



***Pteropsaron indicum*, a new species of signalfish (Teleostei: Trichonotidae: Hemerocoetinae) with a micro-CT analysis of osteology**

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Abstract

An unusual yellow-striped deepwater hemerocoetine fish trawled up from 70 m depth in the Lakshadweep Sea (Laccadive Sea) off Kerala, southern India is described here as the new species *Pteropsaron indicum*, based on two male specimens measuring 82 and 84 mm SL. The new species of signalfish is notable among the grouping of three genera sharing crowded dorsal-fin spines and a maxillary spine (*Acanthaphritis*, *Osopsaron*, and *Pteropsaron*) in having only three dorsal-fin spines, greatly extended dorsal-fin soft rays in addition to the greatly extended dorsal-fin spines, high counts of rays in the dorsal and anal fins (D- III,27 and A- 29), a high number of vertebrae (38), and a relatively large body size. *Pteropsaron indicum* possesses the distinctive arrangement of the spinous-dorsal-fin-pterygiophore complex found in this subset of trichonotid fishes. In *P. indicum*, the complex is placed between the fourth and fifth neural spines. The micro-computed tomography technique (micro-CT) is used to illustrate that osteological peculiarity in fine detail.

Key words: ichthyology, taxonomy, systematics, India, Kerala, Indian Ocean, Lakshadweep, Laccadive, *Osopsaron*

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Introduction

The enigmatic grouping of the hemerocoetine trichonotid fishes has been taxonomically mobile in recent years. Until relatively recently, they were considered members of Percophidae, and still are in Eschmeyer's Catalog of Fishes (Fricke et al. 2019), the World Register of Marine Species (2019), and Fishbase (Froese & Pauly 2019). However, Smith & Johnson (2007) moved them into the family Trichonotidae, which previously held only the sanddivers of the genus *Trichonotus* Bloch & Schneider, 1801, based on a shared distinctive specialized configuration of the suspensorium. Subsequent authors have followed Smith & Johnson's placement (Allen & Erdmann 2012, Iwamoto 2014).

The relationship between the members of the broad hemerocoetine trichonotid grouping remains opaque, with a set of derived characters almost randomly assorted among the species, making any subgrouping subjective depending on which feature is considered diagnostic. These characters include the crowded dorsal-fin-spine complex, a maxillary spine, a snout barbel, a dorsal operculum on iris, scales on the cheek, scalloped scale margins, branching of fin rays, a filamentous caudal-fin ray, and various combinations of greatly extended dorsal-fin spines and/or rays, anal-fin rays, or pelvic-fin rays (Nelson 1982, Parin 1985, Smith & Johnson 2007, Allen & Erdmann 2012, Iwamoto 2014).

Species of *Pteropsaron* Jordan & Snyder, 1902 and the closely related *Osopsaron* Jordan & Starks, 1904 account for a majority of the hemerocoetine trichonotids and includes those species with the unusual crowded dorsal-fin-spine complex (found also in *Acanthaphritis* Günther, 1880 and 4 other genera) in combination with a maxillary spine—the combination shared only with *Acanthaphritis*. *Acanthaphritis* is then (tenuously) separated from *Pteropsaron*/*Osopsaron* by the character of a snout barbel in males (Smith & Johnson 2007). *Pteropsaron*/*Osopsaron* is presently composed of 12 species, 4 of which have been described since 2007 as additional deeper water collections have been made. The species are typically tiny and fragile (most less than 50 mm SL, and some less than 30 mm SL) and usually found below normal diving depths, more than 50 m deep (several species are bathydemersal, below 200 m). In general, fishes that small and inconspicuous are poorly sampled by trawling, which is commonly used for collecting fishes from deep waters. We describe here a new species of *Pteropsaron* from Indian waters that is distinctly larger and appears in local deep trawl samples. The new species exhibits its own unique combination of derived characters and broadens the range of meristic values, further bridging potential divisions within the *Pteropsaron*-like hemerocoetines.

Materials and Methods

Type specimens are deposited at the Western Ghat Field Research Centre, Zoological Survey of India, Kozhikode, Kerala, India (ZSI/WGRC) and the Department of Aquatic Biology and Fisheries, University of Kerala, Thiruvananthapuram, Kerala, India (DABFUK).

