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ABSTRACT

A new record of a rare deep-water scorpionfish *Ectreposebastes niger* (Fourmanoir, 1971), is described from the south-western Indian Ocean. This is the ninth record in the Indian Ocean and the first documented record of this species in the waters of Reunion Island. It is also the first record of this species in the Indian Ocean since 1982. Its congener, *Ectreposebastes imus* Garman, 1899 is more common: together with non-published records from museums and online databases the number of verified Indian Ocean records exceeds 15 individuals. Both species are pseudo-oceanic, usually associated with continental and peri-insular slopes and seamounts between 200 and 1300 m depth, occupying a wide range of habitats from demersal to pelagic in the meso- and bathypelagic zones.

RÉSUMÉ

Nouvelle signalisation d'Ectreposebastes niger (Fourmanoir, 1971) (Setarchidae, Scorpaeniformes) : un rare poisson bathypélagique du mont sous-marin La Pérouse, océan Indien occidental, et répartition d'*Ectreposebastes* Garman, 1899 dans l'océan Indien.

Le rare poisson pélagique *Ectreposebastes niger* (Fourmanoir, 1971) est nouvellement signalé du sud-ouest de l'océan Indien, près de l'île de la Réunion. Il s'agit de la neuvième signalisation dans l'océan Indien, la première dans les eaux de l'île de la Réunion, et la première dans l'océan Indien depuis 1982. L'espèce congénérique *Ectreposebastes imus* Garman, 1899 est plus commune : 15 individus sont mentionnés dans l'océan Indien après analyse de la littérature scientifique, des collections de musées et/ou des bases de données en ligne. Les deux espèces sont pseudo-océaniques étant normalement associées avec les pentes continentales et péri-insulaires et les monts sous-marins entre 200 et 1300 m de profondeur, où elles occupent une large gamme d'habitats démersaux à semi-pélagiques dans les zones méso- et bathypélagiques.

KEY WORDS

Deepwater habitat,
pseudo-oceanic species,
pelagic occurrence,
fish morphology,
otoliths,
genetic analysis,
new record.

MOTS CLÉS

Habitat en eau profonde,
espèce pseudo-océanique,
signalisation pélagique,
morphologie des poissons,
otolithes,
analyse génétique,
signalisation nouvelle.

INTRODUCTION

The pelagic scorpionfish *Ectreposebastes niger* (Fourmanoir, 1971) is a rare deep-water species that inhabits meso- and bathypelagic environments in the Pacific and Indian Oceans (Fourmanoir 1971; Paulin 1982; Mandrytsa 1990; Allen *et al.* 2006; Motomura & Struthers 2015). Biology, ecology, habitat and geographic distribution of *E. niger* are still poorly known. This species occasionally occurs in catches of mid-water and demersal trawls deployed during commercial and research fishing operations. It was identified and described relatively recently by Fourmanoir (1971) as *Pontinus niger*. Its validity, however, was immediately challenged: Collette & Uyeno (1972) synonymized *P. niger* with *Ectreposebastes imus* Garman, 1899. While doubts on the identity of *E. niger* and *E. imus* were expressed by Eschmeyer & Randall (1975) and by Paulin (1982) (the latter referring to W. N. Eschmeyer pers. comm), the validity of *P. niger* was re-established some 20 years later (Mandrytsa 1990) preserving its place in the genus *Ectreposebastes* Garman, 1899 (WoRMS Editorial Board 2020). Hence, the genus currently includes two closely-related species: *E. imus* Garman, 1899 (midwater scorpionfish) and *E. niger*. Scale size and counts as well as proportions of body depth, caudal peduncle, dorsal and pectoral fins, and preopercular spine size are the few morphological characters that allow these species to be distinguished from each other (Eschmeyer & Randall 1975; Mandrytsa 1990).

Ectreposebastes imus was considered as a single valid species between 1972 and 1990. Therefore, most records of *E. imus* reported during that period may represent either of the two species.

The midwater scorpionfish *E. imus* is relatively common but not abundant: numerous records of a single or few individuals are known throughout the global oceans from temperate and tropical waters (Eschmeyer & Collette 1966; Eschmeyer & Randall 1975; Fourmanoir 1976; Moser *et al.* 1977; Eschmeyer 1986; Mandrytsa 1990; Poss & Eschmeyer 2002; Bianchi *et al.* 2004; Balanov *et al.* 2009; Escáñez & Brito 2011; Hashim 2012; Govindam *et al.* 2013; González *et al.* 2014; Froese & Pauly 2019; Eduardo *et al.* 2019). However, because of the similarity between *E. niger* and *E. imus*, their synonymisation in the past, and as the re-establishment of *E. niger* was published in Russian (Mandrytsa 1990), which may have delayed the recognition of *E. niger*'s validity, the distribution and habitat of both species remain obscure at least in the Indo-Pacific.

In the Indian Ocean, both species are known from a few published records. Three individuals of *E. niger* were reported as *Ectreposebastes* sp. from the Mozambique Channel and Saya-de-Malha Bank by Scherbachev *et al.* (1978), and four other individuals from the Saya-de-Malha Bank and the eastern Indian Ocean by Mandrytsa (1990) (Fig. 1).

Similarly, two specimens of *E. imus* were reported from the Saya-de-Malha Bank and the eastern Indian Ocean by Mandrytsa (1990). Two other individuals from the Arabian Sea and the Bay of Bengal were indicated by Hashim (2012) and two individuals from the Andaman Sea were described by

Kawai *et al.* (2017). Non-georeferenced sources mentioned the presence of this species off Indonesia (Pauly *et al.* 1996) and along the south-west coast of India (Govindam *et al.* 2013).

Here we describe a new record of *E. niger* from the pelagic zone of the tropical southwestern Indian Ocean. Then, we discuss the regional distribution and habitat of both *E. niger* and *E. imus* based on published data, museum collection inventories accessible from online databases, and other online sources. We also present the first description of otolith shape for *E. niger* and results of genetic sequencing of this species.

MATERIAL AND METHODS

One individual of *Ectreposebastes niger* (183 mm total length (TL); 165 mm standard length (SL) (Fig. 2) was caught on 18 September 2016 in a midwater trawl by the *R/V Antea* during the LA PÉROUSE research cruise (<https://doi.org/10.17600/16004500>). The authors were onboard during the capture, collecting fishing and environmental data, and preserved the specimen. The capture position lay between 19°45.84'S, 54°05.28'E and 19°41.43'S, 54°03.80'E (respectively start and end positions of trawling). This midwater trawl was operated in the proximity of La Pérouse Seamount, a steep underwater topographic feature of the southwestern Indian Ocean with an average minimum depth of about 60 m, a crescent-like shape and a length of 12 km along its largest extension (Marsac *et al.* 2020). The seamount is situated at 90 nautical miles (nmi) (c. 160 km) northwest of the Reunion Island, France (Fig. 1).

The research midwater trawl was an 'International Young Gadoid Pelagic Trawl' (YGPPT) with a horizontal opening of 15.8 m and a vertical opening of 8 m. A cod-end of 5 mm stretched mesh was used. The trawl was towed horizontally at 3 knots (c. 1.5 m s⁻¹) with a target fishing depth of 500 m, although the range of fished depths was 485–590 m during the set that captured the specimen. The tow was performed between 17:46 (trawl at fishing depth) and 18:55 (trawl at the surface) local time (GMT+3) with total duration 69 min.

