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New Fossil Harpidae from Southeastern Australia

Angus Hawke [1] & Sebastien Guyonneau [2]
Melbourne, Victoria, Australia - angushawke@hotmail.com
Le Verdon, France - okhaen@outlook.com

ABSTRACT This study provides a taxonomic description of two new species of fossil Harpidae from the the Bioclastic limestones of the Roe Calcarenite South Western Australia, which is late Pliocene to early Pleistocene in age (2.59 - 1.81 Ma). The new species *Austroharpa pasi* and *Morum solus* have been compared to their congeners and evolutionary aspects discussed.

KEYWORDS Mollusca, gastropoda, new species, fossil, *Austroharpa*, *Austroharpa pasi, Morum*, *Morum solus,* Pliocene, Miocene, Australia

INTRODUCTION

The Roe Calcarenite is a late Pliocene to early Pleistocene limestone formation on the Roe Plains of southeastern Western Australia and is renowned for its rich assemblage of fossilised shells, particularly Gastropods. The species within this formation are typical of warm, shallow marine conditions and would have been influenced by the strong Leeuwin Current. (McNamara & Kendrick, 1994) According to the West Australian Museum, the Roe Calcarenite contains nearly 600 species of molluscs, predominantly gastropods and bivalves. Of these species, approximately two-thirds are extant. Many of the species now found in the Roe Calcarenite now inhabit warmer northern waters, indicating a likely historical shift in marine biogeography, associated with climatic and oceanographic changes during the Late Pliocene. While most of the species within the Roe Calcarenite have been described, a number of rarer taxa remain undocumented in the scientific literature. This study examines two previously undescribed species within the family Harpidae, which is a small group of predatory marine gastropods within the order Neogastropoda and encompass three extant Australian genera: *Harpa*, *Morum*, and *Austroharpa*. The genus *Harpa* includes the largest and most vividly coloured species, predominantly distributed across the Indo-Pacific and tropical Atlantic Oceans. The genus *Morum* was initially classified within the family Cassidae, although it was re-evaluated based on anatomical characteristics, leading to its reclassification under Harpidae. *Morum* typically inhabit marine environments ranging from intertidal zones to depths of several hundred meters and are usually found on or near hard substrates, with most species preferring depths exceeding 50 metres. *Morum* are distributed across various tropical and subtropical marine regions worldwide, although in Australia they are generally restricted to the tropical waters of Northern Australia. Fossil species of *Morum* in Australia are not well known and appear to be restricted to the Bass, Eucla and Otway Basins. The last genus in the group is *Austroharpa*, which are endemic to Australian waters, with extant species mostly inhabiting deep marine environments along the southern coast of Western Australia, extending eastward to southern Queensland. Fossil records of *Austroharpa* are found in the Eucla, Murray, Otway, Bass, and Gippsland Basins, with stratigraphic occurrences ranging from the Late Oligocene to the Pliocene epochs. Adult shells typically range between 20 and 60 mm in

length and are characterized by a large, paucispiral, bulbous protoconch and axial ribs that exhibit minimal curvature near the suture. The prominent protoconch suggests a non-planktotrophic mode of larval development, indicating direct development without a free-swimming larval stage. Despite their distinctive morphology, the ecological roles and life history strategies of *Austroharpa* species remain poorly understood. It is hypothesised that fossil species occupied ecological niches analogous to those of their extant counterparts. In general, most of the species are scarce, with the exception of two fossil species, *Austroharpa kendricki* Ludbrook, 1978 and to a lesser degree *Austroharpa spiralistriata* Ludbrook, 1978 from the Eucla Basin of south Western Australia. Contemporary malacological research often focuses exclusively on either extant or fossil taxa, with limited integrative studies bridging the two. Since the description of *A. kendricki***,** there has been a paucity of taxonomic revisions of fossil Harpidae, from Australia, underscoring the need for comprehensive studies that integrate morphological, ecological and molecular data to elucidate the evolutionary history and systematics. The evolutionary trajectory of both *Morum* and *Austroharpa* during the Cenozoic era in southeastern Australia is obscured by preservation biases within the fossil record which is attributable to fossil bearing outcrops of a particular age being well represented, while others are non-existent. For instance, there are no noteworthy deposits of early to middle Eocene in south-eastern Australia, so this essentially represents a considerable gap in our knowledge. Another issue is the different environments in which the fossils bearing outcrops have formed. For example, if the fossil bearing horizons were formed in shallow water, then presumably the assemblage of species would exclude deeper water species and vice versa. Fossil evidence indicates that both *Morum* and *Austroharpa* underwent a diversification event during the early Miocene, achieving peak species richness in the Middle Miocene, a period characterized by elevated global temperatures. Subsequent global cooling commencing around 14.5 million years ago, known as the Middle Miocene Disruption, coincided with widespread extinctions and biogeographic shifts, likely contributing to a decline in species diversity around this time and shift in geographical distributions. Late Miocene records for *Austroharpa* are very rare; however, it is plausible that additional species existed during this interval, given the presence of multiple descendant species in contemporary southern Australian waters.