Measurements were made by digital micrometer and are presented as holotype, followed in parentheses by the paratype, if different. Lengths of specimens are mm standard length (SL), measured from the front of the upper lip to the base of the caudal fin (posterior end of the hypural plate); body depth is the vertical distance at the base of the first dorsal spine; body width is the maximum width side-to-side just posterior to the gill opening (unsqueezed); head length (HL) is the horizontal distance from the front of the upper lip to the posterior margin of the operculum, not including the long flap over the pectoral-fin base; head depth is the vertical distance at the midline of the orbit; snout length is the distance from the front of the upper lip to the anterior edge of the bony orbit; orbit diameter is the horizontal distance from edge to edge of the bony orbit; interorbital width is the least bony width; upper-jaw length is the full oblique length; caudal-peduncle depth is the least depth and caudal-peduncle length is the horizontal distance from the base of the last anal-fin ray to the caudal-fin base; lengths of fin spines and rays are measured to their junction with the body; caudal-fin length is the horizontal distance from the base of the fin to a vertical at the tip of the longest central ray (the filamentous uppermost branched caudal-fin ray is not included); pectoral-fin length is the length of the longest ray; pelvic-fin length is measured from the junction with the body to the stretched tip of the longest soft ray; scale counts are approximate due to many scales being missing on type specimens.

Pteropsaron indicum, n. sp.

Indian Signalfish

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Figures 1–7.

Holotype. ZSI/WGRC/IR/VER.3080, male, 82 mm SL, India, Lakshadweep Sea, off Kerala coast, 8.16°, 73.4°, about 70 m, commercial trawler, 27 November 2015.

Paratype. DABFUK/FI/305, male, 84 mm SL, same data as holotype.

Diagnosis. A species of hemerocoetine trichonotid with two separated dorsal fins, three dorsal-fin spines rooted closely together, first spine greatly elongated, second and third moderately extended, and a fused pterygiophore complex placed between 4th and 5th neural spine and 5th spine bent down below complex; second dorsal fin with 27 unbranched segmented rays, mid-fin rays greatly elongated; 29 anal-fin soft rays, all but first two rays branched, none elongated; short pectoral fin with 17 or 18 rays, branched except one to three uppermost and one or two lowermost; 1,5 pelvic fin elements, all rays branched and not elongated; extended filamentous uppermost branched caudal-fin ray; prominent maxillary spine present; no barbels on head; dorsal operculum present on iris; head mostly scaled except cheek scales absent; about 40 lateral-line scales, each large and with scalloped posterior margin; 2 upper+13 lower gill rakers; 10 precaudal+28 caudal=38 vertebrae (including urostyle); a prominent bright-yellow midlateral stripe from pectoral-fin insertion to posterior body, a dorsal stripe along base of soft dorsal-fin rays extending out along upper portion of caudal fin, and a ventral lateral stripe from mid-abdomen to base of caudal fin just above level of anal-fin base; three bright-yellow oblique bars anteriorly: one under eye, second on opercle, and third over pectoral-fin base; branchiostegal rays bright yellow; reaches at least 84 mm SL.



Figure 1. *Pteropsaron indicum*, fresh holotype, ZSI/WGRC/IR/VER.3080, male, 82 mm SL, Lakshadweep Sea, India (B. Kumar).



Figure 2. *Pteropsaron indicum*, fresh holotype, ZSI/WGRC/IR/VER.3080, male, 82 mm SL, Lakshadweep Sea, India (B. Kumar).

