ISSN 0738-9388

Volume: 50 THE FESTIVUS ISSUE 3

A New *Lautoconus* Species Radiation from Gambia, West Africa

Edward J. Petuch [1] and David P. Berschauer [2]
[1] Department of Geosciences, Florida Atlantic University, Boca Raton, Florida 33458
epetuch@fau.edu
[2] 25461 Barents Street, Laguna Hills, California 92653
shellcollection@hotmail.com

ABSTRACT Six sympatric species of the cone shell genus *Lautoconus* Monterosato, 1923 have been discovered on an isolated rock reef near the Gambia River Mouth, Gambia, West Africa. Of these, four were found to be new to science and, together, they represent a previously unknown Gambian endemic species radiation. These include: *Lautoconus fernandi* new species, *L. gambiensis* new species, *L. rikae* new species, and *L. wolof* new species. The poorly-known Gambian endemic cone, *Lautoconus orri* (Ninomiya and da Motta, 1982) was also found to be a component of the rock reef fauna, as was the wide-ranging *L. guinaicus* (Hwass, 1792) (Senegal to Ghana). The Gambian cluster of sibling species represents the farthest-south separate radiation of *Lautoconus* known from the West African coast.

KEY WORDS Gambia, West Africa, Cone Shells, Conidae, *Lautoconus*.

INTRODUCTION

In early 2018, the well-known Belgian malacologists and shell dealers Fernand De Donder and Rika Goethaels initiated one of the first thorough investigations of the molluscan fauna of Gambia and the Gambia River Mouth, West Africa. During this research and collecting trip, they worked with the local fishermen, who saved deeper water shells for them, and conducted intensive surveys of the intertidal sand flats, mud banks, and rocky reef platforms along the entire Gambian coast. All of these environments proved to house rich molluscan assemblages, most of which contained rarely-seen and poorly-known species, many of them "lost" since their original descriptions. One of these habitats, a rocky reef-like platform covered with *Enteromorpha* and *Ulva* green algae (Figure 1), was visited during an unusually low tide. This rocky area, which is normally flooded with a meter of water, was found to contain a previously-unknown cone shell fauna, comprising six species of the genus *Lautoconus* Monterosato, 1923. Previously, West African ecosystems with large numbers of sympatric *Lautoconus* species were known only from Senegal, especially the areas along the Cape Verde Peninsula and the Petit Cote (Monteiro, Tenorio, and Poppe, 2004; Abalde, *et al*., 2017). The discovery of a new Gambian species radiation demonstrates that conid "evolutionary hot spots" extend farther south along this coast than was originally thought.

The algae-covered rock reef that De Donder and Goethaels discovered extended along the sandy beach line off Tanji, south of the Gambia River Mouth. The local water conditions were murky due to suspended sediments and phytoplankton blooms, the result of the nutrient-rich effluent from the nearby Gambia River. The high concentration of dissolved nutrients has resulted in extensive eutrophication, as evidenced by the thick growths of the green algae *Enteromorpha* and *Ulva* that carpeted the rock reef. These

ISSN 0738-9388

eutrophic water conditions also would support an immense polychaete worm population, the perfect food resource for a diverse fauna of the vermivorous cone shell genus *Lautoconus*. In this area with the huge polychaete biomass, the Belgian explorers collected over four hundred specimens comprising two previously-described cones and four that were completely new to science. The two known taxa included the large-shelled *Lautoconus guinaicus* (Hwass, 1792), which ranges from the Cape Verde Peninsula of northern Senegal south to Ghana, and the smaller *L. orri* (Ninomiya and da Motta, 1982) (Figure 3 G, H), which is endemic to the area of the Gambia River Mouth (author's note: the triangular and flat-topped *L. orri* has often been incorrectly synonymized with the Senegalese *L. mercator* (Linnaeus, 1758), which is found only along the western edge of the Cape Verde Peninsula; the two congeners are now known to be distinct). These two known species, *L. guinaicus* and *L. orri*, were found to be fairly common on the Tanji rock reef.

