The Subspecies of *Leporicypraea mappa* (LINNAEUS, 1758) from the Western Indian Ocean (Gastropoda: Cypraeidae)

By FELIX LORENZ, D-Buseck-Beuern & RANDALL J. BRIDGES, USA-Phoenix

With 6 figures

Keywords

Gastropoa, Cypraeidae, *Leporicypraea mappa*, new subspecies, Indian Ocean, fluorescence.

Abstract

Leporicypraea mappa ultraviola n. ssp. from the East African coast and Madagascar shows strong fluorescence under ultraviolet light, which lacks in *L. m. subsignata* MELVILL, 1888 from the Mascarenes. The name *rosea* GRAY, 1824, formerly in use for both populations, becomes a *nomen dubium*.

Zusammenfassung

Leporicypraea mappa ultraviola n. ssp. von der Küste Ostafrikas und Madagascar zeigt starke Fluoreszenz unter ultraviolettem Licht, die bei *L. m. subsignata* MELVILL, 1888 von den Maskarenen fehlt. Der Name *rosea* GRAY, 1824, der in Gebrauch für beide Populationen war, wird zum *nomen dubium*.

Introduction

The *Leporicypraea mappa* (LINNAEUS, 1758) species-complex is a highly diverse and widespread group of look-alike taxa distributed across the Indo-Pacific. Its members are of particular interest to researchers of shell-structure because they display a bright red fluorescence from 600 to 700 nanometers (nm) when illuminated with long-wave (365 to 400 nm) ultraviolet (UV) light (COMFORT 1949, LORENZ 1991, WOODBRIDGE 1961). An exception are the populations from the Mascarene Islands (Mauritius, La Réunion, St. Brandon and Rodrigues). These shells do not show this characteristic fluorescence, plus they display a number of further differences, when compared to the populations from the African mainland and Madagascar. We have therefore decided to divide these populations, using the presence or absence of fluorescence, as one distinguishing feature.

Abbreviations

CLSF	CHIAPPONI LORENZ Seashell Foundation, Lecco, Italy
CT	columellar teeth
H/L	height/length ratio in %
H/W	height/width ratio in %
L	length (mm)
LT	labral teeth
mR	mass ratio
MAM	Collection of MICHAEL A. MONT, Owings Mills, Maryland, USA
MNHN	Museum National d'Histoire Naturelle, Paris, France
Nl	normalized
SMF	Senckenberg Naturkundemuseum, Frankfurt, Germany
W/L	width/length ratio in %

Material and Methods

Photography of specimens was done with an Olympus XZ-1 digital camera (Olympus Imaging America Inc., Center Valley, Pennsylvania 18034, USA) for fluorescent and normal daylight shots, and an Olympus C-2020Z for reflected ultraviolet light photos. Illumination for reflected UV and fluorescence of the specimens was provided by a high power narrow bandwidth UV light emitting diode (LED) with a peak wavelength of 390 nm (LZ4-00UA04, LED Engin, San Jose, California 95134 USA). For the fluorescent photographs a Tiffen Haze 2A filter (The Tiffen Company, Hauppauge, New York 11788 USA) was used in front of the camera lens to reduce any residual deep blue coloration from the UV-LED illumination. To filter out non-UV light in the reflected UV photographs, a stacked combination of a B+W 403 UV-pass filter (SCHNEIDER Optics, Van Nuys, California 91406 USA) and a Schott BG-38 infrared cut-off filter (SCHOTT North America, Inc., Elmsford, New York 10523 USA) was used in front of the camera lens. To record the fluorescent emission spectrum, we utilized an Ocean Optics HR2000 USB spectrometer and the SpectraSuite software package (Ocean Optics, Dunedin, Florida USA). The relative irradiance spectra were corrected for sensor and instrument

response by using a quartz-halogen light as a black-body reference.

The morphometric analysis of shells considers only adult specimens of typical (not pathological) shape. Length, width, height, teeth-count, and weight were used to compare the shells. The results are presented in the formula proposed by BRIDGES & LORENZ (2012) as follows:

L (W/L–H/L–H/W) LTnl : CTnl [mR]

Raw shell measurements are listed as length × width × height (mm), (labral:columellar teeth, counted), and shell's weight (in grams). Most shells studied have been collected more than five years prior to this description, so they are all in a similar state of fading to allow an objective comparison of their colors. All paratypes are from the type locality, Mitsio Island, Madagascar, and are currently owned by the first author, unless noted otherwise.