Description. Dorsal-fin elements III+27; anal-fin rays 29; pectoral-fin rays 17 (18); pelvic-fin elements I,5; spinous dorsal fin with a very short crowded base, first dorsal-fin spine 76 (66)% SL, second spine 30 (27)% SL, third spine 13 (10)% SL; interdorsal space 5 (7)% SL; soft-dorsal-fin base long, 59 (62)% SL, all rays segmented and unbranched, first ray 7 (7)% SL, second ray 9 (11)% SL, 10th ray 40 (35)% SL, 20th ray 20 (22)% SL, last ray 18 (24)% SL; anal-fin base long, 60 (61)% SL, no spines, all rays segmented and all but first two branched, last split to base, about 6th to 10th rays longest, first ray 6 (6)% SL, second ray 7 (8)% SL, 10th ray 9 (8)% SL, 20th ray 7 (10)% SL, last ray 8 (9)% SL; pectoral fin short, longest ray 7th from bottom, 17 (20)% SL, all rays branched, except one or two uppermost and one or two lowermost ray unbranched; pelvic fins inserted well anterior to pectoral fins and dorsal-fin spines, short, not reaching to anal-fin origin, and widely separated, pelvic-fin spine short 6 (5)% SL, all pelvic-fin rays segmented and branched, fourth ray longest, 15 (12)% SL, reaching back to about base of second anal-fin ray; caudal-fin shape uncertain due to broken rays, length of central rays 21 (24)% SL, uppermost branched ray filamentous and extended to at least 32 (broken)% SL, 6+6=12 segmented caudal-fin rays, two uppermost and two lowermost unbranched, zero to two upper and one or two lower procurent rays.

Body cylindrical, body depth 12 (11)% SL, body width 10 (9)% SL; spinous dorsal fin well anterior on body, over pectoral-fin base, predorsal length short, 28 (26)% SL; pelvic fins thoracic, insertion well anterior to pectoral-fin and dorsal-fin insertions, prepelvic length 23 (20)% SL; preanal distance 35 (35)% SL; caudal-peduncle very short, length 2 (3)% SL, caudal-peduncle depth 5 (4)% SL. Head somewhat flattened and short, head length 27 (27)% SL not counting membranous flap of operculum, counting membranous flap head length 29 (30)% SL; head depth (at midpoint of orbit) 12 (12)% SL or 42 (41)% HL; snout short and pointed, snout length 17 (18)% HL, snout length into orbital diameter 1.88 (1.72), no barbel at snout tip, a short pointed maxillary spine on each side, spine less than half pupil diameter long (Fig. 3); upper and lower lip about equal, neither distinctly protruding; jaw short, ending below mid-pupil, oblique length 40 (38)% HL; upper and lower jaws with small caniniform teeth in a narrow band with multiple irregular rows, innermost largest; a few short caniniform teeth in two widely separated patches, apparently palatine; no (central) vomerine teeth; tongue long and relatively narrow with a spatulate tip; eye large, orbit diameter 32 (31)% HL, a dorsal operculum present on iris (Fig. 3); interorbital very narrow, 3 (3)% HL; anterior naris a small flat opening, posterior naris a larger elliptical opening adjacent to upper orbital rim; numerous head pores in rows and patches, from behind maxillary spine to many of variable