In addition to the known species, an endemic species radiation, comprising four new *Lautoconus* species, was also discovered to inhabit the Tanji reef. We here propose that these new taxa have become reproductively isolated from their Senegalese relatives to the north and have evolved into a new cluster of siblings; the result of a barrier formed by the wide area of open sand beaches and lack of suitable habitats along the Petit Cote to the north. The Tanji rock reef, with its rich polychaete worm fauna, acted as an island and refugium for any cone shell migrants, allowing them to evolve in isolation and form their own cluster of species. Through the kindness of Rika Goethaels the authors were able to examine over fifty macro photographs of each new species together with measurements. In the absence of anatomical and genetic data, we here describe *L. fernandi*, *L. gambiensis*, *L. rikae*, and *L. wolof*., as morphospecies in the following sections. The holotypes are deposited in the National Museum of Natural History, Paris, France and bear MNHN catalog numbers.

Figure 1. View of the type locality of *Lautoconus fernandi*, *L. gambiensis*, *L. rikae*, and *L. wolof*, off Tanji Beach, Gambia. Note that the exposed rock reef (during an extreme low tide) is covered with the eutrophic-loving green algae *Enteromorpha* and *Ulva*. The four new cone species, along with *Lautoconus orri* and *L. guinaicus*, were found among rubble and in crevices covered by the algal growths.

SYSTEMATICS

Class Gastropoda
Subclass Sorbeoconcha
Order Prosobranchia
Infraorder Neogastropoda
Superfamily Conoidea
Family Conidae
Subfamily Puncticulinae
Genus *Lautoconus* Monterosato, 1923

ISSN 0738-9388

Lautoconus fernandi Petuch and Berschauer, new species
(Figure 2 A, B)

Description. Shell large for genus, averaging around 38 mm, elongated, fusiform, narrow, with high pyramidal spire whorls; shoulder distinctly rounded, forming wide, broad carina-like flange; subsutural area concave, forming slightly canaliculate spire whorls; body whorl smooth with silky texture, with anterior end being encircled with 10-12 small, low spiral cords; sutural channel of spire whorls ornamented with 2 very fine incised spiral threads; shell color variable, usually dark blackish-brown, with 3 wide bands of small triangular tent-shaped spots, with one around shoulder, one posterior of mid-body line, and one just anterior of mid-body line; anterior tip colored pale orange-tan or orange; spire whorls colored dark blackish-brown with very numerous, closely-packed white crescent-shaped flammules; white crescent flammules intersect depressed area of channeled suture; some specimens pale sky blue with 3 wide black bands, overlaid with continuous network of tiny black tent markings; aperture uniformly narrow, dark purple with 2 narrow white bands; periostracum thin, smooth, translucent.

Type Material. HOLOTYPE - length 35.4 mm, width 19.4 mm, at low tide on an algae-covered rock platform, Tanji, Gambia, MNHN IM-2000-34012; OTHER MATERIAL EXAMINED - 2 specimens, lengths 36.15 mm and 21 mm, same locality as the holotype, in the De Donder-Goethaels Collection, Peutie-Vilvoorde, Belgium: 3 specimens, lengths 35.2 mm, 36.0 mm, and 37.1 mm, same locality as the holotype, the research collection of the senior author; 3 specimens, 35.4 mm, 30.2 mm, and 26.1 mm, same locality as the holotype, in the research collection of the junior author.

Type Locality. Found exposed at extreme low tide, on a rocky reef covered with dense growths of the green algae, off Tanji Beach, Gambia.

Distribution. Known only from the rock reefs near the mouth of the Gambia River, Gambia.

Ecology. The new species was found, exposed at low tide, in small pockets on an eroded sandstone rock platform, covered with dense growths of the green algae *Enteromorpha* and *Ulva* (Figure 1). Here, *Lautoconus fernandi* most probably feeds on the small polychaete worms that are so abundant in the nutrient-rich sediments at the mouth of the Gambia River.

Etymology. Named for Fernand De Donder of Peutie-Vilvoorde, Belgium, who collected the type material of the new *Lautoconus* species while collecting in Gambia and who has made many important contributions to our knowledge of the West African malacofauna.