Leporicypraea mappa ultraviola n. ssp.

Material

50 adult, live-collected specimens of the new subspecies, all of which are designated as paratypes.

Holotype: 68.6×39.8×34.0 (25:28) 45.4 g; Mitsio Island, northern Madagascar, coll. MNHN 26987
Paratype 1: 71.9×42.7×37.1 (28:28) 47.0 g; coll. CLSF 15300
Paratype 2: 64.1×36.2×31.8 (26:28) 35.9 g; coll. CLSF 15301
Paratype 3: 70.5×40.9×34.9 (27:32) 40.3 g; coll. MAM 5893
Paratype 4: 63.4×37.6×32.9 (26:30) 35.6 g; coll. CLSF 15302
Paratype 5: 71.1×41.8×35.6 (28:31) 44.7 g; coll. CLSF 15303
Paratype 6: 70.0×41.9×35.5 (27:31) 38.7 g; coll. MAM 5894
Paratype 7: 73.0×44.2×38.9 (27:28) 49.8 g; coll. BRIDGES
Paratype 8: 75.8×45.3×38.3 (27:30) 48.2 g; coll. MAM 5895
Paratype 9: 68.8×40.4×34.6 (27:31) 40.0 g; Nosy Be, northern Madagascar, coll. CLSF 15304
Paratype 10: 73.9×45.3×40.4 (27:27) 56.5 g; coll. MAM 5896
Paratype 11: 65.5×38.4×33.1 (25:31) 45.3 g; coll. MAM 5897
Paratype 12: 76.7×43.9×37.2 (27:34) 56.0 g; Nosy Be, northern Madagascar, coll. CLSF 15305
Paratype 13: 74.9×42.8×37.1 (29:31) 55.5 g; coll. CLSF 15306
Paratype 14: 75.3×42.1×37.2 (28:36) 50.2 g
Paratype 15: 69.3×42.8×37.6 (27:27) 52.8 g
Paratype 16: 74.4×45.5×38.1 (28:31) 55.0 g
Paratype 17: 80.6×49.4×43.5 (33:29) 68.5 g; coll. CLSF 15307
Paratype 18: 82.7×50.6×42.5 (31:32) 64.8 g
Paratype 19: 67.2×40.0×33.0 (27:33) 40.7 g
Paratype 20: 74.9×43.2×37.4 (30:34) 53.3 g; Dar-es-Salaam, Tanzania, coll. CLSF 15308
Paratype 21: 79.2×47.8×38.7 (32:32) 52.3 g; coll. MAM 5898
Paratype 22: 67.1×37.7×32.4 (29:37) 37.2 g
Paratype 23: 62.5×38.8×32.1 (26:28) 37.6 g; SMF 341796
Paratype 24: 70.6×42.3×36.3 (28:30) 46.8 g; Nacala, Mozambique
Paratype 25: 75.1×44.9×38.0 (30:32) 50.0 g; coll. MAM 5899
Paratype 26: 70.5×40.0×34.7 (31:32) 41.0 g; coll. MAM 5900
Paratype 27: 69.8×41.3×35.2 (30:31) 43.6 g
Paratype 28: 77.0×44.3×38.0 (31:31) 58.6 g; coll. MAM 5901
Paratype 29: 71.2×40.6×34.7 (30:31) 47.0 g
Paratype 30: 67.5×41.0×34.9 (27:27) 41.9 g; coll. BRIDGES
Paratype 31: 66.7×38.7×32.9 (26:32) 39.2 g
Paratype 32: 72.5×43.3×37.1 (28:35) 45.5 g; coll. MAM 5902
Paratype 33: 69.8×39.7×33.7 (30:33) 41.8 g
Paratype 34: 65.6×37.1×32.0 (27:29) 39.0 g
Paratype 35: 69.2×43.3×36.6 (30:28) 46.1 g
Paratype 36: 70.4×41.5×35.4 (30:31) 47.7 g
Paratype 37: 70.6×41.3×35.0 (28:34) 44.4 g
Paratype 38: 64.5×36.7×31.6 (28:31) 33.5 g; coll. BRIDGES
Paratype 39: 68.4×38.7×33.6 (26:31) 40.3 g; South Madagascar, coll. MAM 5903
Paratype 40: 75.0×45.9×37.1 (29:32) 56.0 g; coll. MAM 5904
Paratype 41: 73.6×43.2×36.4 (26:32) 45.1 g
Paratype 42: 62.9×35.2×29.6 (26:32) 26.8 g
Paratype 43: 59.8×33.8×28.6 (29:31) 28.5 g
Paratype 44: 61.2×35.8×29.5 (27:30) 20.7 g
Paratype 45: 68.2×39.4×33.8 (28:34) 35.6 g
Paratype 46: 73.0×45.5×37.3 (29:30) 54.2 g; coll. CLSF 15309
Paratype 47: 71.5×42.2×34.7 (28:35) 47.6 g
Paratype 48: 59.6×35.1×30.2 (26:30) 24.4 g; coll. MAM 5905
Paratype 49: 69.1×39.4×34.0 (28:32) 42.9 g
Paratype 50: 65.9×38.1×32.5 (27:30) 39.3 g; coll. BRIDGES