Sea surface temperature (SST) measured during vertical profiling of the water column with CTD probe was 23.6°C, and the temperature at 500 m depth was 10.4°C.

The ocean floor topography (Marsac *et al.* 2020) shows that the trawl haul was performed over the depths 1400–3000 m at a distance of less than 8 nmi (c. 15 km) west of La Pérouse seamount.

The fish was photographed on board (Fig. 2) with a Nikon D7100 digital camera, resolution 24 Mpx, and TL and SL were measured. Otoliths were extracted onboard, cleaned and stored dry separately. After measurement, the specimen was stored frozen at –18°C for c. 90 days, then was thawed for 12 hours before examination. After measurements, weighing and sampling (muscle samples were taken for DNA analysis) the fish was preserved in 10% neutral buffered formaldehyde for 48 hours, soaked in freshwater for 4 hours and transferred to 70% ethanol. The specimen was deposited in the collection of the Museum national d'Histoire naturelle, Paris (catalogue number MNHN-IC-2019-0078).

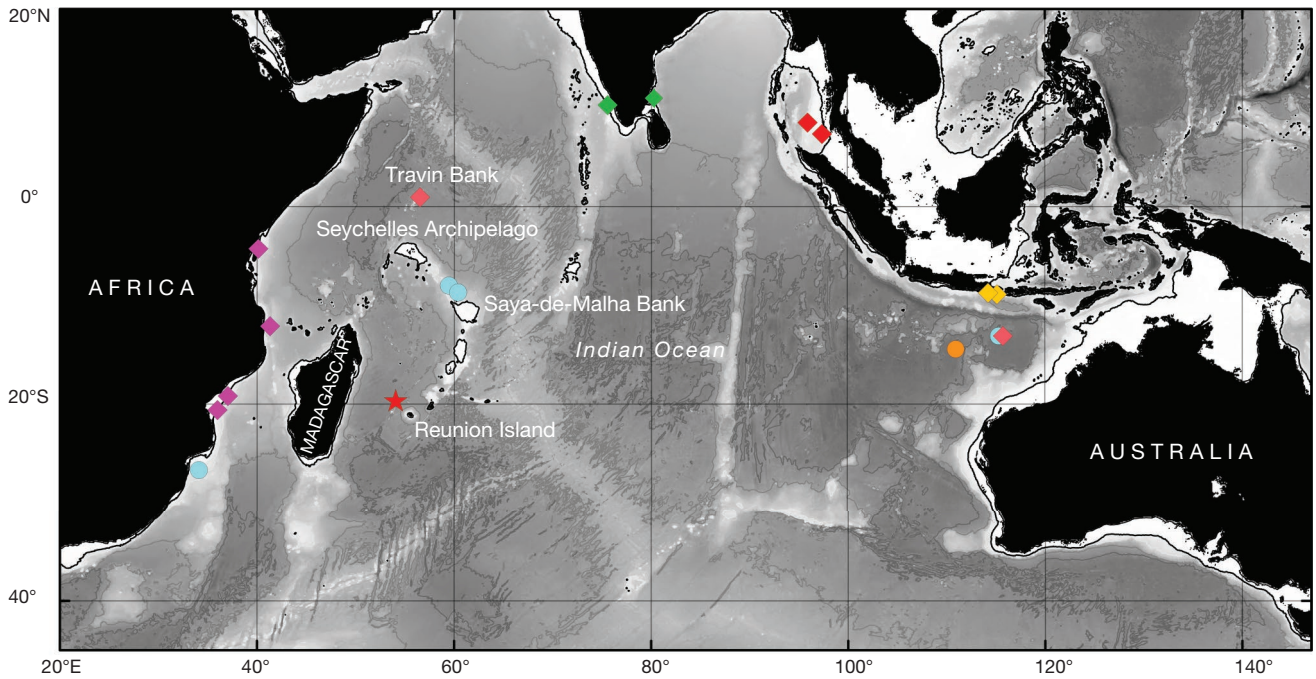


Fig. 1. — Geographic position of *Ectreposebastes* Garman, 1899 species records from the Indian Ocean. Symbols: *E. niger* (Fourmanoir, 1971): ★, this study; record of [MNHN-IC-2019-0078](#); published records: ●, Mandrytsa (1990); ●, the specimen from the NSMT collection (Dr G. Shinohara, 2019 pers. comm.), also presented in GBIF (wrong position) and ALA 2017 (initial species identification as *E. imus* Garman, 1899 was modified by ALA team based on empirical criteria without examination of the specimen). *E. imus* Garman, 1899: Published records: ◆, specimens from YugNIRO cruises (collection ZISP) (Mandrytsa 1990); ◆, Indian records (Hashim 2012); ◆, from a Thailand survey (Kawai *et al.* 2017). Electronic references: ◆, SAIAB collection records (source: GBIF); ◆, from JETINDOFISH Project expeditions sampling stored both in NHMUK fish collection database and CAS (source: GBIF and NHMUK). Note that the occurrence positions of *E. niger* and *E. imus* in the Eastern Indian Ocean (Mandrytsa 1990) are artificially jittered to improve visibility and to decrease superposition, however, both individuals were caught in the same trawl. The 200 m isobaths (black line) and isobaths from 1000 to 5000 m (in 1000 m steps, light grey lines) are shown. Coastline and bathymetry data are from GEBCO (2003, 2016).

Straight length measurements were taken to the nearest mm with digital calipers following Eschmeyer & Collette (1966), Mandrytsa (1990), Kai & Nakabo (2013) and expressed as percentage of SL. Otoliths (Fig. 3) were examined under a light microscope (Olympus CX41 under $\times 40$ magnification) and photographed with an Olympus E-5 digital camera, resolution 12 Mpx. Otolith description followed the terminology of Tuset *et al.* (2008). Most scales of the specimen were lost, therefore all scale counts correspond to the number of scale pockets.

GENETIC ANALYSIS

DNA was extracted in the laboratory from muscle tissue taken from the lower cranial area of the fish, close to the otoliths chambers. Tissue was air-dried, minced with a sterile scalpel on a Petri dish and incubated overnight in a Proteinase K and lysis buffer solution. The DNA extraction was completed using the NucleoSpin Tissue Kit (Macherey-Nagel, Düren, Germany) according to the manufacturer's instructions.

The DNA-barcoding fragment of the mitochondrial cytochrome c oxidase subunit I gene (COI) was amplified using a primer cocktail (Ivanova *et al.* 2007). All amplifications were performed using illustra™ PuReTaq™ Ready-To-Go™ PCR Beads (GE Healthcare UK, Little Chalfont, UK) in a final volume of 25 μ L containing 1 μ L of each primer (10 pmol/ μ L) and 1-2 μ L of genomic DNA.

The polymerase chain reaction (PCR) was set to an initial denaturation at 94°C for 5 min followed by 35 cycles of 30 s at 94°C, 40 s at 48°C and 50 s at 72°C with an additional final elongation phase of 7 min at 72°C.

The PCR product was checked via electrophoresis on a 1.5% agarose gel and product lengths were verified using a 100-1000 bp reference ladder. Ten microliters of PCR product were purified with a 2.5 μ L mix containing exonuclease I (20 U/ μ L) and alkaline phosphatase (1 U/ μ L) using an incubation of 15 min at 37°C and 20 min at 75°C.

All purified PCR products were sequenced in both forward and reverse directions by Macrogen Inc. (Amsterdam, the Netherlands) using M13 universal primers.