Discussion. With its large fusiform shell and high spire, *Lautoconus fernandi* most closely resembles *L. trencarti* (Nolf and Verstraeten, 2008) from the Petit Cote of northern Senegal, particularly in the area near Somone. The new Gambian species differs from its Senegalese congener in having a distinctly wider and less-sloping shoulder area and in having the characteristic shallow subsutural channel and slightly canaliculate spire whorls. Although both species often exhibit dark blackish-brown color forms, the dotted color pattern and tent markings on dark *L. trencarti* are much finer and better defined than those of dark forms of *L. fernandi*, which are more diffuse and have a blurred appearance. *Lautoconus trencarti* also lacks the prominent and distinctive crescent-shaped white markings that dominate the spire whorls of *L. fernandi*.

ISSN 0738-9388

Lautoconus gambiensis Petuch and Berschauer, new species
(Figure 2 C, D, E)

Description. Shell of average size for genus, around 25 mm, narrow, elongated, distinctly fusiform, with high pyramidal spire and sloping spire whorls; shoulder slightly-angled, forming wide rounded, carina-like ridge; subsutural area slightly depressed, forming wide, shallow channel; channeled suture of shoulder and spire whorls ornamented with 4 large, prominent spiral cords; body whorl smooth and silky, with anterior tip being encircled with 6-8 low, widely-separated spiral cords; shell base color bright olive-green or khaki-green, overlaid with very numerous fine pale brown longitudinal hairlines; some specimens with small, widely-scattered amorphous white flammules on posterior half of body whorl; prominent, narrow solid white band present just anterior of mid-body line; white mid-body band often marked with small, very fine pale brown flammules and rows of dots; spire whorls olive-green, marked with closely-packed narrow, amorphous bluish-white or pale green flammules; aperture uniformly narrow, deep purple-brown within interior, with one thin white band; periostracum thin, smooth, translucent.

Type Material. HOLOTYPE - length 21.6 mm, width 11.5 mm, at low tide on an algae-covered rock platform, Tanji, Gambia, MNHN IM-2000-34013; OTHER MATERIAL EXAMINED - 2 specimens, lengths 22 mm and 20.5 mm, from the same locality as the holotype, in the De Donder-Goethaels collection, Peutie-Vilvoorde, Belgium; 3 specimens, lengths 22.0 mm, 26.3 mm, and 33.1 mm, from the same locality as the holotype, in the research collection of the senior author; 3 specimens, lengths 27.2 mm, 21.7 mm, and 20.3 mm, from the same locality as the holotype, in the research collection of the junior author.

Type Locality. Found exposed at extreme low tide, on a rocky reef covered with dense growths of the green algae, off Tanji Beach, Gambia.

Distribution. Known only from the rock reefs near the mouth of the Gambia River, Gambia.

Ecology. The new species was found, exposed at low tide, in small pockets on an eroded sandstone rock platform, covered with dense growths of the green algae *Enteromorpha* and *Ulva* (Figure 1). Here, *Lautoconus gambiensis* most probably feeds on the small polychaete worms that are so abundant in the nutrient-rich sediments at the mouth of the Gambia River.

Etymology. Named for the West African country of Gambia, to which this new species is endemic.

Discussion. With its fusiform narrow shape and high spire, *Lautoconus gambiensis* most closely resembles *L. senegalensis* Gulden, Moolenbeek, and Guld, 2017 from the Ndayane area of the Petit Cote of northern Senegal. The new Gambian species differs from its Senegalese congener in being proportionally wider across the shoulder, in having distinctly channeled shoulder whorls that are sculpted with four large, heavy spiral cords, and in having a proportionally higher spire with more protracting whorls. The shell colors are also very different between the two similarly-shaped shells, with *L. gambiensis* being an almost solid olive-green or khaki-green shell with scattered fine brown lines, while *L. senegalensis* is a pale sky-blue shell or blue shell that is copiously covered with a dense network of dark brown zig-zag flammules and numerous small brown dots, often aligned in two broad bands.