Formula: 70(59–50–85) 20:21 [14.8]

Description

The shell is medium-sized, narrow cylindrical with slightly convex dorsal profile and flat base. The margins are slightly calloused and rounded. The posterior extremity is narrowly tapering, the opening narrow. The spire is projecting and pointed, the protoconch covered with callus of the extremity. The anterior extremity is bordered with callus-flanges that are deeply grooved above. The opening of the canal is sharply bordered, narrow, and curved to the right on anterior view. The aperture is narrow and nearly straight, barely widening anteriorly. The long terminal ridge constricts the canal on basal view. The teeth are restricted to the aperture on both sides. They are notably finer on columellar side, where they extend into the shell to meet the columella, which is not calloused at all. The fossula is hardly projecting and covered by ridges, which are prolongations of the anterior columellar teeth. The area directly above is calloused, forming a shallow ridge along the aperture.

The ground color is cream to pale-brown, with indistinct, darker-pink dashes which are reminiscent of interrupted, wavy, embryonal banding. The basal and marginal callosities are whitish-pink. The margins are densely spotted with small, crowded, purple spots, which also continue on to the base, becoming smaller and less distinct towards the middle. The area directly left and right of the teeth is unspotted and paler yellow. There is a compact, indistinct, darker blotch on the middle of the base. The teeth, and their prolongations onto the fossula on columellar side, are bright red.

The dorsal ground color is yellow-cream with indistinct, wavy, embryonal bands covered by darker, dorsal netting. This secondary pattern consists of fine, brown, longitudinal lines which are interrupted occasionally, and which form short, irregular branches that create the visual impression of a net-pattern. The dorsal line is moved just a bit away from the shell's axis, towards the labral side. It has few finger-like branches of varying length left and right. The extremities are somewhat darker brown than the adjacent callus. The sharp edge around the anterior canal is paler yellow.

The paratypes show no variation in shape, except for different degrees of callus accumulation on base and margins. The intensity of the purple color of the basal blotch and the marginal spots varies. In fresh shells, the purple color-elements are striking, but fade rapidly to grey-brown as the empty shell dries. The basal blotch is always present, but sometimes quite pale. The dorsal netting varies slightly in density and the degree in which the pattern condenses along the dorsal line. In many shells, the netting abruptly stops above the margins, forming a narrow, darker, wavy, longitudinal band.

Subadult shells at a certain stage of growth show only the primary netting of longitudinally and transversely oriented stripes, which in some cases form a regular square-pattern that is still visible along the dorsal line and below the above-mentioned borderline between the secondary dorsal netting and the margins (e.g. in paratype 3, Figure 5 on the left, arrows and in subadult shells as on the right). In approximately one out of ten shells, the secondary dorsal netting leaves irregular, indistinct lacunae.

Under UV light (365 to 400 nm) the entire shell shows a red fluorescence, which is most intense towards the extremities on basal view.

Habitat and distribution

Leporicypraea mappa ultraviola n. ssp. is widely distributed in the Western Indo-Pacific: The type locality is the Nosy Mitsio Archipelago, 70 km north of Nosy Be, Northern Madagascar (12°52'S 48°35'E), where commercial divers collect large numbers of shells at 8 to 20 m. It has been recorded along the African mainland reefs, from Ras Hafun, Somalia, along the coast of Kenya and Tanzania, to Mozambique. It is most abundant in the north of Madagascar, less common in the south. It is found in the Comoros and the Seychelles, and it was collected at 20 to 30 m on Saya de Malha Bank. Specimens labeled Dahlak Archipelago (southern part of the Red Sea), India, Sri Lanka, Chagos, and the Maldives exist in collections, but all of these occurrences require confirmation (Fig. 6).