Forward and reverse sequences were assembled using Geneious (v. R10, Biomatters, Auckland, NZ) and reciprocally verified, and a 555 bp long contig was generated. The sequence was then exported in FASTA format for further analysis. Sequence analysis was performed on Barcoding of Life Data System v. 4 (BOLD) (Ratnasingham & Hebert 2007) on 1 April 2019 using the Identification Engine, which searches in the entire BOLD reference database for best matches to the query sequence.

Phylogenetic and molecular evolutionary analyses were conducted using MEGA version X software (Kumar *et al.* 2018). The evolutionary history was inferred using the Neighbor-Joining method (Saitou & Nei 1987). The evo-

lutionary distances were computed using the Maximum Composite Likelihood method (Tamura *et al.* 2004) with 1000 bootstraps using a species that evolved early in the Scorpaeniformes, *Trachyscorpia cristulata* (Goode & Bean, 1896), as an outgroup (an individual with BOLD ID ANGBF14113-19). Automatic Barcode Gap Discovery (ABGD) analysis (Puillandre *et al.* 2012) was applied to check potential species segregation within the genus *Ectreposebastes*, using online web interface available at <https://bioinfo.mnhn.fr/abi/public/abgd/abgdweb.html>, consulted 10 August 2020.

INDIAN OCEAN LIMITS

The Indian Ocean area is considered here following the official description of the International Hydrographic Organisation: from the Asian Continent to Antarctica, with its western and eastern borders positioned at 20°E off South Africa and 146°55'E off Southern Australia respectively (IHO 1953).

ABBREVIATIONS

Institutions, collectors (Sabaj 2019)

IRD	Institut de Recherche pour le Développement, Marseille;
MNHN	Muséum national d'Histoire naturelle, Paris;
NSMT	National Museum of Nature and Science, Tokyo.

Databases, programs

ALA	Atlas of Living Australia website at http://www.ala.org.au ;
AFORO	A web-based environment for shape analysis of fish otoliths. http://aforo.cmima.csic.es/ (Lombarte <i>et al.</i> 2006);
FishBase	World Wide Web electronic publication. http://www.fishbase.org (Froese & Pauly 2019);
GBIF	Global Biodiversity Information Facility. http://data.gbif.org ;
INSD	International Nucleotide Sequence Database. https://www.ddbj.nig.ac.jp/insdc-e.html , a joint database of INSDC, International Nucleotide Sequence Database Collaboration. http://www.insdc.org/ ;
NHMKUK	Natural History Museum (2014). Dataset: Collection specimens. Resource: Specimens. Natural History Museum Data Portal (data.nhm.ac.uk). https://doi.org/10.5519/0002965 , http://data.nhm.ac.uk/ ;
OBIS	The Ocean Biogeographic Information System. https://obis.org/ ;
SAIAB fish	South African Institute for Aquatic Biodiversity fish collection database of the South Africa http://specify-portal.saiab.ac.za/specify-solr/fish/as on 19.01.2017, currently https://www.gbif.org/dataset/1aacc653-c71c-4695-9b6e-0e26214dd817 , accessed 22 July 2020;
WoRMS	World Register of Marine Species http://www.marinespecies.org .

Measurements and counts

LL	lateral line;
OL	otolith length;
OH	otolith height;
SL	standard length;
TL	total length.

SYSTEMATIC ACCOUNT

Family SETARCHIDAE Matsubara, 1943

Genus *Ectreposebastes* Garman, 1899

Ectreposebastes niger (Fourmanoir, 1971)
(Fig. 2)

Pontinus niger Fourmanoir, 1971: 42, fig. 6.

TYPE MATERIAL. — **Holotype**. Pacific Ocean • MNHN-IC-1970-0034, 122 mm SL, 09°56'S, 141°52'W; 0-1200 m depth; 12.IX.1969; CARIDE 5; R/V *Coriolis*.

MATERIAL EXAMINED. — **La Réunion** • MNHN-IC-2019-0078; no sex data; 165 mm SL; Southwestern Indian Ocean; 19°45.84'S, 54°05.28'E-19°41.43'S, 54°03.80'E; 18.IX.2016; Romanov, IRD LA PÉROUSE leg; R/V *Antea*.

DISTRIBUTION. — Indo-West Pacific meso- and bathy-pelagic, mostly near continental/peri-insular slopes in tropical and temperate waters.

DESCRIPTION

Individual MNHN-IC-2019-0078 (165 mm SL)

External morphology. Medium-sized, black-coloured scorpaeniform fish with black-yellowish eyes. Pinkish muscles visible through semi-transparent skin in scale pockets; scale pocket edges black. Body relatively high, slightly compressed laterally, flabby, lacking scales (most scales lost, except some pored LL scales) (Fig. 2). Most fin spines, some fin rays broken due to fragile, poorly-ossified nature. First pre-opercular spine weakly developed; others damaged. Lacrimal spines short, intact on the left side but damaged on right. Body proportions shown in Table 1.

Otoliths. Thick and robust. Otolith shape triangular with pointed rostrum (Fig. 3); ventral rim convex; post-dorsal rim almost straight without depression; pre-dorsal rim forming angle close to 90° with post-dorsal rim. Otolith height almost equal to otolith length (ratio OH/OL 0.75-0.79 for right and left otoliths respectively). *Sulcus acusticus*: archae-sulcoid, ostial, median. *Ostium* and *cauda*: undifferentiated, oval. Anterior region: double-peaked; rostrum broad, short, slightly pointed, antirostrum very short, rounded, broad; *excisura* wide with shallow notch. Posterior region: oblique to round or oblique to irregular.

REMARK

The morphology of our specimen corresponds well to the original description given by Fourmanoir (1971) and later by Mandrytsa (1990). Body measurements are close to the ranges presented in other studies. However, many proportions are close to or even outside of the lower end of reported ranges (Table 1).

GENETIC ANALYSIS

A 555 bp region of the mtDNA COI gene was isolated from the specimen and the sequence was deposited in the INSD (accession number: MN181524). The query sequence did not find 100% match to the mtDNA COI region of any other



FIG. 2. — Individual of *Ectreposebastes niger* (Fourmanoir, 1971) caught in the pelagic environment during the LA PÉROUSE cruise. Scale bar: 10 mm. Specimen MNHN-IC-2019-0078. Photo credit: Francis Marsac.

specimens. The nearest matches were non-identified specimens *Ectreposebastes* sp. (98.13% to 98.31% similarity) and *Ectreposebastes imus* (97.10% to 98.13% similarity). Neighbour joining tree analysis (Fig. 6) shows distinct clustering between *E. imus*, *E. niger* and *Ectreposebastes* sp. DNA signatures. The *E. imus* branch is separated from another branch that contains our *E. niger* specimen (MN181524) and *Ectreposebastes* sp. specimens (FOAE60706, FOAF803-07) collected from the Southwestern Pacific: Coral Sea (off Australian coast) and from over Lord Howe Rise.

An ABGD analysis aimed at detecting genetic gaps between species (Puillandre *et al.* 2012) clustered *Ectreposebastes* sequences into three lineages, segregating *E. imus*, *E. niger* (MN181524) and *Ectreposebastes* sp.