ISSN 0738-9388

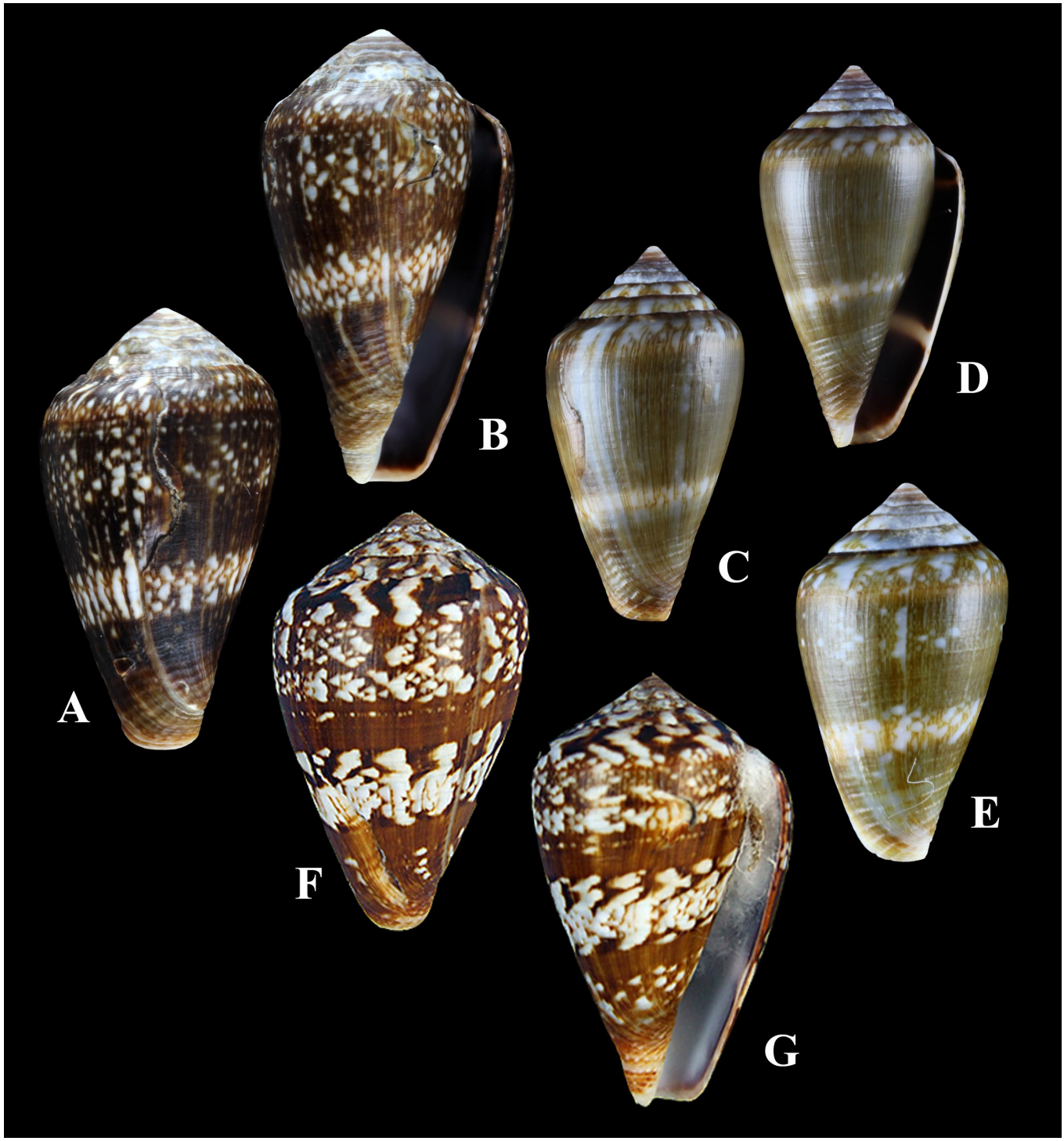

Figure 2. Gambian Cone Shells: *Lautoconus fernandi* and *Lautoconus gambiensis*
A, B= *Lautoconus fernandi* Petuch and Berschauer, new species, holotype, length 35.4 mm, MNHN IM-2000-34012; **C, D=** *Lautoconus gambiensis* Petuch and Berschauer, new species, holotype, length 21.6 mm, MNHN IM-2000-34013; **E =** *L. gambiensis* Petuch and Berschauer, new species,length 20.4 mm, in the collection of the junior author; **F, G=** *Lautoconus guinaicus* (Hwass, 1792), length 35.0 mm. All specimens were collected on the algae-covered rock platform off Tanji Beach, Gambia.