MATERIALS AND METHODS

The authors have examined specimens from museums and private collections and additional material was obtained from field research 2009-2025. Mature, adult specimens were used for morphometric analysis and to evaluate key characteristics. The following measurements were taken; shell length, width and height. In the absence of soft-bodied anatomical characters, molecular data and colour pigmentation, this taxonomic study is primarily based on three types of evidence. These are: a) morphological (*i.e.*, what characters can be used to differentiate between distinct taxa), b) spatial (*i.e.*, to what extent does the geography influence evolutionary relationships), and c), temporal (*i.e*., to what extent can supposed age differences between deposits inform of evolutionary changes).

SYSTEMATICS

Superfamily Neogastropoda (incertae sedis)
Family Harpidae Bronn, 1849
Genus *Austroharpa* H. J. Finlay, 1931
Type species: *A. pulligera* Tate, 1889

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Austroharpa pasi Hawke & Guyonneau, n. sp**.**
(Plate 1, Figures 1 to 12)

Figure 1. *Austroharpa pasi* Hawke & Guyonneau, n. sp**.**

Description. Solid shell, small for genus, typically 22-25 mm, sub-pyriform to broadly ovate shape, tapering to a narrow anterior, unequally biconical, short-stepped spire, usually 20% of the length of shell, smooth convex rounded paucispiral protoconch, consisting of 1½ whorls, 3 whorls in teleoconch. Shoulder angulate to sub-angulate with slightly flattened subsutural ramps. 12 to 14 strong to moderate axial ribs on outer whorl, fading towards the siphonal canal. Slightly spinose at shoulder, parietal callus thin narrow or absent. Some specimens with denticles in aperture, although usually without. Intercostal space smooth on upper ¾ of shell, spiral striae present on lower ¼ of shell. Umbilicus absent on anterior canal, small anal notch on posterior canal. Moderately deep siphonal canal. Curvature of neck moderate, lip thick reflected.

Type Material. Plate 1

Holotype 1 a-b: Holotype - 27.0 mm (L), 19.8 mm (W), (WA Museum - 2025.357).

2 a-b: 26.3 (L), 19.4 (W) © G. & P. Poppe.

3 a-b: 24.0 mm (L), 17.5 mm (W), 14.0 mm (H). Hawke collection.

4 a-b: 23.3 mm (L), 16.3 mm (W), 13.0 mm (H). Guyonneau collection.

5 a-b: 27.6 mm (L), 20.3 mm (W), 16.1 mm (H). Guyonneau collection.

6 a-b: 26.3 mm (L), 19.3 mm (W), 14.9 mm (H). Guyonneau collection.

7 a-b: Johan Pas collection.

8 a-b: 26.0 mm (L), 19.0 mm (W), 14.0 mm (H). © Naturalis RGM.SSS.34596.c

9 a-b: 29.0 mm (L), 20.0 mm (W), 15.0 mm (H). © Naturalis RGM.SSS.34596.b

10 a-b: 30.5 mm (L), 21.4 mm (W) mm © G. & P. Poppe.

11 a-b: Johan Pas collection.

12 a-b: Johan Pas collection.

Distribution. Known only from the bioclastic limestones of the Roe Calcarenite of SW Australia, late Pliocene to early Pleistocene 2.59 - 1.81 Ma. (Refer to Map 1).