L. mappa ultraviola n. ssp. is found at 2 to 15 m under coral slabs in vital reef areas, down to at least 50 m, where it lives in crevices of rocks.

Etymology

The name *ultraviola* (Lat. *ultra* = beyond, *viola*: violet) refers to the property of showing bright red fluorescence when viewed under ultraviolet light.

Discussion

In his taxonomic review of the family Cypraeidae, RAYBAUDI (1985) used the name *alga* PERRY, 1811 for any *Leporicypraea* (including the related

geographica) from the Western Indian Ocean. As noted by LORENZ & HUBERT (1993), *alga* was introduced only by a picture that was not revealing of any features suitable to characterize a subspecies in the *mappa*-complex. The general problem encountered on reviews of the *mappa*-subspecies was triggered by the fact that throughout their ranges, the conchologically similar *L. geographica* SCHILDER & SCHILDER, 1938 is found in the same habitat. RAYBAUDI did not accept the existence of two different *mappa*-like cowries in the Indian Ocean, and considered them individual variations. LORENZ & HUBERT (1993, 2000) attempted a compromise of listing two subspecies: *mappa geographica* and *mappa rosea*, with a large overlap in their distributions. *L. geographica* differs from all Indian Ocean subspecies of *mappa* by the lack of a basal blotch, a rhomboidal instead of a cylindrical shape, the dorsal line being situated further towards the labrum and by larger, less numerous lateral spots. The systematic status of *geographica* and *mappa* as separate species was finally confirmed by the analysis of mtDNA (MEYER 2004). This method also supports the division of the various taxa discussed in the following (MEYER, pers. comm. with the first author, 2013).

Fig. 1: *Leporicypraea mappa subsignata* (MELVILL, 1888). Figure in SOWERBY's Thesaurus (1847)

The name *Leporicypraea mappa rosea* (GRAY, 1824) was formerly used for both, the subspecies described as *ultraviola* n. ssp. herein, and the populations from the Mascarene Islands. It was introduced in two lines of text - not accompanied by a picture or reference to a locality: "*Testa alba brunneo lineolis brunneis ornata, linea dorsali lata centrali, lateribus purpureo-guttatis, fauce aurantia.*" = "White shell decorated with brown lines, dorsal line broad in the middle, sides spotted purple, mouth golden." The use of this name, despite the rather sparse characterization, was suggested in LORENZ & HUBERT (1993): "(...) the original description of *m. rosea* is quite unambiguous as it refers explicitly to the characteristic purple patches on base and sides and to the yellow-orange coloration of aperture and teeth, although no picture is connected with the description." At that time, the authors were merely aiming to separate the East African *geographica* (not showing any purple coloration) from the sympatric Western Indian Ocean *mappa* populations. For this purpose, *rosea* served as the earliest appropriate name.

With the addition of *aliwalensis* (LORENZ, 2002) and *ultraviola* n. ssp., the Indian Ocean now has three subspecies of *mappa*, with a number of taxonomic consequences. First, it makes the name *rosea* a *nomen dubium*, due to the lack of an illustration and precise locality data, this name cannot be safely assigned to any of the subspecies in question. Secondly, the next younger available name of *mappa* from the Indian Ocean, *subsignata* MELVILL, 1888, becomes the name for the Mascarene populations, as it explicitly refers to a shell from St. Brandon, north of Mauritius. The illustration MELVILL refers to is in SOWERBY's Thesaurus figures 24, 25 (see Figure 1 herein) and clearly shows a shell likely to be of that origin.

Therefore, *mappa subsignata* replaces *rosea* and refers to the population of *mappa* from the Mascarenes. The more widespread *mappa ultraviola* addresses the populations of *rosea* which were already noted to be conchologically different in LORENZ (2002: 31).

The South African *aliwalensis* was most certainly unknown at the time *rosea* was introduced and it does not correspond to the description of *rosea*. Incidentially, the name *subsignata* is commonly in use for for all kinds of *mappa* and its variations among dealers.

L. mappa ultraviola n. ssp. is easily distinguished from *mappa subsignata* by showing bright red fluorescence throughout the shell (even in juveniles), when viewed under ultraviolet light of a range of 365 to 400 nm. Shells of *m. subsignata* do not show any fluorescence dorsally and on most of the base, but merely towards the extremities where there may be a hint of fluorescence.