ISSN 0738-9388

Lautoconus rikae Petuch and Berschauer, new species
(Figure 3 A, B, C)

Description. Shell of average size for genus, around 24 mm, stocky, slightly turbinate, wide across shoulder, with low, domed, subpyramidal spire whorls; shoulder slightly angled, with sloping subsutural areas; body whorl smooth and silky, with 12-14 thin, closely-packed spiral cords encircling anterior end; shell color varying from solid blackish-brown to dark greenish-brown, with lighter bands present around shoulder and mid-body; large, widely-scattered amorphous pure white patches often scattered around body whorl; anterior tip pale orange-brown; spire whorls black or very dark brown, marked with widely-scattered large amorphous white patches; aperture uniformly narrow, deep purple within, marked with 2 thin white bands, one at posterior end and one at center; periostracum thin, smooth, translucent.

Type Material. HOLOTYPE - length 17.9 mm, width 9.8 mm, at low tide on an algae-covered rock platform, Tanji, Gambia, MNHN IM-2000-34014; OTHER MATERIAL EXAMINED - 2 specimens, lengths 23.4 mm and 21.2 mm, in the De Donder-Goethaels collection, Peutie-Vilvoorde, Belgium; 3 specimens, lengths 23.2 mm, 25.0 mm, and 26.1 mm, same locality as the holotype, in the research collection of the senior author; 3 specimens, lengths 23.6 mm, 24.3 mm, and 19.5 mm, same locality as the holotype, in the research collection of the junior author.

Type Locality. Found exposed at extreme low tide, on a rocky reef covered with dense growths of the green algae, off Tanji Beach, Gambia.

Distribution. Known only from the rock reefs near the mouth of the Gambia River, Gambia.

Ecology. The new species was found, exposed at low tide, in small pockets on an eroded sandstone rock platform, covered with dense growths of the green algae *Enteromorpha* and *Ulva* (Figure 1). Here, *Lautoconus rikae* most probably feeds on small polychaete worms that are abundant in the nutrient-rich sediments at the mouth of the Gambia River.

Etymology. Named for Rika Goethaels of Peutie-Vilvoorde, Belgium, who, along with Fernand De Donder, collected the type material of the four new species and who has greatly contributed to our knowledge of the mollusks of Gambia and West Africa.

Discussion. With its stocky, rotund shape, broad shoulder width, and low spire, *Lautoconus rikae* is similar only to the sympatric Gambian endemic, *Lautoconus orri* (Ninomiya and da Motta, 1982) (Figure 3 G, H). The new Gambian species differs from its sympatric congener in having a proportionally higher spire with more pyramidal-shaped whorls, in having a distinctly rounded shoulder with a more sloping subsutural area, and in being a more slender shell that is not as triangular and wide across the shoulder. *Lautoconus rikae* also differs from *L. orri* in being a much more darkly-colored shell, being mostly solid dark brown, blackish-brown, or dark khaki, and lacking a complex netted pattern, having, instead, scattered large white flammules.

Lautoconus wolof Petuch and Berschauer, new species
(Figure 3 D, E, F)

Description. Shell of average size for genus, around 23 mm, stocky, rotund, turbinate, wide across shoulder, with broadly subpyramidal spire; shoulder angled, with subsutural area sloping; body whorl smooth and silky, with 12

ISSN 0738-9388

thin spiral cords encircling anterior end; spire whorls sculptured with 4 very fine spiral cords; base shell color dark blue or bluish-green, overlaid with variable amounts of large dark brown or black amorphous longitudinal flammules, most often arranged in 2 wide bands, one around mid-body and one around anterior end; 10-12 spiral rows of dots and dashes present on some specimens, being most prominent on blue areas of body whorl; aperture uniformly narrow, dark purple-black within interior, with 2 thin white bands present; periostracum thin, smooth, translucent.