Etymology. Named in honour of Johan Pas, who kindly provided specimens for us to study.

Discussion. *Austroharpa pasi* n. sp. is a distinctive species, which is restricted to the Roe Calcarenite deposits of south Western Australia. It is much scarcer than other fossil *Austroharpa* from the same region which may explain why it has been overlooked until now. Barry Wilson illustrated a specimen of *Austroharpa pasi* n. sp, in the December 1992 issue of World Shells, stating the location as Roe Plains. While he recognised it as a different species to *A. kendricki*, he mistakenly referred to it as *Austroharpa cassinoides* (Tate, 1889), which is an extremely rare species known only from SA. While *A. cassinoides* is similar in appearance, it can easily be separated from *Austroharpa pasi* n. sp. by way of larger size, less robust shell, and additional rows of sub-spinose nodes on the shoulder. *Austroharpa pasi* n. sp. also superficially resembles *A. kendricki*, which is a sympatric species from the same area, although it can be easily separated by the smaller in size, sub-pyriform shape; compared to the narrower obovate shape in *A. kendricki* (Plates 2-4). The axial ribs are also much stronger and usually less numerous in *Austroharpa pasi* n. sp.

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Typically 12 to 14 axial ribs, compared to 16 to 17 in *A. kendricki*. Other distinguishing features of *Austroharpa pasi* n. sp. include the broader, sub-spinose shoulder, with a short-stepped spire, which is notably taller and not as stepped in *A. kendricki*. The upper two thirds of the body whorl in *Austroharpa pasi* n. sp. lack the transverse spiral lirae running perpendicular to the axial ridges and the protoconch is also much smaller (Table 1). The results of our study along with the morphometric analysis show little variation in this species and no evidence of intergrades with *A. kendricki*. It also suggests the likely path of evolution for *Austroharpa pasi* n. sp. is: - *Austroharpa pachycheila* (Tate, 1893) → *Austroharpa clathrata* (Tate, 1889) → *A. cassinoides* → *Austroharpa pasi* n. sp.

	A. kendricki	***A. pasi,*** n. sp.	***A. cassinoides***
Typical Size (mm)	30 to 35	20 to 25	28 to 35
Shape	Obovate	Sub-pyriform to broadly ovate	Sub-pyriform
Thickness of shell	Moderate to thick	Thick	Moderate
Spire	Moderately tall, somewhat pointed	Short, subangulate	Short
Number of axial ribs	15-18	12-13	11-12
Body whorl sculpture	Middle and lower half of body whorl contain transverse spiral lirae	Upper two thirds of the body whorl lack any transverse spiral lirae	Upper body whorl contains 3 equal transverse spiral lirae
Typical expression of shoulder nodules	Weak to strong prominent shoulder nodules	Strong prominent shoulder nodules	Additional rows of sub-spinose nodes on the shoulder
Curvature of the neck	Shallow to moderate	Shallow	Shallow
Typical expression of axial ridges	Moderate, sharp	Strong, smooth	Strong, moderately sharp
Denticles on columella callus	Present in some specimens	Present in some specimens	Absent

Table 1. Comparison table of Roe Plains species.

However, *A. kendricki* and *A. learorum* Hart & Limpus, 1998, possibly belongs to this clad, although the exact nature of their evolutionary relationship requires further investigation.

SYSTEMATICS

Superfamily Neogastropoda (incertae sedis)
Family Harpidae Bronn, 1849
Genus *Morum* Röding, 1798
Type species: *M. purpureum* Röding, 1798

Morum solus Hawke & Guyonneau, n. sp.
(Plates 6-8)

Figure 2. *Morum solus* Hawke & Guyonneau, n. sp.