The shells of *m. ultraviola* (70(59–50–85) 20:21 [14.8]) are mostly large and cylindrical, whereas *m. subsignata* (60(60–50–84) 20:22 [15.3]) are oval and rather broad. The mass ratios (mR) of the

shells differ consistently, demonstrating that *m. ultraviola* is a relatively less heavy shell.

In *m. subsignata*, the dorsal pattern is coarser, more regular, less longitudinally aligned, and it forms numerous, distinct, circular lacunae at least on the right side of the dorsal line. In contrast, the pattern of *m. ultraviola* mainly consists of fine longitudinal lines with less of a tendency to form lacunae. The most apparent difference is the brightness and distribution of the purple color on the base in *m. subsignata*, which does not fade to grey-brown over time as in *m. ultraviola*.

The South African *m. aliwalensis* LORENZ, 2002 (formula: 67(58–49–84) 19:20 [15.2]) differs from the new taxon by a less cylindrical shape, more rostrate extremities, a mostly brown instead of purple spotting, a wider, more curved aperture, and a much coarser, reticulated, dorsal pattern.

Recently, a typical specimen of *m. subsignata* was collected off deep water in the north of Zanzibar in Tanzania. This finding is the only record outside the Mascarene Islands. The dark, live collected specimen (Fig. 2) does not show fluorescence dorsally and is also otherwise indistinguishable from specimens of Mascarene origin. If further occurrences of *m. subsignata* within the range of *m. ultraviola* can be confirmed, then the systematic ranks of these taxa need to be lifted. In this case, *m. subsignata* would be considered a valid species and *m. ultraviola* a subspecies of *m. aliwalensis*, which would be given the rank of a species as well, based on the same level of genetic distance of this group from the Pacific *mappa*-complex. The second interesting aspect of finding the non-fluorescent *m. subsignata* in an area inhabited by the fluorescing *m. ultraviola* and *geographica* indicates also that the phenomenon is not the result of a different locality, geology or habitat.

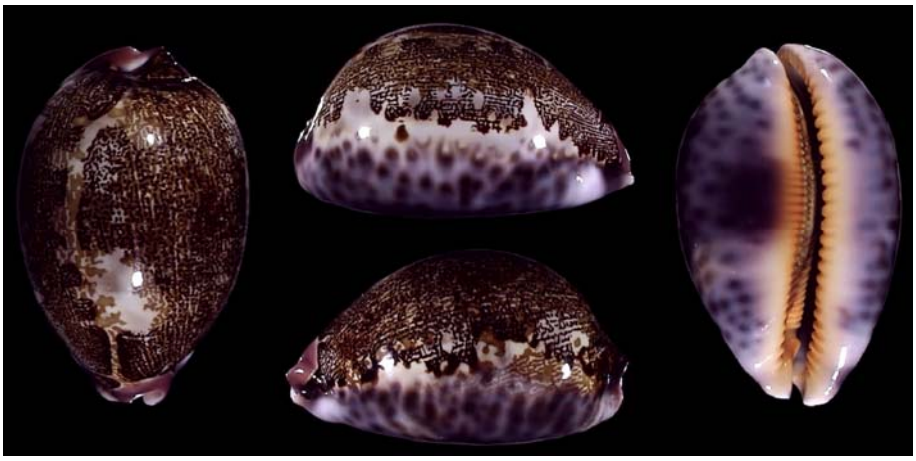

Fig. 2: *Leporicypraea mappa subsignata* (61.1 mm) from northern Zanzibar, Tanzania.

It is surprising that the most purple of all map-cowries, *m. subsignata*, is the only one that does not show fluorescence – an oddity discovered by Prof. ALEX HUBERT more than 20 years ago. While working on the first edition of the "Guide" with the first author in 1990, a UV lamp was used as a tool to detect Philippine fakes that were becoming popular at the time. On looking at different drawers of cowries, the group of map cowries displayed the most striking fluorescence, except the little group from the Mascarenes!

This phenomenon of showing red fluorescence is characteristic of the *Leporicypraea mappa* species-complex with *m. subsignata* being the only exception. The causes and biological function of this fluorescent phenomena are currently under study. It is certain that the presence or absence of fluorescence reveals fundamental chemical and/or structural differences in the shell's composition and the genes involved in its formation. As all populations of the *mappa*-complex from the Indian Ocean basically have a similar habitat and diet, ecological factors are unlikely to play a role in the presence or absence of fluorescence.