Type Material. HOLOTYPE - length 21.1 mm, width 12.0 mm, at low tide on an algae-covered rock platform, Tanji, Gambia, MNHN IM-2000-34015; OTHER MATERIAL EXAMINED - 2 specimens, lengths 21.0 mm and 18.8 mm, from the same locality as the holotype, in the De Donder-Goethaels collection, Peutie-Vilvoorde, Belgium; specimens, lengths 19.0 mm, 21.1 mm, and 22.0 mm, from the same locality as the holotype, in the research Collection of the senior author; 2 specimens, lengths 26.4 mm, and 23.9 mm, same locality as the holotype, in the research collection of the junior author.

Type Locality. Found exposed at extreme low tide, on a rocky reef covered with dense growths of the green algae, off Tanji Beach, Gambia.

Distribution. Known only from the rock reefs near the mouth of the Gambia River, Gambia.

Ecology. The new species was found, exposed at low tide, in small pockets on an eroded sandstone rock platform, covered with dense growths of the green algae *Enteromorpha* and *Ulva* (Figure 1). Here, *Lautoconus wolof* most probably feeds on small polychaete worms that are abundant in the nutrient-rich sediments at the mouth of the Gambia River.

Etymology. The taxon, proposed as a noun in apposition, honors the Wolof people, and the Wolof Language, of Senegal and Gambia.

Discussion. Of the known West African *Lautoconus* species, *L. wolof* is most similar, in shape and general form of the color pattern, to *L. pineaui* (Pin and Tack, 1989), from the Popenguine area in the Petit Cote region of Senegal. The new Gambian endemic species differs from its northern congener in being consistently a smaller and more slender shell, in having a narrower shoulder area that is less angled, in having a proportionally higher spire with more sloping spire whorls, and in being a much more darkly-colored shell, having closely-packed dark brown or black longitudinal flammules and spiral rows of dots and dashes on a dark blue background. The Senegalese *L. pineaui* is a much lighter-colored shell, most often having a pale pinkish-tan or pale blue base color overlaid with widely-scattered large reddish-brown flammules. In having the blue base color, spiral rows of dots and dashes, and large black flammules on the spire whorls, *L. wolof* also resembles *L. echinophilus* (Petuch, 1975) from sea urchin beds in the N'Gor region of the Cape Verde Peninsula, Senegal. The new Gambian cone differs from its urchin-dwelling northern congener in being a larger, broader, and more inflated species, in having a better-defined and angled shoulder, and in having larger, darker, and more numerous color patches on the spire whorls. The ecologies of the two congeners also differ greatly, with *L. wolof* living on an algae-covered rock platform in quiet water conditions, while *L. echinophilus* lives under rock-boring sea urchins in high surf areas along the open coast (see Petuch, 1975 for a description of the ecology of *L. echinophilus*).