Description. Solid shell, small for genus, typically 20 mm. Sub-pyriform shape, tapering to a narrow anterior. Unequally biconical, short-stepped spire, usually 15-20% of the length of shell. Smooth convex rounded paucispiral protoconch, consisting of 1-1½ whorls, 3-4 whorls in teleoconch. Shoulder angulate to sub-angulate with slightly flattened subsutural ramps. Body whorl exhibits 12 to 14 strong to moderately developed axial ribs intersected by approximately eight prominent primary spiral cords, each primary spiral cord is flanked by one to two secondary, finer spiral threads, resulting in the appearance of up to 24 narrower spiral elements across the shell surface. Shoulder slightly spinose, with nodules formed at the intersections of axial ribs and spiral cords. The aperture is slender and narrow with a reflected outer lip. Parietal callus is thin, narrow, or occasionally absent, presenting as a subtle glaze over the parietal wall. Denticles may be present within the aperture in some

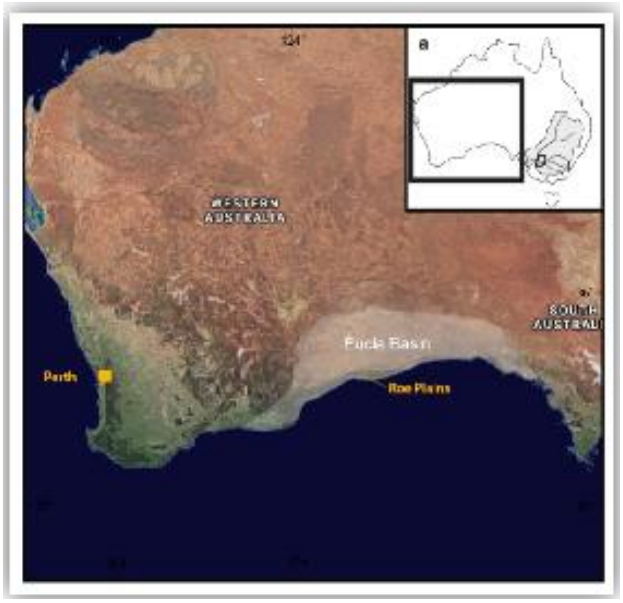
specimens. Siphonal canal is shallow, lacks an umbilicus. Slight curvature in neck, contributing to the overall shell profile.

Type Material.

Holotype 37.5 mm (L), 20.0 mm (W), (WAM 89.732)
Paratype 23.3 mm (L), 16.3 mm (W), AHC
Paratype 22.7 mm (L), 13.4 mm (W), (WAM 80.130)
Paratype 21.6 mm (L), 13.1 mm (W), (WAM 81.027).

Distribution. Known only from the Roe Calcarenite SW Australia, late Pliocene early to Pleistocene 2.59 - 1.81 Ma. (Refer to Map 1).

Etymology. Solus: Meaning "alone," "only," or "single." Refers to the species being the sole representative of the genus in Southern Australia.



Map 1. Location of Bioclastic limestones of the Roe Calcarenite SW Australia, which is late Pliocene to early Pleistocene 2.59 - 1.81 Ma.

Discussion. *Morum solus* n. sp. is a very rare species that is currently recognized as the only known representative of the genus in southern Australia during the Pliocene and Pleistocene epochs. Morphologically, it exhibits the closest affinity to *Morum lorenzi* D. Monsecour, 2011, a species endemic to the Cargados Carajos Shoals (St. Brandon) in the western Indian Ocean. However, *Morum solus* n. sp is distinguishable by its more robust shell, pronounced axial ridges intersected by prominent spiral cords and the development of more spinose nodules at these intersections. Plate 5 shows a side-by-side comparison of *M. solus* and *M. lorenzi*. There are no extant species of *Morum* in southern Australia, although fragmentary specimens of a related species have been recovered from the Batesford Quarry in Victoria, suggesting a broader historical distribution of the genus in the region.

