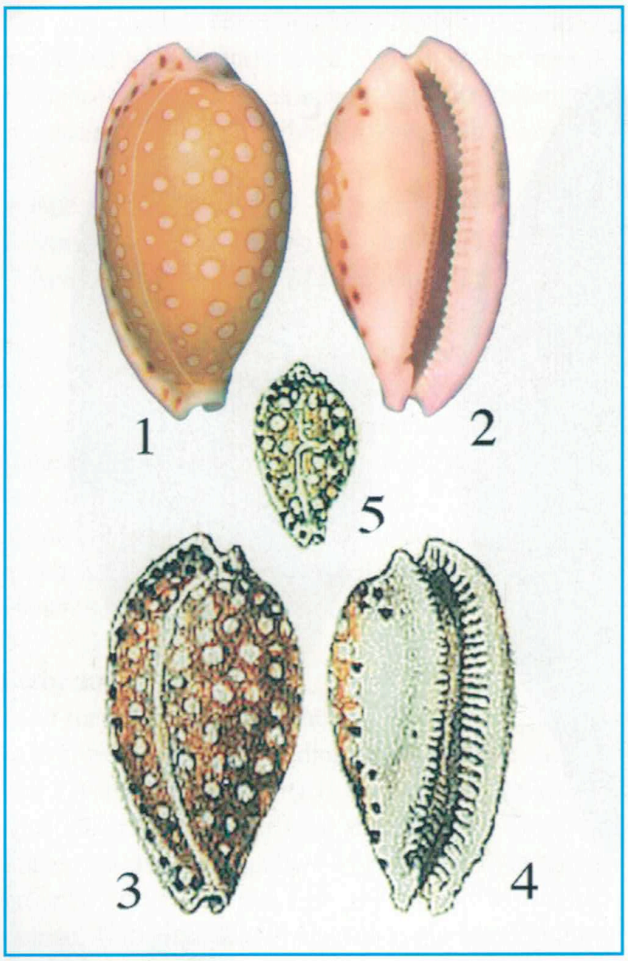


Table 2:

1-2: *C. cumingii*, holotype after Walls & Taylor
3-4: *C. cumingii*, holotype after Sowerby
5: *compta*, holotype after Sowerby

relatively coarser, and less numerous than the columellar ones, by the outer lip less declivitous in front, the labial teeth produced more equally, the body whorl less inflated, the extremities less produced, the dorsal lacunae smaller and more numerous; it seems to live together with cumingii in eastern Polynesia (...)." In the treatise of the Dautzenberg collection (1952) the features ascribed to typical *cumingii* sensu Schilder & Schilder reveal that according to them, the typical *cumingii cumingii* is the small series of shells examined herein as "A". Obviously, few specimens of the variety B were known to the Schilders who seemingly interpreted those as large *cumingii*.

Their *cleopatra* corresponds to the set C of this work. They did not know any specimens between 16 and 20 mm, which may be explained by the frequencies of shell length in the set examined herein (gap 2). Sowerby's historical figures of *cumingii* show a large shell (Sowerby, 1870, Pl. 31 fig. 349-350; all shells on that plate are depicted at the same scale, see also Plate 2, fig. 3-4 in that work). This specimen now in the collection of the British Museum of Natural History is the holotype of *cumingii*. It is also illustrated in Taylor & Walls (1975, p. 143). The length of this shell is 27.8 mm, which is exceptionally large (see Plate 2, fig. 1-2). There is little doubt that Schilder & Schilder's *cleopatra* is a synonym of *cumingii* sensu strictu. Another type specimen illustrated on Sowerby's plate 31 (fig. 351) is that of *compta* Pease, 1860 (see Plate 2, fig. 5 in that work). It is shown to scale next to *cumingii* and measures about one third of the *cumingii* type figure, is paler and more rostrate. The original description of *compta* reads as follows: "Shell oblong-ovate, rather solid; colour pale fawn-yellow, ornamented with somewhat remote, round, white spots of irregular size, and a flexuous dorsal line of same colour; sides and base white, the former conspicuously dotted with dark brown; extremities produced, the posterior curving to the left; umbilical region concave; right side margined; aperture narrow, flexuose; teeth small, even, twenty eight on the outer lip, not extending over the middle; columella teeth twenty-three, not so stout as those on the outer lip, forming an even line on the inner edge of the aperture; columella smooth, sulcated longitudinally, gibbous above and dentated on the extreme inner edge." The normalized number of teeth (considering that the holotype of *compta* measures approximately 10 mm) is 40:32. The labral teeth of *compta* are short, the aperture curved and the spire exposed and umbilicate. All these features clearly identify *compta* as the proper name for the morphologically distinct set of shells herein called "A". The name *compta* has been synonymized with *cumingii* by all authors whose attention was probably distracted by the abnormal dorsal line. Nobody noticed the marked differences in shell structure. The minute size of these shells has probably prevented their recognition.

Conclusion

The set of shells examined herein permits the following conclusions: No perceptible differences except larger size could be found between medium-sized specimens (B) and large specimens (C). Small shells (A), on the other hand, show consistent morphological differences which allow a distinction at least on a subspecific level. There seems to be a geographic separation between the small shells (A) and the other two sets (B, C). The medium-sized and large shells (B and C) occur in the same geographic area and habitat. Although B and C display a slight difference in size, they apparently belong to the same taxonomic unit whose correct name is *Cribrarula cumingii cumingii* Sowerby, 1832. This subspecies seems to occur mainly in Tahiti and Huahine. The small shells

here called "A" can be separated on the level of a subspecies differing from *cumingii* chiefly by the mostly smaller size, more numerous shorter labral teeth, more rostrated posterior extremity, paler dorsal color and fewer lacunae and marginal spots, and finally by the callused ridge bordering the aperture on the columellar side. Occasional specimens of *c. cumingii* may be equally small but otherwise differ by the other features enumerated here. The correct name for the subspecies here called "A" is *Cribrarula cumingii compta* Pease, 1860.

Table 3:
1-4 *C. cumingii compta*, from Tuamotu.
5-8: *C. cumingii cumingii*, from Tahiti.

Plate 3 shows specimens of *cumingii compta* from Tuamotu (Figs. 1-4) and typical *cumingii cumingii* from Tahiti (Figs. 5-8). Scale:

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