The source of the red fluorescence in the map-cowries is the existence of porphyrin compounds (COMFORT 1951, NICHOLAS & COMFORT 1949) within the outermost layer of the shell-structure. Porphyrins are noted for their strong, reddish fluorescence when excited with light near their maximum absorption wavelength, typically around 400 nm. To confirm the presence of porphyrins in our shells, we recorded the fluorescence emission spectra from specimens of *m. ultraviola*, demon-

strating a characteristic spectrum for porphyrins (Fig. 3).

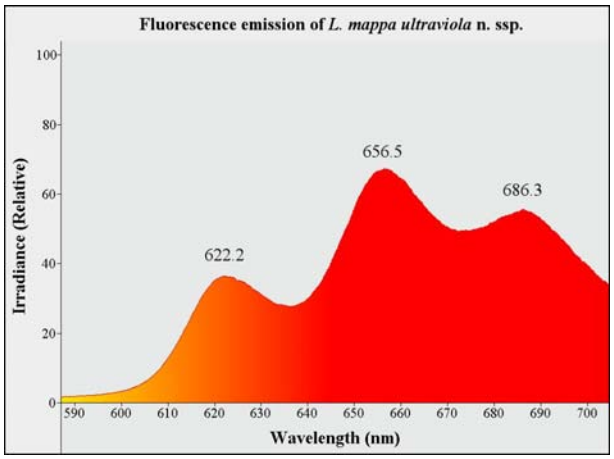

Fig. 3: Emission spectrum from a specimen of *Leporicypraea mappa ultraviola* n. ssp. The excitation wavelength is 390 nm. The displayed peaks are characteristic for porphyrin compounds.

Since the peak absorption of many porphyrins is approximately 400 nm, it is reasonable to predict that the shell would reflect little if any UV light of a similar wavelength, due to the presence of porphyrins. We demonstrate this in reflected UV photographs of both, *m. ultraviola* and *m. subsignata* (Fig. 4). The photograph compares normal white light illumination to the fluorescence as well as the light reflected from the sample when illuminated with UV light, again confirming the presence of porphyrins in the shells.

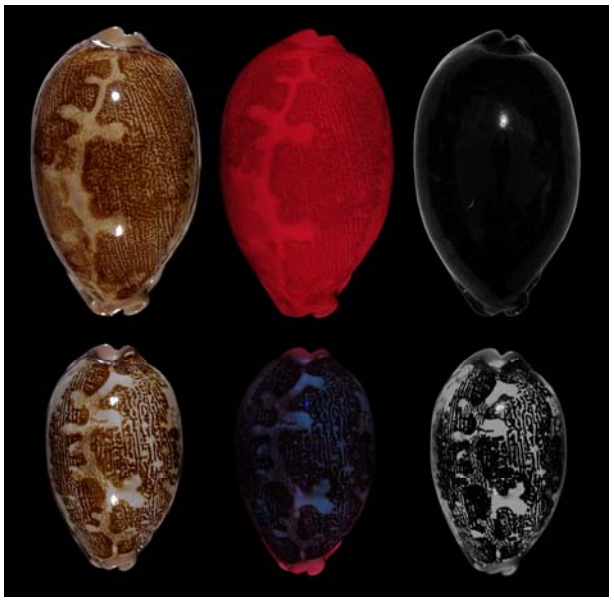

Fig. 4: Comparison of white (left column) and UV light illumination (center and right column) on *m. ultraviola* n. ssp. (top row) and *m. subsignata* (bottom row). The characteristic brilliant red fluorescence (top-center) due to porphyrins present in the shell-structure are clearly shown for *m. ultraviola* as well as the complete absorption of the UV as shown in the reflected UV image (top-right). In contrast, *m. subsignata* displays minimal fluorescence and nearly complete UV reflectance (bottom center and right).

To our knowledge, *L. mappa ultraviola* n. ssp. is the first Gastropod whose conchological separation from a related taxon is based partly on the feature of fluorescence. The reasons for the existence of porphyrins, with their characteristic fluorescence, and why we observe it only in particular cowries (less than 10% of the taxa), remain questions to be addressed in the future.

Fig. 5: *Leporicypraea mappa ultraviola*, left: Paratype 3, left side of shell. The arrows are pointing out the area where the primary layer of pigmentation is still visible. Right: subadult specimen in with only the primary layer of pigmentation has formed (CLSF 14356).