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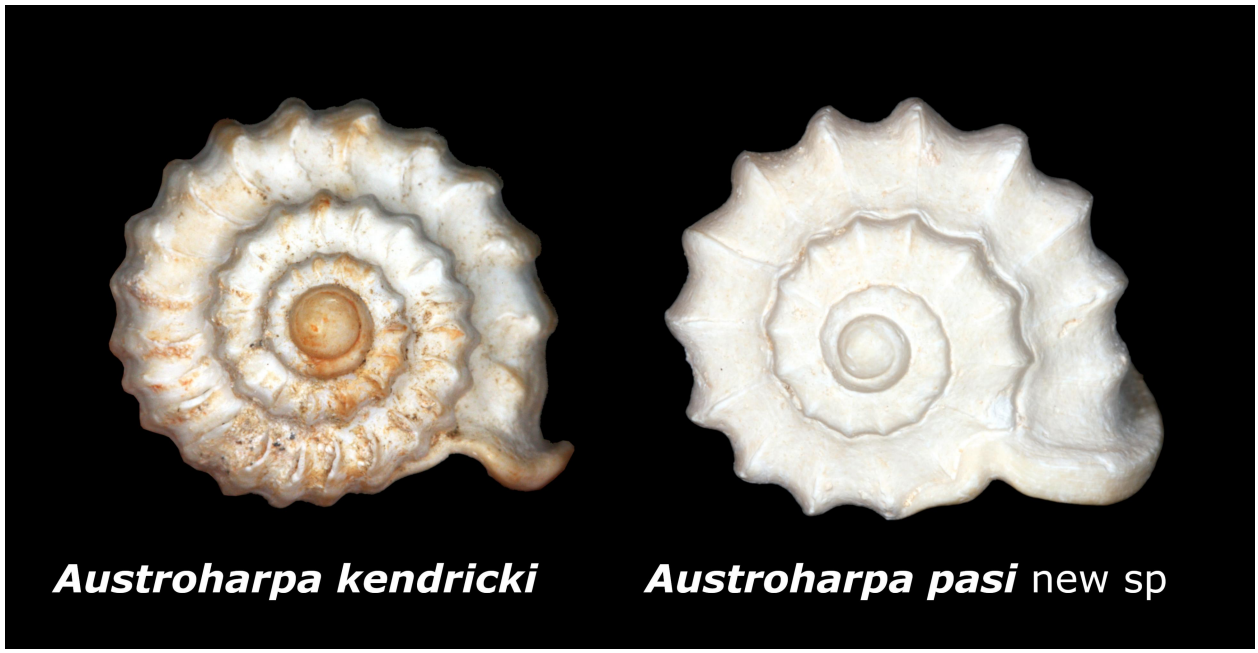

Plate 4. Spire comparison: - Left *Austroharpa kendricki*. - Right *Austroharpa pasi* n. sp.

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Plate 1. Figures 1-12 *Austroharpa pasi* n. sp. (Holotype Figure 1a – 1b).

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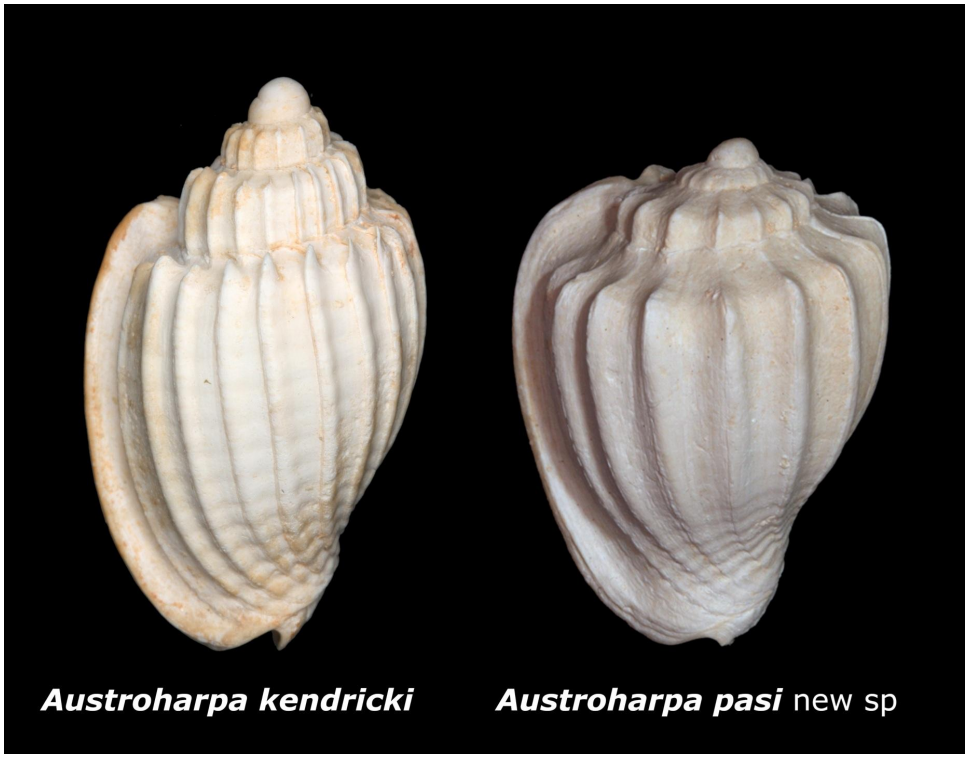

Plate 2. Dorsum comparison: - Left *Austroharpa kendricki*. - Right *Austroharpa pasi* n. sp.