DISCUSSION

MORPHOLOGY, GENETICS, IDENTIFICATION

Morphology and meristic counts of *E. niger* presented here correspond well to other individuals of this species reported in the literature (Table 1). Our specimen is the largest individual of *E. niger* ever reported globally (Fourmanoir 1971; Paulin 1982; Mandrytsa 1990). Hence, values of body proportions, which are close to or beyond the lower reported range, may represent individual growth-related variability.

Externally, our specimen differs from the congeneric *E. imus* by having larger and fewer scales: lower number of horizontal rows of scales above (8 vs 14–16) and below (25 vs 35–48) the LL and lower total number of vertical scale rows (54 vs 83–95) (Mandrytsa 1990). The number of predorsal scales in our individual (11) exceeds the number of predorsal scales observed earlier in *E. niger* (8–10), but does not overlap with *E. imus* (12–17) (Table 1). It appears that *E. niger* also has shorter pelvic fins and a higher caudal peduncle than *E. imus* (Table 1). Other interspecific differences

mentioned in Mandrytsa (1990) (such as longer dorsal fin base and body height) are highly variable among different individuals (Table 1), often overlapping between species, and cannot be used as identification characters. Length of lacrimal and preopercular spines also cannot be used in many cases as the spines are often broken due to their fragile nature. Apparently, scale size and counts are the sole external indicators that allow intrageneric morphological identification of *Ectreposebastes* species.

Genetic analysis shows that the level of segregation between *Ectreposebastes* species is very low. Evolutionary distance between the sequence of our specimen (MN181524) and reference sequences of *E. imus* ranged within 0.0190–0.0248, while distance with *Ectreposebastes* sp. lies between 0.0170–0.0190. However, distinct clustering detected through neighbour joining tree analysis (Fig. 6) indicated segregation of *E. imus* from *E. niger* and *Ectreposebastes* sp. ABGD analysis confirms that *E. imus* and *E. niger* (MN181524) are separate species. At the same time ABGD shows that *Ectreposebastes* sp. from the Southwestern Pacific and *E. niger* (MN181524) represents separate lineages. Considering that the *E. niger* holotype originated from the southern Pacific (French Polynesia), the two individuals of *Ectreposebastes* sp. (FOAE60706, FOAF803-07) collected in the Coral Sea may represent the ‘true’ *E. niger*. The genetic divergence of the Indian Ocean lineage identified here as *E. niger* (MN181524) based on morphological criteria may indicate ongoing allopatric speciation between Pacific and Indian Ocean populations. Further studies are necessary to better understand the level of divergence within *E. niger* across the Indo-Pacific, and therefore genetic sampling, careful examination and preservation are essential for any specimens discovered in the future.

The separation of *E. niger* and *E. imus* remains challenging in view of their overall morphological and genetic similarity. For example, the synonymisation of the two species by

TABLE 1. — Total length and body proportions (in % of SL, except TL, SL, otoliths length and height in mm, total weight and otoliths weight in g) of *Ectreposebastes niger* (Fourmanoir, 1971) from the south-western Indian Ocean and from specimens collected in the Indian Ocean and the Pacific. Comparative measurements for *E. imus* Garman, 1899 are also given. Measured dimensions are given following terminology of Mandrytsa (1990) and Kai & Nakabo (2013), except for terms and measurements adopted from Escáñez & Brito (2011) given in *italics*, and from Frable *et al.* 2015 given in **bold italics**. Non-overlapping characters between the two species are underlined. * Including 3 ind. from Scherbachev *et al.* 1978 (measurements and proportions are taken from Mandrytsa (1990)).

Measurement	<i>Ectreposebastes niger</i> (Fourmanoir, 1971)				<i>E. imus</i> Garman, 1899		
	This study, MNHN-IC-2019-0078	holotype MNHN-IC-1970-34	Scherbachev <i>et al.</i> (1978)	Mandrytsa (1990)	Mandrytsa (1990)	Eschmeyer & Collette (1966)	Escáñez & Brito (2011)
<i>n</i>	1	1	3	7*	8	37	2
Total length	183	–	–	–	–	–	84, 98
Standard length	165	118	90, 120, 125	112.7 (83.0-141.5)	136.9 (55.0-222.0)	–	71, 83
Snout length	12.7	13.2	14.6, 14.2, 14.1	12.5 (11.4-13.6)	13.2 (11.5-15.1)	14.2 (13.0-17.0)	14.1, 12.0
Orbit diameter horizontal	4.9	7.4	6.4, 7.1, 6.9	7.7 (6.8-8.5)	7.6 (6.0-9.2)	–	7.0, 8.4
Head length	34.7	38.2	44.5, 40.6, 41.4	41.0 (38.5-42.9)	41.5 (38.6-44.1)	–	39.4, 45.8
Interorbital width	12.5	13.5	13.2, 12.8, 13.1	12.6 (10.8-13.7)	12.6 (11.4-14.2)	12.9 (10.0-15.0)	–
Upper jaw length	23.2	23.4	25.5, 24.6, 25.1	25.3 (24.6-25.9)	24.1 (20.4-26.4)	–	–
Predorsal fin length	34.0	38.5	39.4, 39.5, 39.4	36.4 (34.9-38.6)	38.3 (30.5-43.3)	45.8 (41.0-49.0)	–
Preanal fin length	71.9	77.0	–	69.5 (67.4-75.0)	70.6 (64.4-76.1)	–	–
Prepectoral fin length	41.8	44.7	–	42.6 (40.1-43.7)	43.5 (39.2-47.2)	–	–
<i>Prepelvic fin length</i>	45.5	–	–	–	–	–	–
Body depth (max)	39.1	38.1	35.7, 32.3, 33.4	31.8 (28.6-36.1)	38.7 (31.9-49.6)	42.3 (37.0-52.0)	43.7, 41.0
<i>Depth at dorsal fin origin</i>	37.4	–	–	–	–	–	–
<i>Depth at pelvic fin origin</i>	37.5	–	–	–	–	–	–
<i>Depth at anal fin origin</i>	33.6	–	–	–	–	–	–
Caudal peduncle depth	13.5	11.0	–	9.5 (8.6-10.0)	9.0 (8.0-9.6)	–	8.5, 8.4
Length of dorsal fin base	54.6	50.4	–	54.8 (50.5-57.4)	51.7 (49.2-59.1)	–	–
<i>Spinous dorsal fin base length</i>	39.6	–	–	–	–	–	–
<i>Soft rayed dorsal fin base length</i>	18.1	–	–	–	–	–	–
1 st dorsal fin spine length	1.2	4.1	–	6.3 (5.1-7.3)	7.0 (6.6-7.2)	–	–
2 nd dorsal fin spine length	1.7	–	–	10.6	10.6 (9.9-11.3)	–	–
3 rd dorsal fin spine length	3.9	–	–	–	–	–	–
4 th dorsal fin spine length	3.1	–	–	–	–	–	–
5 th dorsal fin spine length	4.0	–	–	–	–	–	–
Pectoral fin length	34.8	44.7	40.0, 35.0, 35.2	38.2 (35.3-40.7)	39.7 (32.3-43.6)	–	38.0, 38.6
<i>Pectoral fin base depth</i>	11.9	–	–	–	–	–	–
Pelvic fin ray length	9.4	18.8	–	18.2 (18.2)	23.4 (22.0-26.4)	–	–
Pelvic fin spine length	5.1	–	–	–	–	–	–

Table 1. — Continuation.