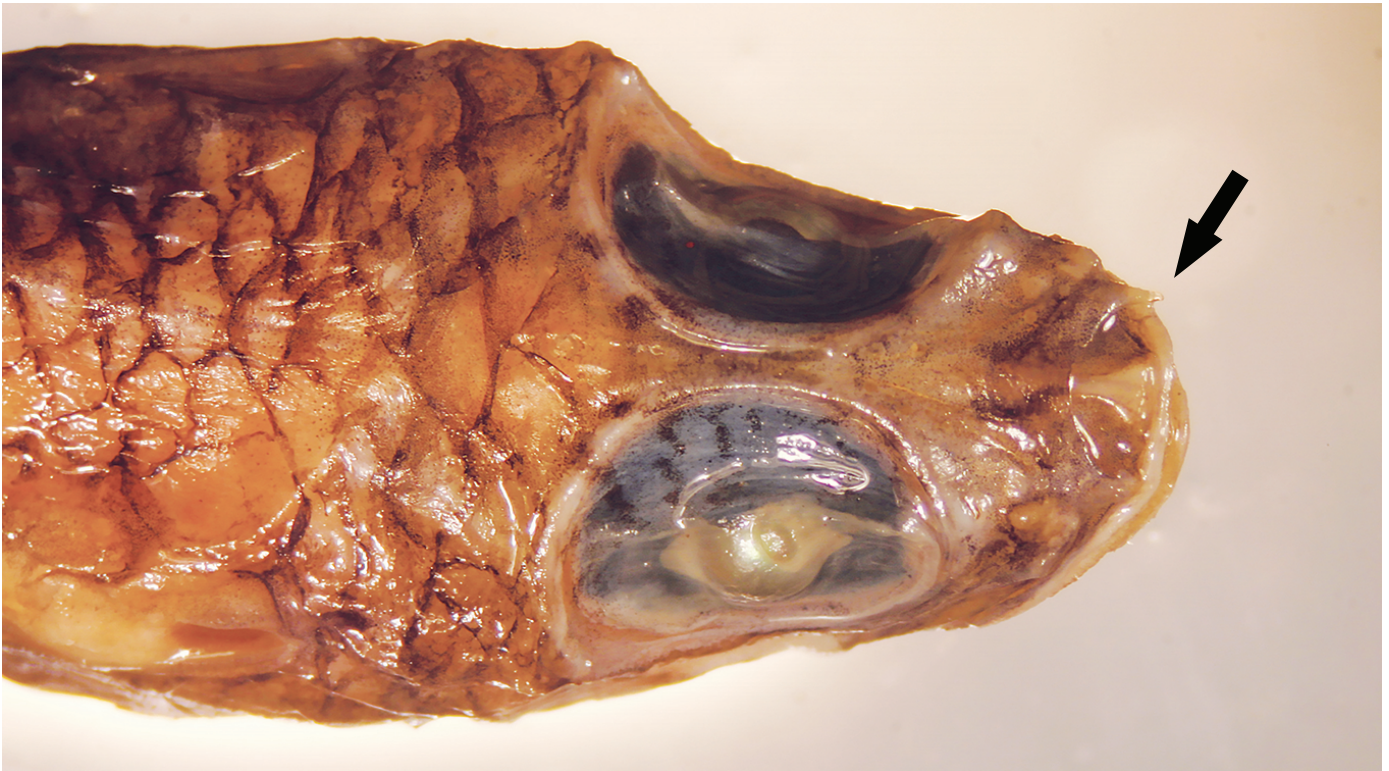


Figure 3. *Pteropsaron indicum*, preserved holotype, dorsal view of head, arrow indicates left maxillary spine; note dorsal operculum on iris of left eye, ZSI/WGRC/IR/VER.3080, male, 82 mm SL, Lakshadweep Sea, India (B.C. Victor).

size around entire orbital rim with patch at the upper posterior quadrant, interorbital with a pair of larger pores side by side behind a transverse row of 4 smaller pores, rows of numerous pores along preopercular and opercular margins and along mandible; preopercle a tilted-back L-shape, rounded angle, edge mostly smooth with small irregularities; opercular margin mostly smooth with a large membranous flap, about pupil-sized, extending over pectoral-fin base. Gill rakers few, short, about one tenth length of gill filament: two on upper limb and 13 on lower limb of first branchial arch of holotype.

Body covered with large cycloid scales, head with large cycloid scales extending forward over cranium up to level of orbit (Fig. 3) and about 5 rows of scales across operculum, no scales on cheek, posterior isthmus with scales; about 40 large scales along lateral midline of body, midline row tubed, with pointed scalloped posterior margins (Fig. 4), three rows of scales between tubed row and base of dorsal fin, no scales on fins.

Urogenital papilla a short narrow tube in male type specimens.

Osteology. (Figs. 5–7) Precaudal vertebrae 10 plus 28 caudal vertebrae (including urostyle); anal-fin pterygiophores relatively long, especially anteriorly, with 4 inserted anterior to first hemal spine (Fig. 5).

Caudal osteology is somewhat simplified, with hypochordal elements of caudal skeleton mostly fused into two plates, deeply separated at