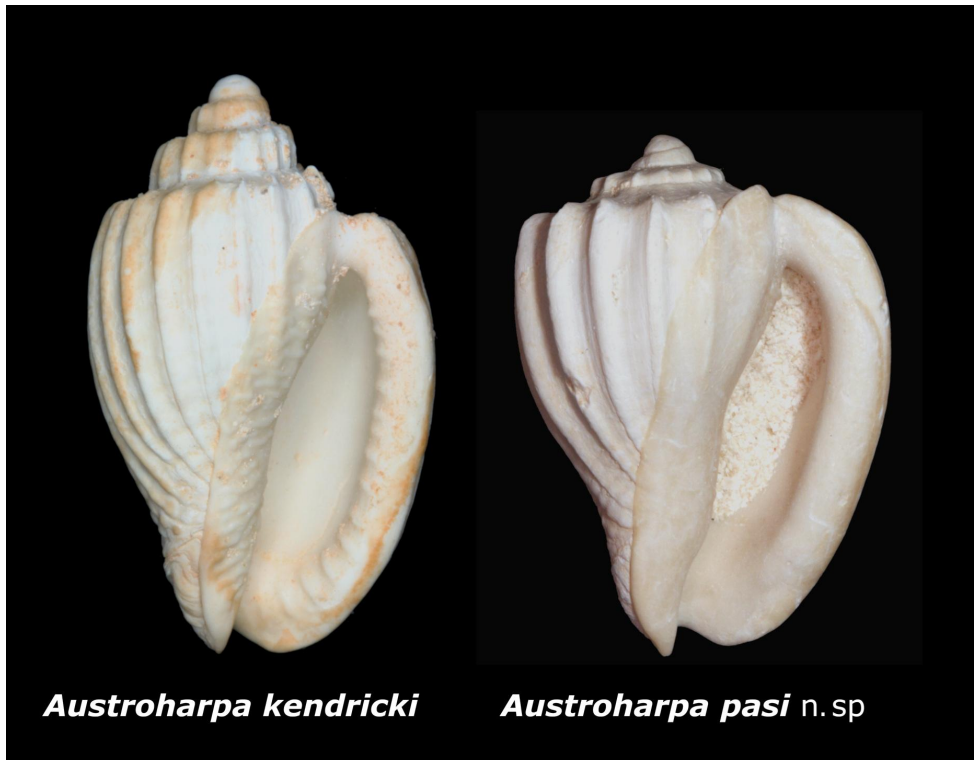

Plate 3. Ventrum comparison: - Left *Austroharpa kendricki*. - Right *Austroharpa passi* n. sp.