Measurement	<i>Ectreposebastes niger</i> (Fourmanoir, 1971)				<i>E. imus</i> Garman, 1899		
	This study, MNHN- IC-2019-0078	holotype MNHN- IC-1970-34	Scherbachev <i>et al.</i> (1978)	Mandrytsa (1990)	Mandrytsa (1990)	Eschmeyer & Collette (1966)	Escáñez & Brito (2011)
Anal fin base length	16.0	15.9	–	16.1 (15.4-17.6)	14.4 (13.5-15.6)	–	–
Anal fin spine I length	2.4	–	–	3.7 (2.9-4.5)	3.6 (2.7-4.1)	–	–
Anal fin spine II length	7.9	–	–	6.7 (5.8-7.7)	8.7 (6.6-10.9)	–	–
Anal fin spine III length	4.5	–	–	9.0 (8.4-9.6)	10.8 (9.0-12.7)	–	–
Caudal peduncle dorsal length	8.1	–	–	–	–	–	–
Caudal peduncle ventral length	12.6	16.1*	–	17.6 (15.5-18.7)*	15.8 (13.9-18.4)	–	–
Length of 1 st lacrimal spine	0.8	0.8	–	1.7 (1.3-2.0)	1.4 (0.9-2.0)	–	–
Length of 2 nd lacrimal spine	1.1	0.8	–	1.6 (1.1-2.0)	1.3 (1.0-2.9)	–	–
Length of 1 st preopercular spine	2.6	1.3	–	4.1 (3.6-4.5)	5.0 (3.6-5.8)	–	–
Length of 2 nd preopercular spine	damaged	1.9	–	5.1 (3.9-6.1)	6.1 (3.9-10.0)	–	–
Length of 3 rd preopercular spine	damaged	2.5	–	6.1 (5.9-6.3)	7.3 (5.6-9.6)	–	–
No. dorsal spines	12	12	12	12	–	12	12
No. dorsal soft rays	10	10	10	10 (9)	–	9-10	9
No. anal spines	3	3	3	3	–	3	3
No. anal soft rays	6	6	6	6	–	5-6	6
No. pectoral rays	18	16	18-19	18 (16-19)	–	18-20	18, 16
No. caudal rays	<u>27</u>	–	–	–	–	–	<u>20, 20</u>
No scales on lateral line	25	32	27-28	27-28	–	–	–
Scales above LL at mid dorsal fin spiny part	<u>8</u>	–	<u>7</u>	<u>8-10</u>	<u>14-16</u>	–	<u>10, 13</u>
Scales below LL at mid dorsal fin spiny part	25	–	19-23	22-32	35-48	–	29, 30
Vertical scale rows	<u>54</u>	<u>55</u>	–	<u>55-63</u>	<u>83-95</u>	–	–
Predorsal scales	<u>11</u>	–	<u>9-10</u>	<u>8-10</u>	<u>12-17</u>	–	–
Gillrakers on 1 arch	14 (Upper 6, Lower 8)	–	–	15-18 (5-7+1+8-10)	–	–	–
Otolith length (L/R)	3.94 / 3.83	–	–	–	–	–	–
Otolith height (L/R)	2.95 / 3.04	–	–	–	–	–	–
Otolith weight (L/R)	0.0097 / 0.0096	–	–	–	–	–	–
Total weight after defrosting	142.7	–	–	–	–	–	–

Collette & Uyeno (1972) was apparently based on misidentification. The individual (NSMT-P 17480) described by Collette & Uyeno (1972) is obviously distinct from *E. niger* by its smaller scales (12 above LL and 35-38 below LL) representing, therefore, *E. imus*.

The number of pored scales in the LL of *Ectreposebastes* spp. is an uncertain character. Combined information from available *E. niger* descriptions given by Fourmanoir (1971), Scherbachev *et al.* (1978), Mandrytsa (1990) and the present study, suggests 25-32 pored LL scales (Table 1). Most descriptions of *E. imus* are lacking information on the number of LL scales, however, Collette & Uyeno (1972) reported *c.* 45 pored

scales in the LL of their specimen. Photographs presented in various papers (Eschmeyer & Randall 1975; Maruyama & Ono 1975; González *et al.* 2014) and photos of museum collection specimens stored in SAIAB (catalogue number 82172) and MCZ (catalogue numbers 164078 and 163321) (accessed through GBIF 2020), demonstrate a much lower number of scales in the LL than mentioned by Collette & Uyeno (1972), close to the range of *E. niger*.

Otolith shape in teleosts tends to be highly species-specific and is widely used in species identification (Jobling & Breiby 1986; Smale *et al.* 1995; Granadeiro & Silva 2000; Campana 2004, 2005). Here we present the first descrip-

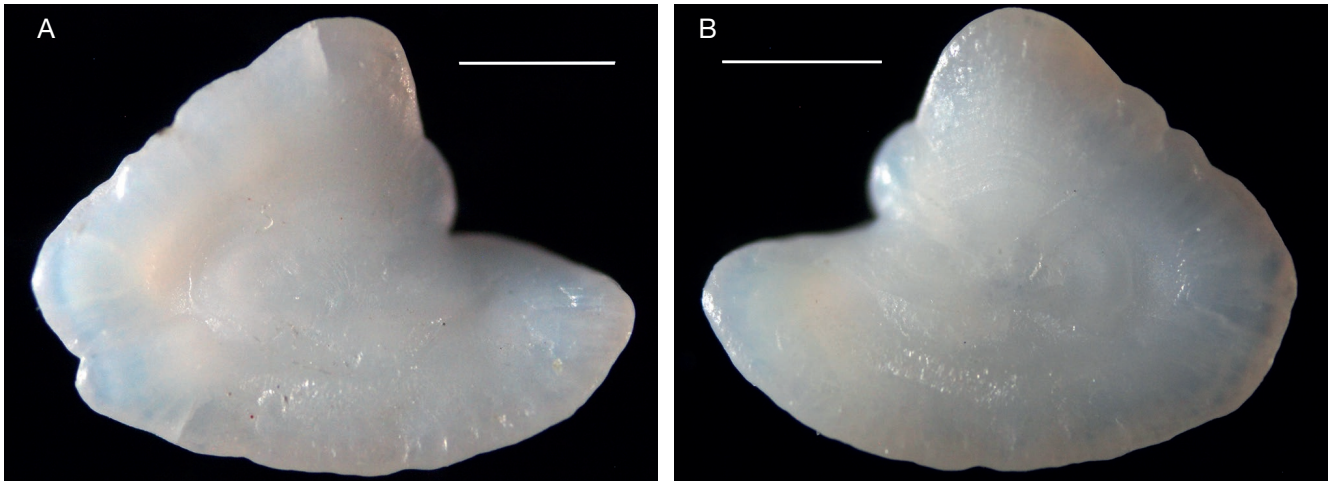


FIG. 3. — Otoliths: left (A), right (B) of *Ectreposebastes niger* (Fourmanoir, 1971), 165 mm SL, 183 mm TL, reported in this study. MNHN-IC-2019-0078. Scale bars: 1 mm.