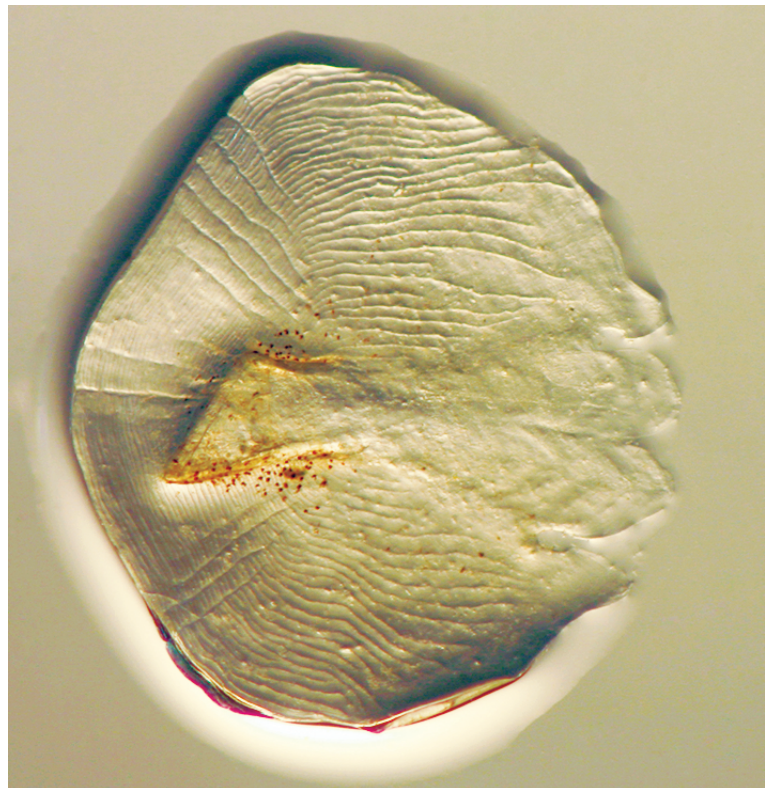


Figure 4. *Pteropsaron indicum*, lateral-line scale of holotype, showing pointed crenulations on posterior margin of tubed scale (on the right) (B.C. Victor).

