
ABOUT THE SUBSPECIES *CRIBRARULA CRIBRARIA ESONTROPIA*

E.L.Heiman*)

Abstract: This article summarizes the conchological information discussed in Heiman (2006) especially the two facts: 1) not all shells belonging to *Cypraea esontropia* Duclos, 1833 from Mauritius and Reunion islands show the main diagnostic shell characters (MDSC) of this taxon—the small dark spots on the base of the shell; 2) these MDSC may also be found in shells of *Cribrarula cribraria* (Linnaeus, 1758). Because there seems to be no other diagnostic shell characters allowing us to separate *C. esontropia* from *C. cribraria* at a specific level the conclusion is drawn that the *Cribrarula* populations from Mauritius and Reunion islands can be treated as the subspecies *Cribrarula cribraria esontropia* (Duclos, 1833). A subspecific level of three other groups of populations of *Cribrarula cribraria* (Linnaeus, 1758) is confirmed conchologically: *Cribrarula cribraria cribraria*, the nominotypical subspecies, *C. cribraria comma* (Perry, 1811) from the western Indian Ocean, and *C. cribraria orientalis* Schilder & Schilder, 1940 from the Philippines. The distribution range of the four discussed subspecies and their diagnostic shell characteristics are given.

Key words: Mollusca, Gastropoda, *Cypraeidae*, *Cribrarula cribraria esontropia*, intraspecific variation, taxonomy.

Cypraea esontropia Duclos, 1833 was first described as a species from the Pacific Ocean. The taxonomic history of this taxon is discussed in the Appendix below. Small dark spots on the shell base, which are clearly visible in a work by Sowerby (1870)—Fig. 1—are traditionally considered the main diagnostic shell character (MDSC) of this taxon. In addition, small dark spots are present on the shell margins.

In Schilder & Schilder (1938) the range of distribution of *C. esontropia* is restricted to Mauritius Island and since then it has been treated as a reasonably uncommon species from Mauritius and Reunion islands; currently it is placed in the genus *Cribrarula*—*Cribrarula esontropia* (Duclos, 1833).

A new form: *C. esontropia francescoi* from southern Madagascar and South Africa described in Merlin & Quiquandon (2002) was treated later as a subspecies of *C. esontropia* by these and other authors who consider that the main diagnostic shell characteristic of this subspecies is the absence of small dark spots on the base: “In *esontropia francescoi* the marginal spotting is restricted to the area above the labral edge, while on the left side it is usually reduced.” This approach shows the conchological closeness between *C. esontropia* and *Cribrarula cribraria* (Linnaeus, 1758) but it disregards the main diagnostic shell character separating the two species—the small dark basal spots found in shells of the former.

This approach creates a problem:

Species (conchologically) are groups of populations the shells of which can be separated from all other cowry populations by at least one well-recognizable diagnostic character showing no intermediates even in extreme specimens; for *C. esontropia* such main diagnostic shell character (MDSC) is, as mentioned above, the dark spots on the base.

If *C. esontropia francescoi* does not have the MDSC of *C. esontropia* it cannot be related to that taxon and is in fact *C. cribraria comma*; or perhaps *C. esontropia* should not be treated as a species.

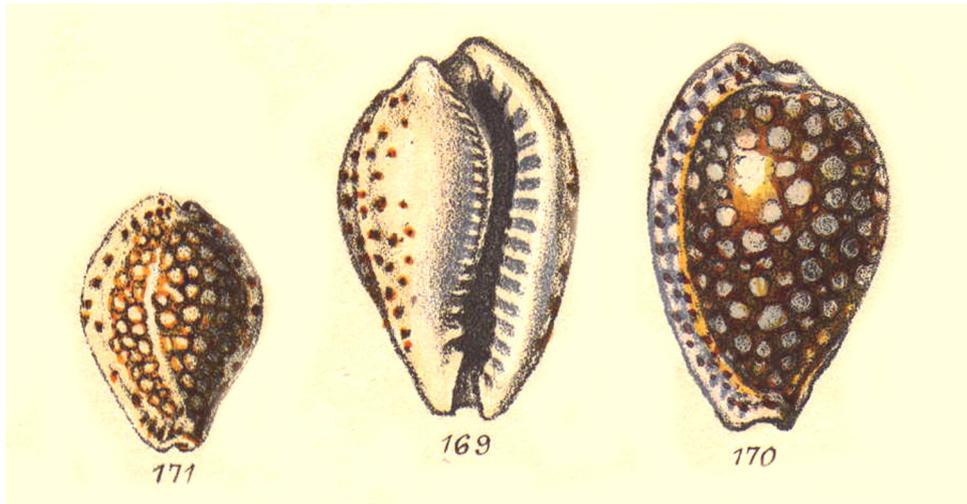
Doubts regarding the true taxonomic identity of *C. esontropia* induced me to reconsider the conchological information about this taxon published in the literature.