FIG. 4. — Left otolith of *Ectreposebastes imus* Garman, 1899 (160 mm total length) from Belize, Caribbean Sea, Western Atlantic. Scale bar: 1 mm. Source: AFORO, Fish ID: 9300.

tion of otolith shape of *E. niger* and comparison with its congener *E. imus*. Otolith OH/OL ratio and overall shape are similar for both species (Figs 3-5). Nevertheless, the otoliths of *E. niger* are clearly distinct from those of *E. imus* of similar sizes. Otoliths of *E. niger* reported in this study had a slightly pointed rostrum and short, rounded antirostrum (Figs 3; 5). In contrast, otoliths of *E. imus* from specimens > 90 mm FL presented in Campana (2004) and the AFORO database (Lombarte et al. 2006) demonstrate a rounded rostrum while the antirostrum was either lacking (Campana 2004) or bluntly pointed (Figs 4; 5). The otolith contour of *E. imus* is less ‘angular’ than that of *E. niger*. Visible differences in otolith shape between *Ectreposebastes* species suggest that this may be an additional robust morphological diagnostic feature. Otolith shape analysis of Pacific *E. niger* specimens may provide further indicators (besides genetics) on potential divergence from the putative Indian Ocean population.

DISTRIBUTION IN THE INDIAN OCEAN

To date, seven individuals of *E. niger* have been reported in the literature from the Indian Ocean region (Table 2). The first records were described by Scherbachev et al. (1978), who reported three individuals caught by midwater and bottom trawls during Soviet research cruises in the Mozambique Channel and over the Saya-de-Malha Bank (Fig. 1). Scherbachev et al. (1978) identified them as *Ectreposebastes* sp. (mentioning however differences with *E. imus*) while re-examination by Mandrytsa (1990) finally attributed these individuals to *E. niger*. Another four individuals were caught, also by the USSR vessels, at the Saya-de-Malha Bank and off Java in 1976-1982, using bottom and midwater trawls respectively (Mandrytsa 1990) (Fig. 1), (Table 2). No new records in the region were reported since.

Direct correspondence with museums allowed us, however, to obtain data on another *E. niger* individual collected from the Indian Ocean. The specimen stored in National Museum of Nature and Science, Tokyo, initially identified as *E. imus* (NSMT-P 61091) was found in the stomach of a longnose lancetfish *Alepisaurus ferox* Lowe, 1833 caught in the open Eastern Indian Ocean in 1982 by tuna longline at approximately 170 m depth (Fig. 1; Table 2). Based on scale counts of the preserved specimen (9 horizontal rows above and 34 below LL) and a photograph (G. Shinohara, 2019, pers. comm.) we identified the specimen NSMT-P 61091 as *E. niger*.

Our record (MNHN-IC-2019-0078) represents the first occurrence of this pelagic scorpionfish in the waters of Reunion Island (Fricke 1999; Letourneur et al. 2004; Fricke et al. 2009) confirming the presence of this species along the Mascarene Ridge: from Saya-de-Malha Bank (past records) to Reunion Island (this study).

Besides the Indian Ocean, *E. niger* occurrence was documented in the Western and Central Pacific Ocean (Fourmanoir 1971; Paulin 1982; ALA 2017); however, no individual was recorded to date in the Eastern Pacific.

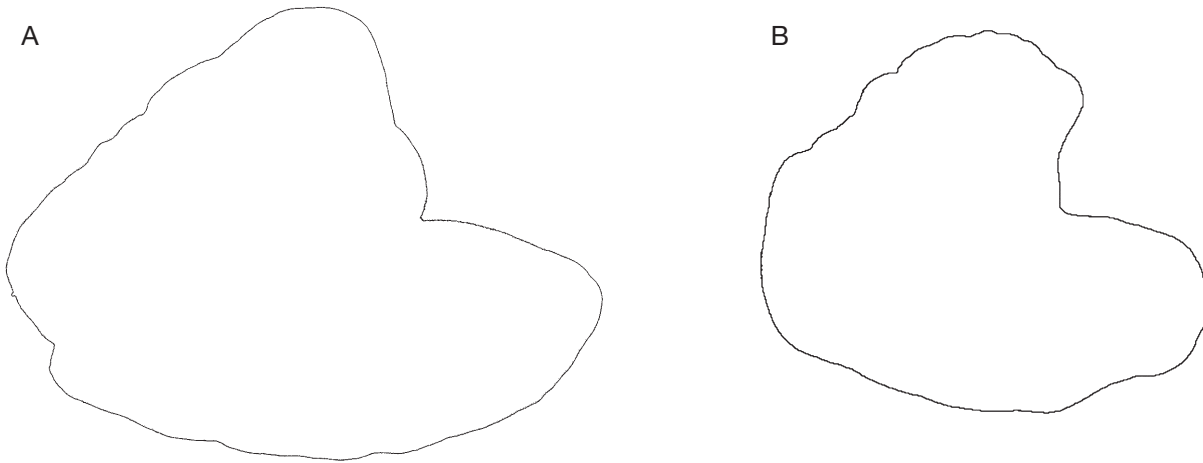


FIG. 5. — Contours of left otoliths of *Ectreposebastes* Garman, 1899 showing difference in otolith shape between the two species of the genus: **A**, *Ectreposebastes niger* (Fourmanoir, 1971) (this study [MNHN-IC-2019-0078](#)); **B**, *Ectreposebastes imus* Garman, 1899 from Belize, Caribbean Sea, Western Atlantic. Source: [AFORO](#), Fish ID: 9300.

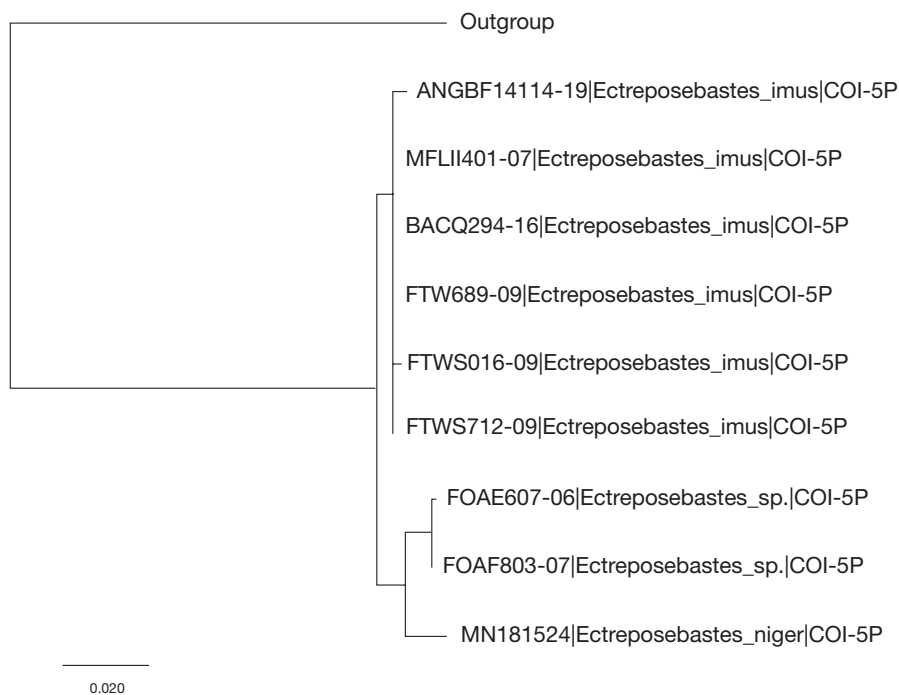


FIG. 6. — Neighbour joining tree of the genus *Ectreposebastes* Garman, 1899 based on DNA sequences of the mitochondrial COI gene. The tree was constructed based on *Ectreposebastes* spp. sequences publicly available in Barcoding of Life Data System v. 4 (BOLD) and the sequence from our specimen of *Ectreposebastes niger* (Fourmanoir, 1971) ([MNHN-IC-2019-0078](#), BOLD accession number: [MN181524](#)). The optimal tree with the sum of branch length = 0.22318084 is shown. The tree is drawn to scale, with branch lengths in the same units as those of the evolutionary distances used to infer the phylogenetic tree. *Trachyscorpia cristulata* (Goode & Bean, 1896) (BOLD ID [ANGBF14113-19](#)) were used as outgroup.