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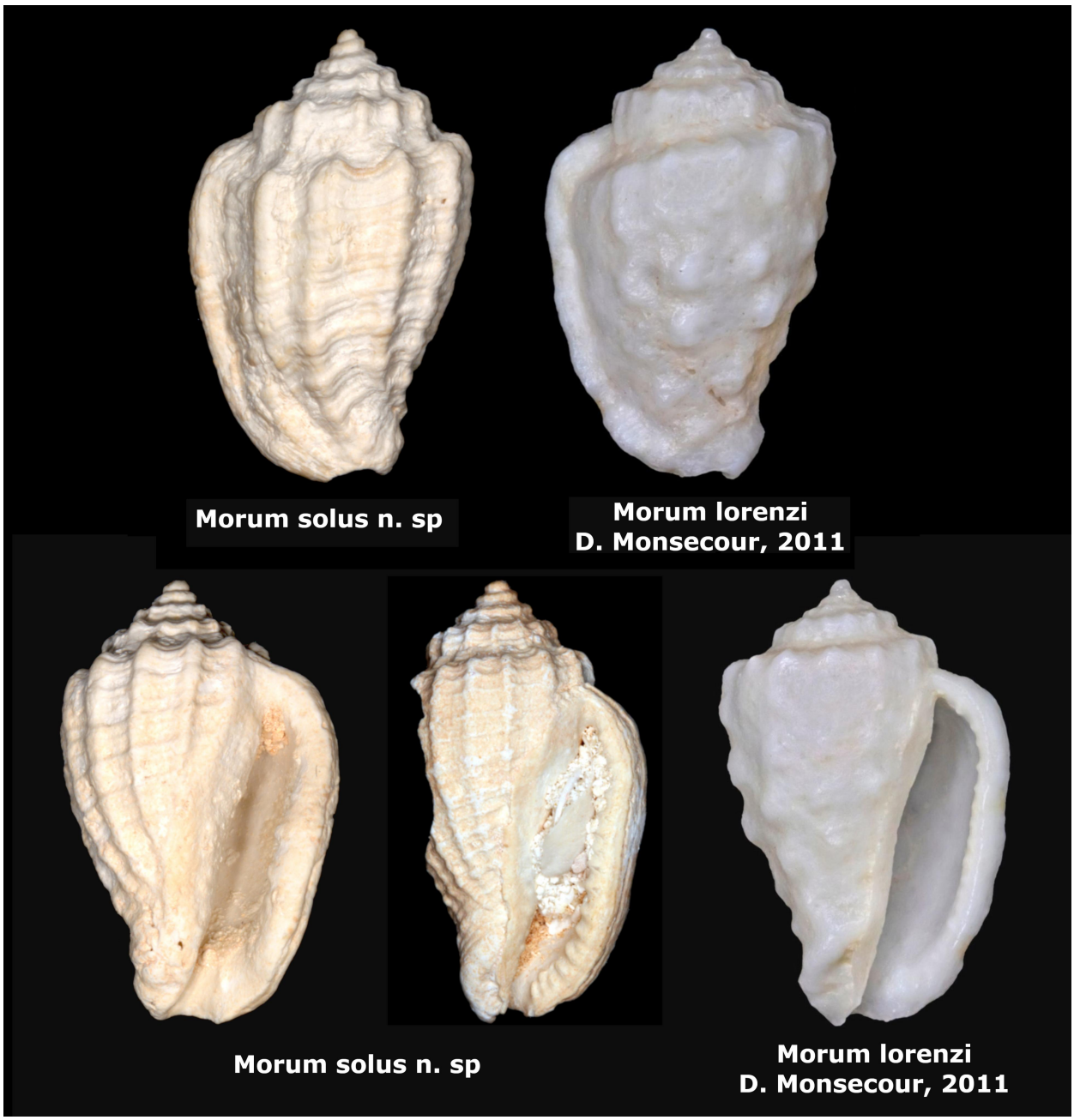

Plate 5. Comparison: - Left *Morum solus* n. sp. Paratype 1 & 4 - Right *Morum lorenzi.*

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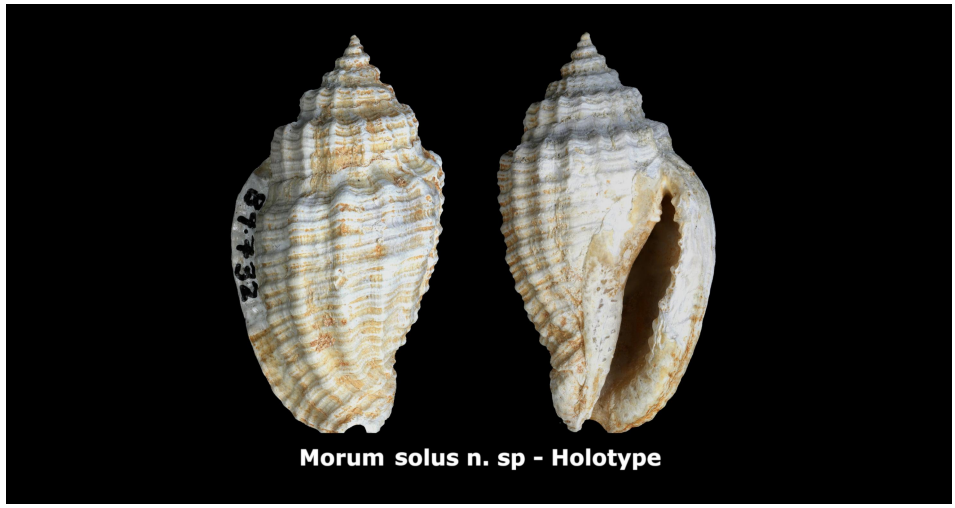