1. As is shown in Heiman (2006—Report-2), the small dark marginal spots were found in 11% of the examined shells of *Cribrarula cribraria orientalis* Schilder & Schilder, 1940 from the Philippines. Even more of shells with such spots (35%) are found in shells of *Cribrarula cribraria comma* (Perry, 1811) from the Western Indian Ocean. In other words, these spots can be found not only in shells of *C. esontropia* but also in shells of *C. cribraria*.

2. It turned out that the basal spots are not present in all shells of *C. esontropia*; they are absent in about 15-20% of the shells from Mauritius and Reunion labeled in collections as *C. esontropia*.

3. I failed to find a diagnostic shell character of a specific rank (a conchological gap), which can be used for separating *C. esontropia* from *C. cribraria comma* of East Africa. The shell size, shape and profile may sometimes differ in these taxa but this difference is of a category "more-or-less" i. e. larger, more globular, more numerous etc. Jay (2003) illustrated using a sample of 702 shells that *C. esontropia* is very variable and its shells may be even subcylindrical (form cribellum).

4. A small sample of *cribraria*-like shells with the basal spots was found in Sri Lanka and even described as a sub-



1. *Cypraea esontropia* pictured in a work by Sowerby (1870), Pl. 20; the Philippines



2-5. *Cribrarula esontropia*, Reunion



6-7. *C. cribraria orientalis*, the Philippines

8-9. *Cribrarula cribraria comma*, Tanzania



10-13. *C. cribraria esontropia*; the Philippines-personally determined by F.A.Schilder; Coen's collection, the HUIJ #51273

species *C. cribraria ganteri* (Lorenz, 1997). This fact shows that the basal spots are not unique to *C. esontropia* and can be found also in populations of *C. cribraria*.

5. Wilson (1984) reported finding of one mature and four sub-adults, plus three dead *cribraria*-like specimens around Dhahran (al-Juraid I.) in the Persian Gulf; some of these shells have small basal spots and they were later identified as *C. esontropia*. This fact also shows that the basal spots are not unique to shells from the Mauritius-Reunion area.

6. In summary: the basal spots are present in many *cribraria*-like shells from the area Mauritius-Reunion (*C. esontropia*), perhaps even in the majority, but they are not present in 100% of the shells; but on the other hand they can be found in shells of *C. cribraria*. A conchological gap between these taxa seems to be absent.

All these facts lead me to reach the conclusion that *esontropia* is not a valid species but a subspecies of *C. cribraria* from a remote, geographically separated area in the south-west part of the Indian Ocean—*Cribrarula cribraria esontropia* (Duclos, 1833).

Subspecies are geographically separated groups of populations of a species. To be diagnosed conchologically, the majority—70% or more—of shells in such a group of populations must differ by at least one shell character from other populations of the same species (for example, by basal spots). This peculiarity is called the main diagnostic shell characteristic. *C. cribraria esontropia* seems to conform well to this criterion.

Two kinds of facts: finding *esontropia*-like shells outside of the Mauritius-Reunion area (the Philippines, Persian Gulf, Madagascar) and a substantial quantity of shells with angled margins in this taxon (below, Fig. 1, shell 171; Fig. 10-13) can be explained by variability of *C. cribraria* producing unusual forms and the absence of a conchological gap between its different populations.

The conchological study—Report-2—confirms that at least three other subspecies of *Cribrarula cribraria* can be separated as is shown in Fig. 10 below: *Cribrarula cribraria comma* (Perry, 1811), *C. cribraria orientalis* Schilder & Schilder, 1940, and *C. cribraria esontropia* (Duclos, 1833)—see pictures Figs. 2-9.

Other populations of *Cribrarula cribraria*, mostly from Australia and the Pacific Ocean, are still under study.

It should be mentioned that there are no distinct borders between the subspecies and they are connected by intermediate zones. For instance, in an area close to Port Douphin, Madagascar, shells with characters of *C. cribraria comma* and *C. cribraria esontropia* can be found together in different proportion: certain percentage of shells may have the basal spots whereas in the others these spots are absent.