Fig. 6: The ranges of the three subspecies of *Leporicypraea mappa* in the western Indian Ocean. The red dot indicates the type locality of *m. ultraviola* n. ssp., the Mitsio Archipelago, Northern Madagascar. The blue arrow points at the north of Zanzibar Island, Tanzania, where a single specimen of *m. subsignata* has been found.

Acknowledgements

We wish to thank JANA KRATZSCH and Dr. MICHAEL A. MONT who checked and helped edit the manuscript. For continued support we thank Dr. CHRISTOPHER P. MEYER, ERIC LE COURT DE BILLOT, JEAN-PIERRE and OLIVIER VAULBERT DE CHANTILLY, BRUNO and IACOPO BRIANO, LUIGI BOZZETTI, MARTY BEALS, OLGA FRASER and Dr. MARCO CHIAPPONI.

Special thanks also to KLAUS GROH and Dr. CARSTEN RENKER for careful editing.

References

BRIDGES, R. J. & LORENZ, F. (2012): A revised morphometric formula for the characterization of cowries. – Conchylia, **43** (1-4): 23-36.

COMFORT, A. (1949): Acid-soluble pigments of shells. (I) The distribution of porphyrin fluorescence in molluscan shells. – Biochemical Journal, **44** (1): 111-117.

COMFORT, A. (1951): The pigmentation of molluscan shells. – Biological Reviews, **26**: 285-301.

GRAY, J. E. (1824): Monograph on the Cypraeidae, a family of testaceous Mollusca. – Zoological Journal, **1** (2): 76.

LORENZ, F. (1991): „Leuchtkauris" - oder: UV Licht bringt es an den Tag. – Club Conchylia Informationen, 23 (1-2): 66-67.

LORENZ, F. (2002): New Worldwide Cowries. Descriptions of new taxa and revisions of selected groups of living Cypraeidae (Mollusca: Gastropoda). – Schriften zur Malakozoologie, **20**: 1-292, 40 pls.; also appeared as a book at ConchBooks, Hackenheim, Germany.

LORENZ, F. & HUBERT, A. (1993): A Guide to Worldwide Cowries. – 571 pp., 124 pls.; Wiesbaden, Germany (Verlag CHRISTA HEMMEN).

LORENZ, F. & HUBERT, A. (2000): A Guide to Worldwide Cowries, 2nd revised and enlarged edition. – 584 pp., 52 + 19 figs., 128 pls.; Hackenheim, Germany (ConchBooks).

MELVILL, J. C. (1888): A survey of the genus *Cypraea* (LINN.), its nomenclature, geographical distribution, and distinctive affinities; with descriptions of two new species, and several varieties. – Memoirs and Proceedings of the Manchester Literary and Philosophical Society, (4) **1**: 184-252, 2 unnumbered figs., pls. 1-2.

MEYER, C. P. (2004): Toward comprehensiveness: Increased molecular sampling within Cypraeidae and its phylogenetic implications. – Malacologia, **46** (1): 127-156.

NICHOLAS, R. E. H. & COMFORT, A. (1949): Acid-soluble pigments of molluscan shells. 4. Identification of shell porphyrins with particular reference to conchoporphyrin. – Biochemical Journal, **45** (2): 208-210.

RAYBAUDI, L. (1985): The Living Cowries - specialized catalogue - *Mauritia* subgenus *Leporicypraea*. – The Connoisseur of Seashells, **3/4**: 8-9.

SOWERBY II, G. B. (1870). Monograph of the genus *Cypraea*. – Thesaurus Conchyliorum, or monographs of genera of shells, **4**: 1-58, pls. 292-328.

WOODBRIDGE III, R. G. (1961): A monograph on fluorescent mollusk shells of the seas, the shores, the fresh waters and the lands of the world. A review of the literature from earliest times to 1960 with original observations. – 29 pp.; Princeton Junction, N.J. (Transspace Laboratory).

Plate 1 (on p. 24)

1st row: *Leporicypraea mappa ultraviola.* 69 mm. Holotype.
2nd row: *L. mappa ultraviola.* 72 mm. Paratype 1.
3rd row: *L. mappa ultraviola.* 64 mm. Paratype 2.
4th row: *L. mappa ultraviola.* right: 71 mm. Paratype 5.

All Mitsio Archipelago, Northern Madagascar.