Occurrences of the congeneric *E. imus* are widely reported throughout the Indian Ocean from the Mozambique Channel, Kenya and in the vicinity of the Travin Bank ([00°26'N](#), [56°00'E](#)) in the west, through India and the Bay of Bengal to Indonesia in the east (Mandrytsa 1990; Pauly *et al.* 1996; Hashim 2012; Govindam *et al.* 2013).

Before this study, the most recent specimen of the genus *Ectreposebastes* recorded in the south-western Indian Ocean was an individual collected during the pelagic ecosystem survey in Mauritius and the Southern Mascarene region by the R/V *Dr. Fridtjof Nansen* (Strømme *et al.* 2010). However, the specimen was not identified to species level and it was

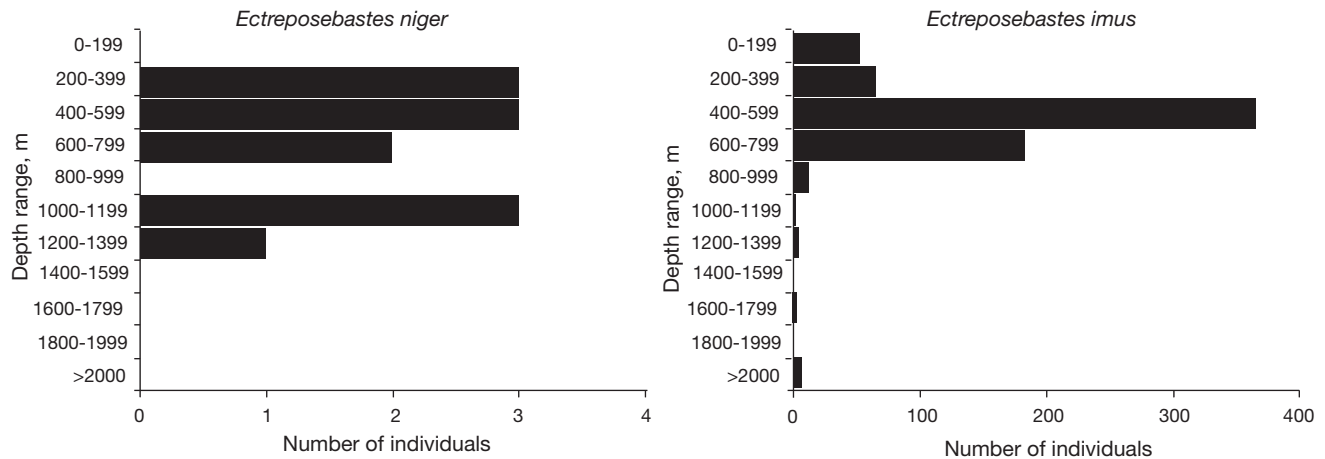


FIG. 7. — Global bathymetric distribution (all records with known capture depth) of *Ectreposebastes niger* (Fourmanoir, 1971) ($n = 12$) (left panel) and *Ectreposebastes imus* Garman, 1899 ($n = 698$) (right panel). Data sources are listed in Table 2 and also in Eschmeyer & Collette (1966); Eschmeyer (1969); Collette & Uyeno (1972); Eschmeyer & Randall (1975); Maruyama & Ono (1975); Paulin (1982); Badrudin *et al.* (2007); Balanov *et al.* (2009); De Paiva *et al.* (2011); Escáñez & Brito (2011); González *et al.* (2014); Chung (2015); ALA, accessed 19 January 2017; GBIF, accessed 19 January 2017; OBIS, accessed 22 July 2020; NHMUK accessed 19 January 2017. The single record of *E. niger* at the depth of 170 m, which was recovered from a predator's stomach (*Alepisaurus ferox*) is not considered here.

not possible to locate the specimen or to obtain a copy of the final version of the report.

Non-georeferenced sources also indicate the presence of *Ectreposebastes* species off Indonesia (Pauly *et al.* 1996; Badrudin *et al.* 2007) and along the south-west coast of India (Govindam *et al.* 2013; Venu 2013).

Online databases (OBIS, GBIF) referenced to museum collections (e.g. SAIAB, CSIRO, MCZ) and published records (Eschmeyer 1969; Eschmeyer & Collette 1966; Maruyama & Ono 1975; Balanov *et al.* 2009; De Paiva *et al.* 2011; Escáñez & Brito 2011; González *et al.* 2014; Tatsuta *et al.* 2014; Motomura & Struthers 2015) confirm the wide occurrence of *E. imus* (GBIF 2017, 2020; OBIS 2017, 2020) suggesting its circumglobal distribution. Outside the Indian Ocean (Fig. 1) its records spread across the Atlantic, while Pacific occurrences are patchy, mostly in the North and Equatorial Western Pacific, Hawaiian Islands (Central Subtropical Pacific), Galápagos Islands (Eastern Central Pacific) and continental slope of Ecuador and Peru.

It should be mentioned, however, that online databases are always a source of ambiguity in species distributions and taxonomy (Romanov *et al.* 2013). Online database sources, e.g. *Catalog of Fishes* (currently *Eschmeyer's Catalog of Fishes*) (Eschmeyer & Fricke 2012; Fricke *et al.* 2020), GBIF, OBIS, SAIAB search portal and ALA are evolving rapidly with changing content, cross-links and URLs. Therefore the use of online databases in their current form without stable URLs and backward content traceability is prone to uncertainty. Their use as a reference and source of data in taxonomic papers is challenging.

A further source of uncertainty in online resources results from several museum specimens that were collected and identified during the period of synonymisation of the two species (CAS, NHMUK): no signs of re-examination are available yet.

HABITAT

Our results and the available published information suggest that *Ectreposebastes* species are distributed along continental/peri-insular shelves, in proximity to seamounts and apparently in deep open-ocean pelagic habitat.

Globally, both species of *Ectreposebastes* occur in the mid-water layer far from the bottom, while catches with demersal trawls (Table 2) and ROV observations on the bottom are also reported (Robertson & Van Tassel 2019). A summary of distribution occurrences by depth strata (Fig. 7) demonstrates that the habitat of the pelagic scorpionfish, *E. niger*, ranged from the upper mesopelagic layer (below 200 m depth) to the bathypelagic depths 1200–1300 m (Mandrytsa 1990). The midwater scorpionfish, *E. imus*, occurs in the epipelagic zone (shallower than 200 m) reaching depths of at least 1000–1150 m according to published records (Collette & Uyeno 1972; Grove & Lavenberg 1997; Badrudin *et al.* 2007). While most sources (e.g. Eschmeyer 1969) suggest 500–800 m depth as preferred habitat for *E. imus*, our compilation (GBIF 2020; OBIS 2020) demonstrates a wider range, through the entire meso- and bathypelagic zones (Fig. 7).