Diagnostic shell characteristics of the recognized *C. cribraria* subspecies

Diagnostic shell characteristics of *C. cribraria esontropia* and other recognized subspecies of *C. cribraria* are given in Table 1 and their range of distribution in Fig. 14. The main diagnostic shell characteristics are given in the shaded blocks.

Table 1

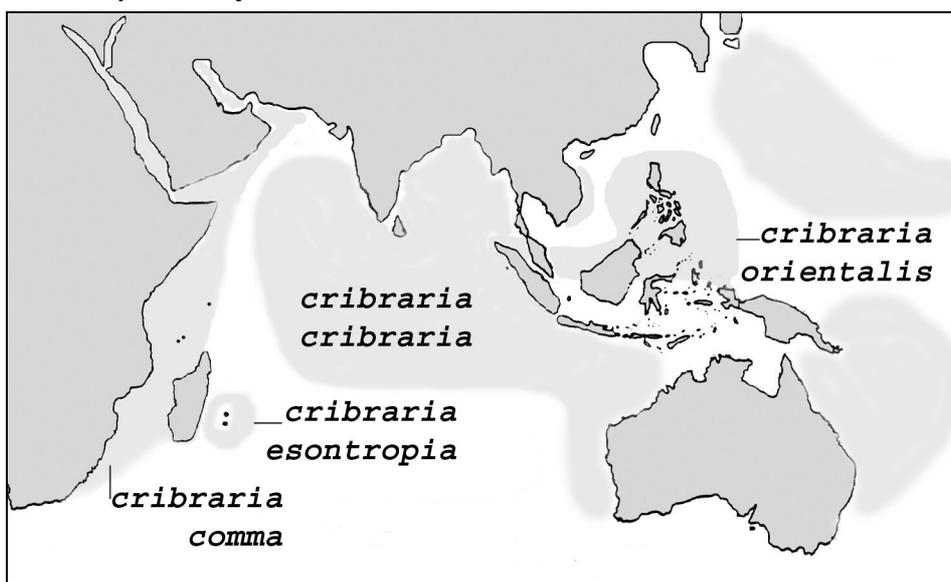
subspecies	shell characteristics					
	Laver, mm	(W/L)aver, %	(H/L)aver, %	dorsal pale lacunae	small dark marginal spots	small dark basal spots
<i>cribraria comma</i>	19	61	48	smaller, more numerous and close	sometimes found	mostly absent
<i>cribraria esontropia</i>	15	58	47	smaller, more numerous and close	mostly distinct, numerous	mostly present
<i>cribraria orientalis</i>	26	57	45	larger and more distant	mostly absent	absent
<i>cribraria cribraria</i>	no data	no data	no data	variable	mostly absent	mostly absent

Populations of the nominotypical subspecies *C. cribraria cribraria* in the Indian Ocean are poorly known. The original description of the species by Linnaeus: “*C. testa umbilicata marginata lutea: punctis rotundata albis*” is too short; it may describe any of subspecies of the species and cannot be useful for delimiting one group of populations from the others. The formulas given in Schilder & Schilder (1938) read:

23.57.19.18 for <i>C. cribraria cribraria</i> ;	22.57.20.19 for <i>C. cribraria melwardi</i> ;
24.61. 19.16 for <i>C. cribraria comma</i> ;	26.61.17.16 for <i>C. esontropia</i> .

Populations of *C. cribraria melwardi* were later renamed *C. cribraria orientalis* Schilder & Schilder, 1940. The difference in the formulas of these groups of populations is too mild in order to separate *C. cribraria cribraria*. The Schilders considered that “the lateral spots seem to occur in populations from the northern part of the Indian Ocean only” but we know currently that they can be found in other populations too.

Unlike shells of the three other recognized subspecies, shells of *C. cribraria cribraria* in the northern part of the Indian Ocean are found sporadically.



14. Approximate range of distribution of *C. cribraria*

Populations of *C. cribraria* in the Western Australia seem to differ substantially from other populations of the species but their conchological statistical characteristics are not known to me.

Acknowledgements

I would like to thank Henk K. Mienis (National Mollusc Collection, Dept. Evolution, Systematics & Ecology, Hebrew University of Jerusalem and Mollusc Collection, National Collections of Natural History, Dept. Zoology, Tel Aviv University) for providing malacological information and discussion this work that resulted in several corrections and additions, B.S. Singer for reading and discussing the manuscript, and Joaquin Inchaustigui (USA) for translating several passages from a work by Hidalgo (1906).