Plate 2 (on p. 25)

1st row: *Leporicypraea mappa subsignata.* 66 mm. St. Brandon.
2nd row: *L. mappa subsignata.* 57 mm. Mauritius.
3rd row left: *L. mappa subsignata.* 64 mm. Mauritius.
3rd row right: *L. mappa aliwalensis.* 74 mm. Aliwal Shoal, Natal, South Africa.
4th row: *L. mappa aliwalensis.* 68 mm. Aliwal Shoal, Natal, South Africa.

Plate 1

Explication on p. 23

Plate 2

Explication on p. 23

Appendix: Comparison data

Leporicypraea mappa subsignata MELVILL, 1888
From the Mascarene Islands

1: 63.9×38.7×32.7 (29:30) 34.6 g; Mauritius
2: 57.1×34.0×29.4 (26:31) 22.0 g; Mauritius
3: 52.7×31.8×26.7 (24:27) 20.4 g; St. Brandon
4: 62.6×36.1×30.8 (28:32) 31.1 g; St. Brandon
5: 55.1×31.0×26.1 (26:30) 19.9 g; Mauritius
6: 61.2×37.3×31.8 (27:29) 30.0 g; Mauritius
7: 57.2×33.3×28.7 (27:32) 23.3 g; Mauritius
8: 67.1×39.4×32.4 (29:31) 38.6 g; Mauritius
9: 63.1×38.9×32.7 (27:33) 31.5 g; Mauritius
10: 54.9×33.3×27.3 (27:28) 25.4 g; Mauritius
11: 56.3×34.3×27.9 (25:30) 26.7 g; Mauritius
12: 64.8×36.5×31.0 (28:35) 31.5 g; Mauritius
13: 54.4×31.7×27.1 (25:30) 23.0 g; Mauritius
14: 59.9×34.7×29.6 (26:30) 27.8 g; Mauritius
15: 64.1×39.2×32.5 (29:31) 39.3 g; Mauritius
16: 57.2×36.3×30.0 (26:31) 33.9 g; St. Brandon
17: 61.8×37.3×31.3 (27:31) 34.2 g; Mauritius
18: 60.4×38.4×31.7 (25:27) 28.7 g; St. Brandon
19: 66.1×42.6×34.8 (27:31) 41.3 g; St. Brandon

Formula: 60(60–50–84) 20:22 [15.3])

Leporicypraea mappa subsignata MELVILL, 1888
From the north of Zanzibar Island, Tanzania

1: 61.1×38.1×32.4 (26:30) 27.7 g;

Formula: 61(62 - 53 - 85) 19:22 [12.5]

Leporicypraea mappa aliwalensis LORENZ, 2002
All from Aliwal Shoal, Natal, South Africa

1: 69.9×40.1×32.8 (30:30) 44.4 g;
2: 69.3×40.3×33.8 (27:29) 33.2 g;
3: 74.2×41.3×35.3 (28:29) 45.1 g;
4: 76.4×42.5×34.8 (27:28) 45.5 g;
5: 67.9×40.4×32.9 (25:24) 41.0 g;
6: 74.0×43.1×34.7 (32:30) 54.9 g;
7: 57.3×33.1×28.6 (25:26) 34.4 g;
8: 68.3×40.6×35.0 (27:34) 43.2 g;
9: 63.8×37.3×30.5 (29:27) 28.3 g;
10: 66.2×36.3×32.1 (27:28) 34.9 g;
11: 63.3×38.0×33.4 (25:26) 44.7 g;
12: 73.5×43.3×36.6 (27:31) 36.5 g;
13: 58.5×33.2×28.1 (27:26) 30.5 g;
14: 60.7×33.7×28.6 (26:24) 25.0 g;
15: 66.4×38.0×32.7 (29:28) 38.4 g;
16: 71.9×41.8×34.6 (29:29) 34.1 g;
17: 68.1×39.2×32.5 (25:28) 37.2 g;
18: 64.3×36.7×32.0 (27:28) 30.1 g;

Formula: 67(58–49–84) 19:20 [15.2])

Addresses of the authors:

Dr. FELIX LORENZ
Friedrich-Ebert-Str. 12
D-35418 Buseck-Beuern, Germany
E-mail: felix@cowries.info

RANDALL J. BRIDGES
11837 N. 22nd + Pl.
Phoenix, AZ, 85028, USA.
E-mail: rbridges@rbridges.com