Plate 6. *Morum solus* n. sp. Holotype (WAM 89.732).

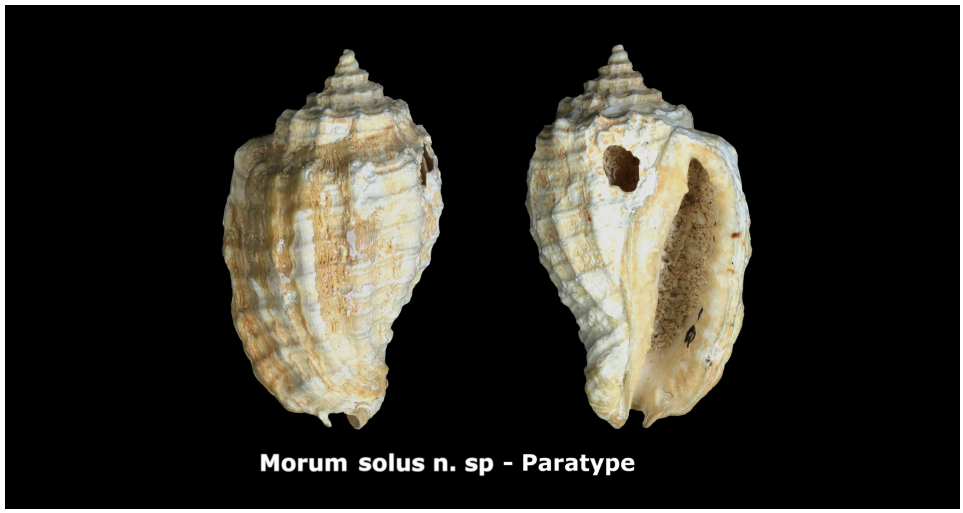

Plate 7. *Morum solus* n. sp. Paratype 3 (WAM 80.130).

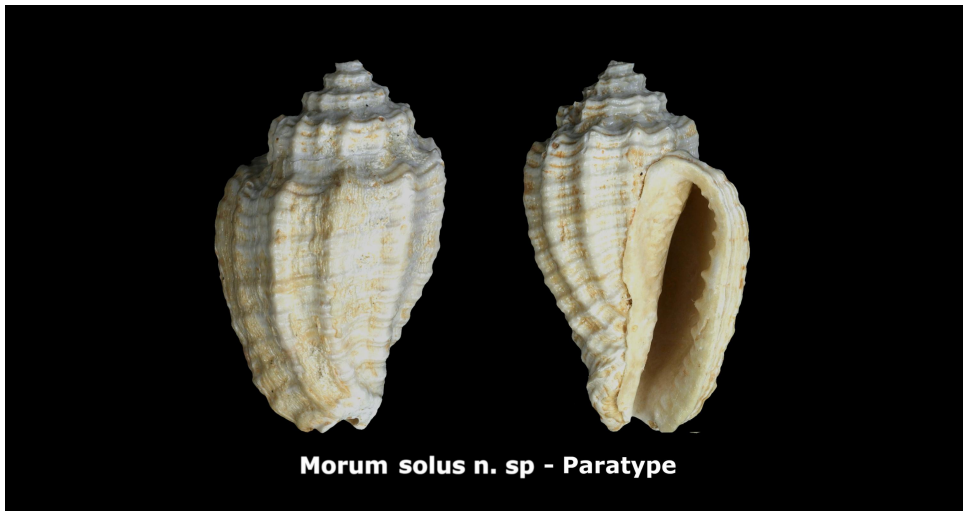

Plate 8. *Morum solus* n. sp. Paratype 4 (WAM 81.027)..