References

- Allan, J. 1956. Cowry shells of world seas. Georgian House, Melbourne. 170 pp.
- Burgess C.M. 1970. The living Cowries. 389 pp. A. S. Barnes & Comp. New York.
1985. Burgess' cowries of the world. 289 pp. Seacomber Publications.
- Dodge, H. 1953. A historical review of the mollusks of Linnaeus. Part 2. The class Cephalopoda and the genera *Conus* and *Cypraea* of the class Gastropoda. Bulletin of the American Museum of Natural History 103(1). New York. 134 pp.
- Heiman, E.L. 2004. Diagnosing cowry species. Published privately. 160 pp.
2006. Intraspecific variation in living cowries. Part 2. CD ROM Electronic book.
- Hidalgo, J.G. 1906-1907. Monografía de las especies vivientes del género *Cypraea*. Madrid. 588 pp.
- Jay, M. 2003. *Cribrarula cribellum* (Gaskoin, 1849) and *Cribrarula esontropia* (Duclos, 1833): one or two species? *Xenophora* 103:20-22.
- Limpalaër, L. 2003a. Retour a Madagascar. 1 Partie: L'affaire androyensis. *Xenophora* 101: 18-20.
- Limpalaër, L. 2003b. *Cribrarula garciai* Lorenz et Raines, 2001. *Xenophora* 102:16-17.

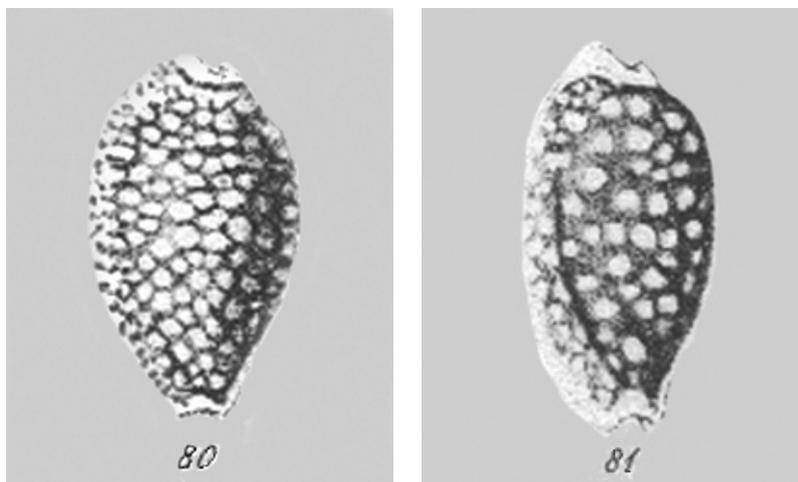
- Limpalaër, L. 2003c. Back to Madagascar. Part 2: on the tracks of *esontropia*. *Xenophora* 102:34-36.
- Lorenz Jr. F. & Hubert, A. 1993. A Guide to worldwide Cowries. 571 pp. Christa Hemmen Verlag, Wiesbaden, Germany.
- Lorenz F. & Hubert, A. 2000. A Guide to worldwide Cowries. 584 pp. ConchBooks Hackenheim Germany.
- Melvill, J. C. 1888. A survey of the genus *Cypraea* (Linne), its nomenclature, geographical distribution, and distinctive affinities: with description of two new species, and several varieties. *Memoirs and Proceedings of the Manchester literary and philosophical Society*, (4)1:184-252.
- Merlin, J.C. & Quiquandon, P. 2002. Les variations de *Cribrarula* ou“ En attendant Lorenz”*Xenophora* 99:31-35.
- Merlin J.C. & Quiquandon, P. 2003. Back to Madagascar, once again. Comments of Loic Limpalaër article. *Xenophora* 103:18-19.
- Reeve, L. A. 1846. *Conchologia iconica*. Monograph of the Genus *Cypraea*.
- Schilder, F.A. 1966. The type localities of living Cypraeidae. *Malakologische Abhandlungen, Staatliches Museum für Tierkunde in Dresden* 2(14):193-233.
- Schilder, F.A. & Schilder, M. 1938. Prodrome of a monograph on living Cypraeidae. *Proc. of Malacological Society of London*, 23:119-231
- Schilder, F.A. & Schilder, M. 1940. Die Verbreitung und Häufigkeit der rezenten Cypraeidae. *Archiv für Molluskenkunde* 72 (2/3):33-56.
- Schilder F.A. & Schilder, M. 1952. Ph. Dautzenberg's collection of Cypraeidae. *Institute Royal des sciences naturelles de Belgique*. Bruxelles. 243 pp. + 4 Plates.
- Schilder M. & Schilder F.A., 1971. A catalogue of living and fossil cowries. *Institut Royal des sciences naturelles de Belgique*. 246 pp.
- Sowerby, G.B.I. 1870. *Thesaurus Conchyliorum* vol. IV.
- Steadman, W.R. & Cotton, B.C. 1943. The cowries (Cypraeidae) of Fiji. *Rec. S. Aust. Mus.* 7(4):309-335.
- Watt, R. 2005. Forms of *Cribraria comma* (Perry 1811) and of *Esonotropia francescoi* (Lorenz 2002) and a description of *Esonotropia francescoi* form mainland. *Xenophora* 110:33-50.
- Wilson, G. 1984. *Cypraea esontropia* in the Arabian Gulf. *HSN* (4:9).