Most *Ectreposebastes* occurrences are associated with seamounts (e.g. La Pérouse seamount (this study); Travin Bank, and Saya-de-Malha Bank) or continental slope areas (Fig. 1; Table 2) (Mandrytsa 1990). In Hawaiian waters, *E. imus* was classified as a potential member of the mesopelagic-boundary community (Reid *et al.* 1991) and called a 'pseudo-oceanic species' (Hulley & Lutjeharms 1989), i.e., inhabiting the mesopelagic-boundary zone that 'overlies the depths where mesopelagic waters impinge on the upper slope of a land mass, island or seamount'.

However, the pelagic scorpionfish reported in the present study was caught in the mesopelagic zone together with 'high-oceanic fishes' like *Benthosema suborbitale* (Gilbert, 1913), *Ceratoscopelus warmingii* (Lütken, 1892), *Sigmops elongatus*

TABLE 2. — Details of capture positions of the Indian Ocean *Ectreposebastes* spp. presented in Fig. 1. Non geo-referenced occurrences are not mapped and not given here. Abbreviations: **TRAWB**, bottom trawl; **TRAWBO**, otter trawl; **TRAWP** pelagic (midwater) trawl; **LLP**, pelagic longline; **ALX**, lancetfish *Alepisaurus ferox* Lowe, 1833; **SL**, standard length; **N/A**, non-available. Geographic positions presented in decimal form in the source were converted into dd°mm.m format. * Re-examined and identified as *E. niger* (Fourmanoir, 1971) by Mandrytsa (1990); ** Apparently collected together. JETINDOFISH Trawl Survey operated in the Indian Ocean (Lohmeyer 1996).

Capture date	Latitude (dd°mm.m)	Longitude (ddd°mm.m)	Sampling gear	Species as given in the source	Collector / Museum		Capture depth, m	Catalogue number	SL	No.	Vessel	Source
					Collector	Museum						
Published data												
27.09.1973	26°41.0' S	034°06.0' E	TRAWB	<i>E. sp.*</i>	- / ZISP		1000	49421	90	1	R/V Fiolent	Scherbachev et al. 1978
18.06.1976	08°42.0' S	060°23.0' E	TRAWP	<i>E. sp.*</i>	- / ZISP		658-722	49422	120, 125	2	R/V Zvezda Kryma	Scherbachev et al. 1978
09.11.1976	08°00.0' S	059°28.0' E	TRAWB	<i>E. niger</i>	- / ZMMU		1200-1320	P-18044	134.5	1	R/V Zvezda Kryma	Mandrytsa 1990
26.04.1982	13°06.0' S	115°31.0' E	TRAWP	<i>E. niger</i>	- / ZISP		390-425	49423	83-141.5	3	R/V Fiolent	Mandrytsa 1990
Museum collections – direct correspondence												
12.01.1982	14°26.0' S	110°52.9' E	LLP, stomach of ALX	<i>E. imus</i>	NSMT		170	NSMTP 61091	127.0	1	Syonan-maru	Dr. G. Shinohara 2019 pers. comm.
This study												
18.09.2016	19°41.43' – 19°45.84' S	054°03.80' – 054°05.28' E	TRAWP	<i>E. niger</i>	EVR, YC, FM / MNHN		475-560	MNHN-IC-2019-0078	165	1	R/V Antea	LA PÉROUSE cruise, IRD, 2016
Published data												
16.06.1976	00°57.0' N	056°32.0' E	TRAWP	<i>E. imus</i>	- / ZISP		800-820	49437	191	1	R/V Zvezda Kryma	Mandrytsa 1990
26.04.1982	13°06.0' S	115°31.0' E	TRAWP	<i>E. imus</i>	- / ZISP		390-425	49438	55	1	R/V Fiolent	Mandrytsa 1990
N/A	10°16.0' N;	075°33.0' E	TRAWBO	<i>E. imus</i>	-		777	-	-	N/A	FORV Sagor Sampada	Hashim 2012
N/A	10°58.0' N;	080°19.0' E	TRAWBO	<i>E. imus</i>	-		637	-	-	N/A	FORV Sagor Sampada	Hashim 2012
27.01.1999	07°21.0' – 07°20.0' N	097°26.0' – 097°25.0' E	TRAWBO	<i>E. imus</i>	PMBC		520-531	PMBC 27953	108.9	1	R/V Chakratong Tongyai	Kawai et al. 2017
05.02.1999	08°30.0' – 08°28.0' N	095°58.0' – 095°58.0' E	TRAWBO	<i>E. imus</i>	PMBC		649-550	PMBC 27954	78.2	1	R/V Chakratong Tongyai	Kawai et al. 2017
Online sources												
15.07.1979**	08°45.08' S	114°16.00' E	TRAWP	<i>E. imus</i>	JETINDOFISH Trawl Survey / CAS		40-180	CAS 54557, CAS 54558	-	2	Jurong	ALA 2018 / NHMUK 2014
15.07.1979**	08°45.08' S	114°16.00' E	TRAWP	<i>E. imus</i>	JETINDOFISH Trawl Survey / NHMUK		-	1986.11.27.58-62	-	1	Jurong	NHMUK 2014
1979-1983	08°43.00' S	114°15.00' E	TRAWP	<i>E. imus</i>	JETINDOFISH Trawl Survey / NHMUK		-	1984.1.1.63	-	1	Jurong	NHMUK 2014
16.07.1979	08°54.00' S	115°09.00' E	TRAWP	<i>E. imus</i>	JETINDOFISH Trawl Survey / NHMUK		-	1986.11.27.55	-	1	Jurong	NHMUK 2014
16.07.1979	08°54.00' S	115°09.00' E	TRAWP	<i>E. imus</i>	JETINDOFISH Trawl Survey / NHMUK		-	1986.11.27.56-57	-	1	Jurong	NHMUK 2014
10.12.1980	04°17.0' S	040°07.0' E	-	<i>E. imus</i>	SAIAB		687-750	14035	-	1	-	SAIAB 2017
19.10.2007	20°35.6' S	035°58.3' E	TRAWB	<i>E. imus</i>	SAIAB		709-721	82172	76	1	-	SAIAB 2017
24.10.2007	19°10.9' S	037°02.2' E	TRAWB	<i>E. imus</i>	SAIAB		444-453	82367	46	1	-	SAIAB 2017
18.11.2007	12°06.0' S	041°18.0' E	TRAWP	<i>E. imus</i>	SAIAB		510	66019	-	1	-	SAIAB 2017

(Günther, 1878), *Argyropelecus aculeatus* Valenciennes, 1850, *Argyropelecus hemigymnus* Cocco, 1829, and other high-oceanic species from families Evermannellidae Fowler, 1901 and Melamphaidae Gill, 1893 (Cherel et al. 2020). Indeed, several records of adults, juveniles and larvae (Moser et al. 1977) from pelagic environments show the rather ubiquitous distribution of *Ectreposebastes* species in the mesopelagic zone of the open ocean.

Alternatively these pelagic records may represent 'lost' individuals transported into oceanic environments by ocean currents. The body shape of *Ectreposebastes* spp. suggests that both species are not strong swimmers; apparently they are not capable of counteracting a persistent current flow. This renders them vulnerable to predators well adapted to pelagic environment. At least two records of *E. imus* and one of *E. niger* were reported from stomachs of the longnose lancetfish *Alepisaurus ferox* (Moser et al. 1977; Choy et al. 2013 Suppl.; Shinohara 2019, pers. comm.), which is known as an ambush pelagic predator (Romanov & Zamorov 2002) inhabiting epi- and mesopelagic layers worldwide.

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