ISSN 0738-9388

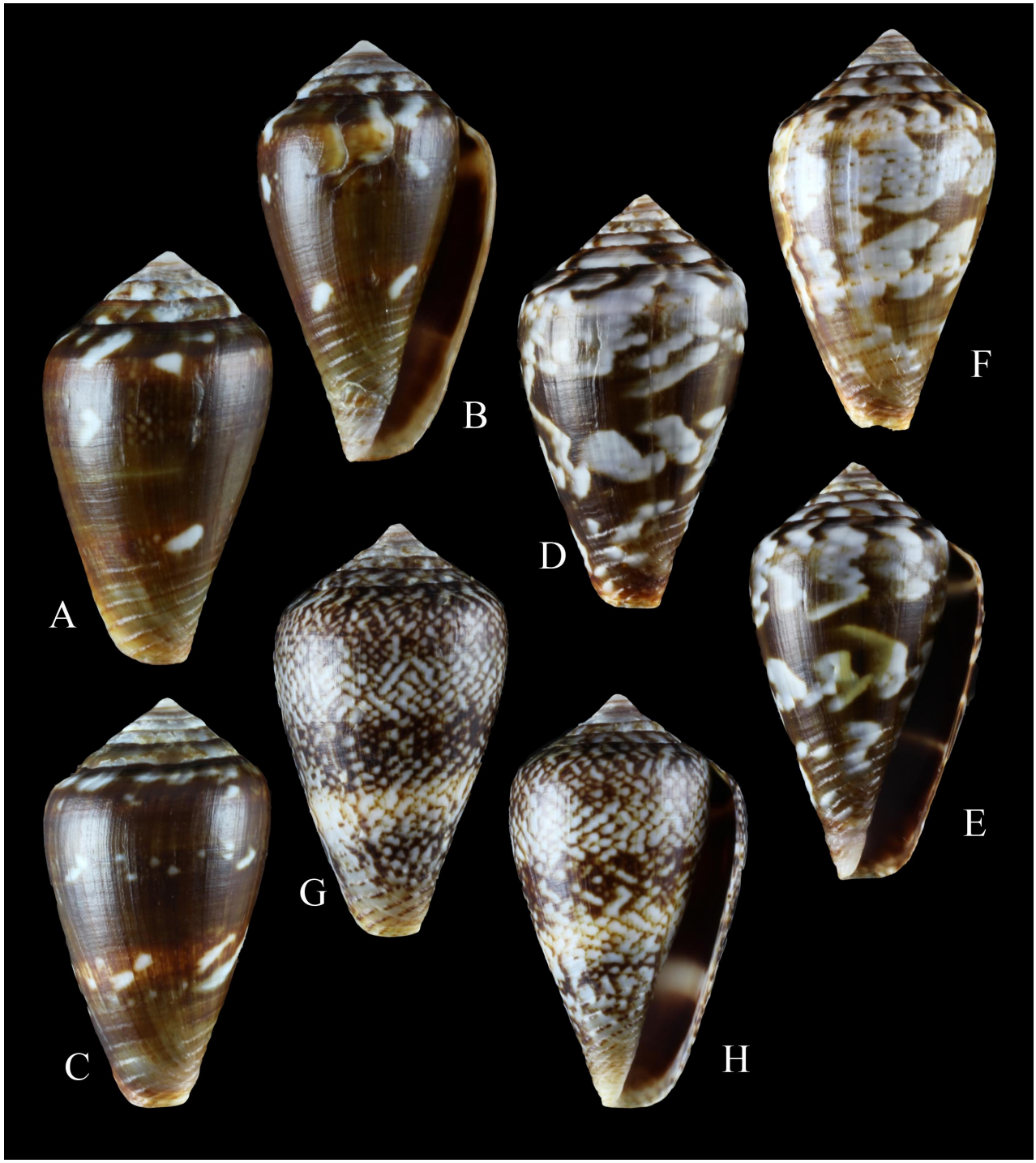

Figure 3. Gambian Cone Shells: *Lautoconus rikae*, *Lautoconus wolof*, and *Lautoconus orri.*
A, B = *Lautoconus rikae* Petuch and Berschauer, new species, holotype, length 17.9 mm, MNHN IM-2000-34014; **C =** *L. rikae* Petuch and Berschauer, new species, length 19.6 mm in the collection of the junior author; **D, E=** *Lautoconus wolof* Petuch and Berschauer, new species, holotype, length 21.1 mm, MNHN IM-2000-34015; **F =** *L. wolof* Petuch and Berschauer, new species, length 26.7 mm in the collection of the junior author; **G, H=** *Lautoconus orri* (Ninomiya and da, Motta, 1982) length 29.1 mm in the collection of the junior author. All specimens were collected on the algae-covered rock platform off Tanji Beach, Gambia.

ISSN 0738-9388

ACKNOWLEDGMENTS

For the donation of multiple study specimens, macrophotographic images and measurements of hundreds of specimens, for the collection of type material of the new species, and for sharing information about the marine environments of Gambia, we thank Fernand De Donder and Rika Goethaels; without their generosity and kindness, this paper would never have come to fruition. We also thank our reviews for their thorough consideration of the manuscript.

REFERENCES

Abalde, S., Tenorio, M.J., Afonso, C.M.L.A. & Zardoya, R. 2017. Mitogenomic phylogeny of cone snails endemic to Senegal. Molecular Phylogenetics and Evolution 112:79-87. DOI: 10.1016/j.ympev.2017.04.20

Monteiro, A., M.J. Tenorio, and G.T. Poppe. 2004. The Family Conidae: The West African and Mediterranean Species of *Conus*. *In* A Conchological Iconography. ConchBooks, Hackenheim, Germany. 99 pp, 164 plates.

Petuch, E. J. 1975. Two New Cone Species from Senegal, West Africa. The Veliger 18(2):178-181.