Appendix

Taxonomic history of *C. esontropia*

According to Schilder (1966) the origin of the holotype of *C. esontropia* is mistakenly stated as the Pacific Ocean.

Reeve (1846) mentioned that *Cypraea esontropia* is “distinguished ...by its thickened growth, by its larger and more contiguous spots, and by the dotted colouring of the sides: characters which appear to be of uniform constancy.” Reeve mentioned also the ivory white base and sides (basal spots are not mentioned) and stated the habitat: Philippine Islands; Cuming. Only the dorsal view of two shells is given on Plate 16, # 80 of the latter work—Fig. 15 below.



15. A copy of figs. 80-81 Pl. 16 in a work by Reeve (1846)

Sowerby (1870:34-35) added an interesting note regarding several taxa similar to *Cypraea cribraria*—*cribraria*, *peasei*, *esontropia*, *cribellum*, *gaskoinii* (the latter two are not discussed below):

“These may be only varieties of one essential species, but they are distinguishable. There is a character of thickness in the white enamel of the base, and a swelling in the teeth in *cribraria*, the typical form of the group, which partly distinguishes it from others. It is more cylindrical than any of them, excepting *cribellum*, which has much fewer teeth, a still more cylindrical form, a more flattened base, and no columellar ledge or groove beyond the surface; the mouth, in consequence, appears wider. Mr. Reeve has figured a side-spotted variety of *cribraria* for *esontropia*, but the true *esontropia* is a broader, heavier, more pyriform shell, with ends more pointed and approximate.”

Three shells from the Philippines are illustrated in Sowerby (1870: Plate 20, ## 169-171)—Fig. 1 above. As one can understand from the note cited, only # 171 is the true *esontropia* according to Sowerby.

Melvill (1888:49) treated *esontropia* as a valid species with “a broader, more pyriform shell” than *C. cribraria* (apparently following Sowerby).

Hidalgo (1906) mentioned that *C. esontropia* is well differentiated from *Cyp. cribraria* by its more oval shape, its blotches which are not as white and closer together, its numerous marginal spots, and the fewer apertural teeth.

In Schilder & Schilder (1938) *esontropia* is mentioned as a species from Mauritius having deltoidal and gibbous shell—the formula 26.61.17.16—“with the aperture narrow, as the outer lip is not constricted in front, with the dorsal line mostly absent, and with the lateral spots extending over the white convex inner lip,” in which “the dorsum shows one or three greyish zones”. In this species, which resembles *Cribrarula gaskoinii* (Reeve, 1846) from the Hawaiian Islands, the anterior columellar teeth are coarse, and the fossula is crossed by cuneiform ribs but has no inner denticles.

In fact, the Schilders corrected in the Prodrôme the original type locality of the species and its synonyms (*Cypraea monstrosa* Smith, 1878; *Cypraea translucida* Melvill, 1888 and *Cypraea pellucida* Taylor, 1916) and considered it to be Mauritius; the same opinion is confirmed later in Schilder (1966).

Steadman and Cotton (1946) followed the same approach.

Schilder & Schilder (1952) studied 12 shells in the Dautzenberg’s collection sized 13-29 mm (3 of 13mm; 16 mm, 19 mm, 20 mm, 22 mm, 23 mm, 25 mm, 26 mm, and 2 of 29 mm) and mentioned “Distribution: Lem.” Only two of the studied shells are from the Lemurian Province; 5 shells are from Queensland, 2 from Polynesia, and 3 from an unknown locality. There is no comment in this work explaining the formula, which is more suitable for larger shells. The Schilders considered that *Cribrarula cribellum* (Gaskoin, 1849) is also a valid species from the Lemurian Province but one of the six specimens in the Dautzenberg’s collection they examined is from Polynesia. Perhaps the Schilders considered that the localities of the specimens of both species: *cribellum* and *esontropia* in the Dautzenberg’s collection may be not correct but they did not indicate this fact.

Dodge (1953) has mentioned: “The only species that could ever be seriously confused with *C. cribraria* is *C. esontropia* Duclos, 1833, a shell from Mauritius. It was long held to be a synonym of the present species [*C. cribraria*] as it resembles it closely except for its marginal spots, which are too numerous for the spotted form of *cribraria*. Duclos’ figure (1833, pl. 26) is instructive. Aside from the number of marginal spots, it varies from all forms of *cribraria* in the following respects: It is more gibbous than *cribraria*, which tends to be depressed. Its outline is deltoidal rather than ovate. Its marginal spots are not confined to the sides but extend over a considerable area of the base. The dorsum shows vague grayish zones.”

Allan (1956) followed the Schilders’ (1938, 1952) approach.

Burgess (1970) also considered that *esontropia* is restricted to Mauritius and can be easily separated from *C. cribraria* by its basilar spotting: “*C. cribraria* is spotted only occasionally (and then very sparsely) on the dorsal edge of the labial callus, and never on the base.”

Schilder & Schilder (1971) listed *esontropia* as a valid species.

Wilson (1984) reported finding of one mature and four sub-adults, plus three dead *cribraria*-like specimens

around Dhahran (al-Juraid I.) in the Persian Gulf, which were identified as *C. esontropia*. “The first difference was in the shape. All three Juraid specimens were deltoid, with produced extremities... Second was the degree of dark lateral spotting in the full adult. This was just beginning to emerge in the young adults, whose shape was also closer to the “normal” *cribraria*, only one of which showed any trace of lateral spotting. The third point of difference was the extent of development of the labial callus in the Arabian shells, and the presence of a discernable columellar callus in the full adult. The last was the presence of basilar spotting in the adult. The younger shells show only one basilar spot, rather faint but clearly not the remains of the red banding on the columella found in some young *cribraria*.”

Burgess (1985:241) mentioned a report by Wilson (1984) and wrote “The live-collected cowries were identified from Wilson’s excellent photographs by myself and Dr. Kay.”

Lorenz & Hubert (1993) considered that *esontropia* consists of two subspecies: *C. esontropia esontropia* and *C. esontropia cribellum* both from Lemurian Province and their areas of distribution overlap.

In Lorenz & Hubert (2000) this approach is the same but the area is restricted to Mauritius and Reunion only.

Subsequent authors (including the present author) did not pay attention to a certain nuance: the basilar spotting is the main diagnostic character of *esontropia* as a species but only if this shell character is found in all shells of the species. It turned out now that in shells of *esontropia* the basilar spots are sometimes absent and that in certain shells of *C. cribraria* the small dark marginal spots may be present. This fact, if confirmed on substantial number of shells, would show that there is no conchological gap of a specific level between *cribraria* and *esontropia* hence these taxa cannot be separated as different species.

In 2002, Merlin & Quiquandon and Lorenz described independently a new subspecies *C. esontropia francescoi* from the southern Madagascar and South Africa. “In *e. francescoi* the marginal spotting is restricted to the area above the labral edge, while on the left side it is usually reduced.” In other words in *esontropia francescoi* the basilar spotting may be absent. This approach contradicts the conchological criterion of *esontropia* as a species: if the presence of the basilar spots is the main diagnostic character of *esontropia* as a species, shells of all subspecies of this species must share the same main diagnostic character.

Jay (2003) showed on a batch of 702 *esontropia*-like shells from Reunion how different shell forms of this taxon intergrade and concluded that shells treated as *C. cribellum* are in fact a flat and subcylindrical form of *C. esontropia*. Typical shells of *esontropia* are oval or subpyriform and globose. In other words ‘cribellum’ is not a valid species but a form i.e. a synonym of *esontropia*.

Limpalaër (2003) mentioned that *C. esontropia francescoi* can “be separated from most of *C. cribraria* from E. Africa or Madagascar by the dark coating of the dorsal adult pattern, which is absent on the labial side of the dorsal line under which lies a juvenile conspicuous banding...However there exist in Fort Dauphin different shells.”

Watt (2005) discussed forms of *C. cribraria comma* and *C. esontropia* in the Western Indian Ocean.

In shells of *C. cribraria ganteri* (Lorenz, 1997) the small marginal spots are present and sometimes these spots can be seen on the base too.

*) Author’s address: heimel@netvision.net.il