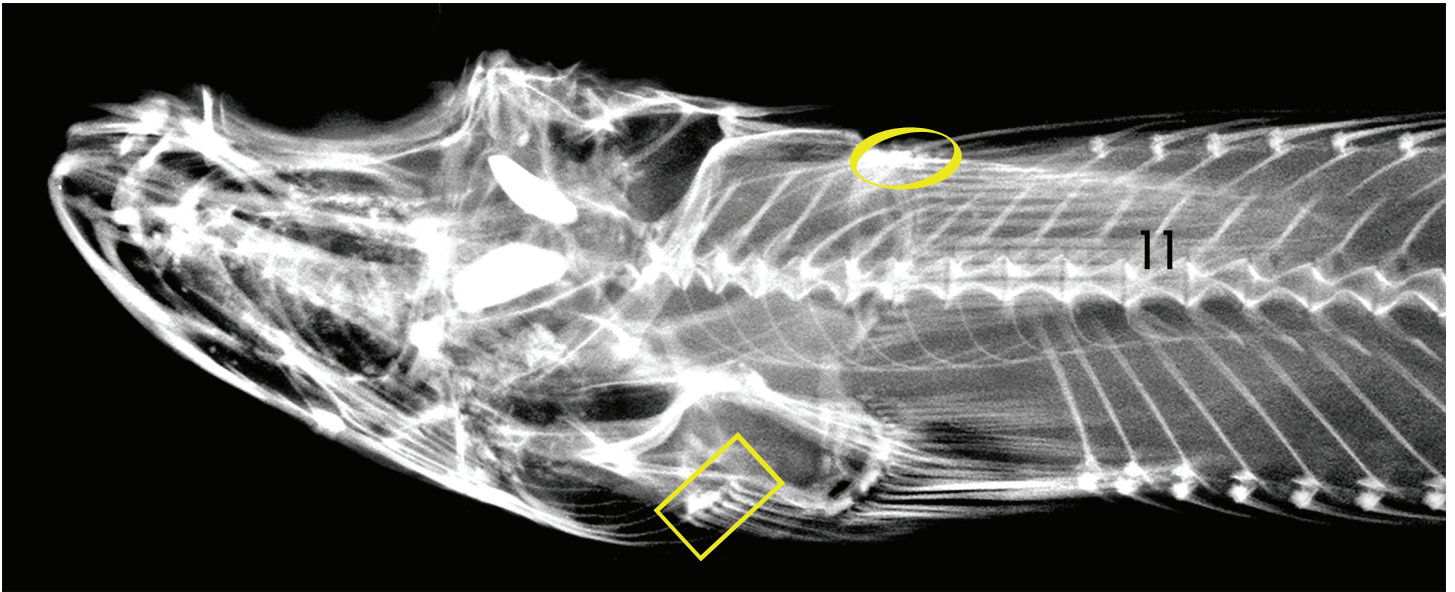


Figure 5. *Pteropsaron indicum*, x-ray of anterior skeleton of holotype, yellow circle indicates the dorsal-fin-spine-ptyerygiophore complex, yellow box indicates pelvic-fin insertion; numeral 11 overlies the eleventh vertebral body (the first caudal vertebra), with a hemal spine (courtesy Benjamin Frable).

midline; upper plate is composed of fully fused urostyle and hypurals 3, 4 and 5, whereas lower plate is composed of fully fused hypurals 1 and 2, and adjacent autogenous parhypural, especially well separated proximally. Two long, thin, closely adjacent epurals are well separated from upper plate; last neural spine, on preural vertebral body 2 (pu2), is long and about same size as spine of pu3. Ventrally, last hemal spine is long and widened and supports lowermost two caudal-fin rays.

Micro-computed-tomography images (Fig. 7) show dorsal-fin-spine-ptyerygiophore complex in fine detail, placed between neural spines 4 and 5: fourth neural spine is somewhat shortened, probably making way for well developed muscles that wave spines in life, while fifth is bent far down to make space, followed by less bent-down neural spines 6 and 7. First ptyerygiophore of second dorsal fin is inserted between neural spines 7 and 8. Fused ptyerygiophore complex supports three spines, which have flanged bases that pivot on top of a central dorsal keel on complex; fused complex has a large, ridged, ventral process curved forward, likely for muscle insertions to move first spine: first process is followed by 4 about-equal shorter processes pointing straight down, and then posterior end of fused complex ends in a bifurcated point. This arrangement suggests possibility additional processes are vestigial ptyerygiophores of lost additional dorsal-fin spines, especially since other species in complex typically have 4 to 6 dorsal-fin spines.

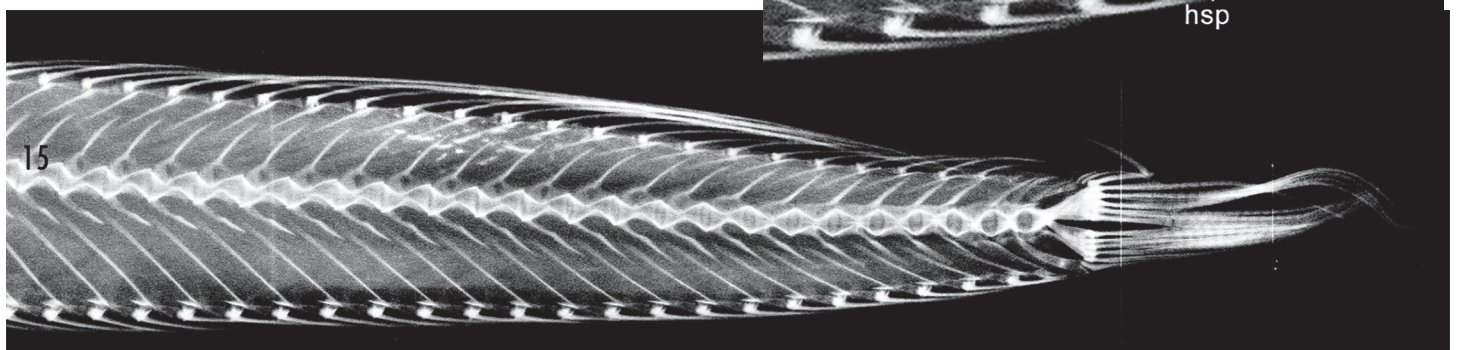


Figure 6. *Pteropsaron indicum*, x-ray of posterior skeleton of holotype: inset of caudal skeleton: nsp=neural spine, ep=epural, pc=procurrent ray, uh=urohyal, h=hypural, ph=parhypural, hsp=hemal spine (courtesy Benjamin Frable).

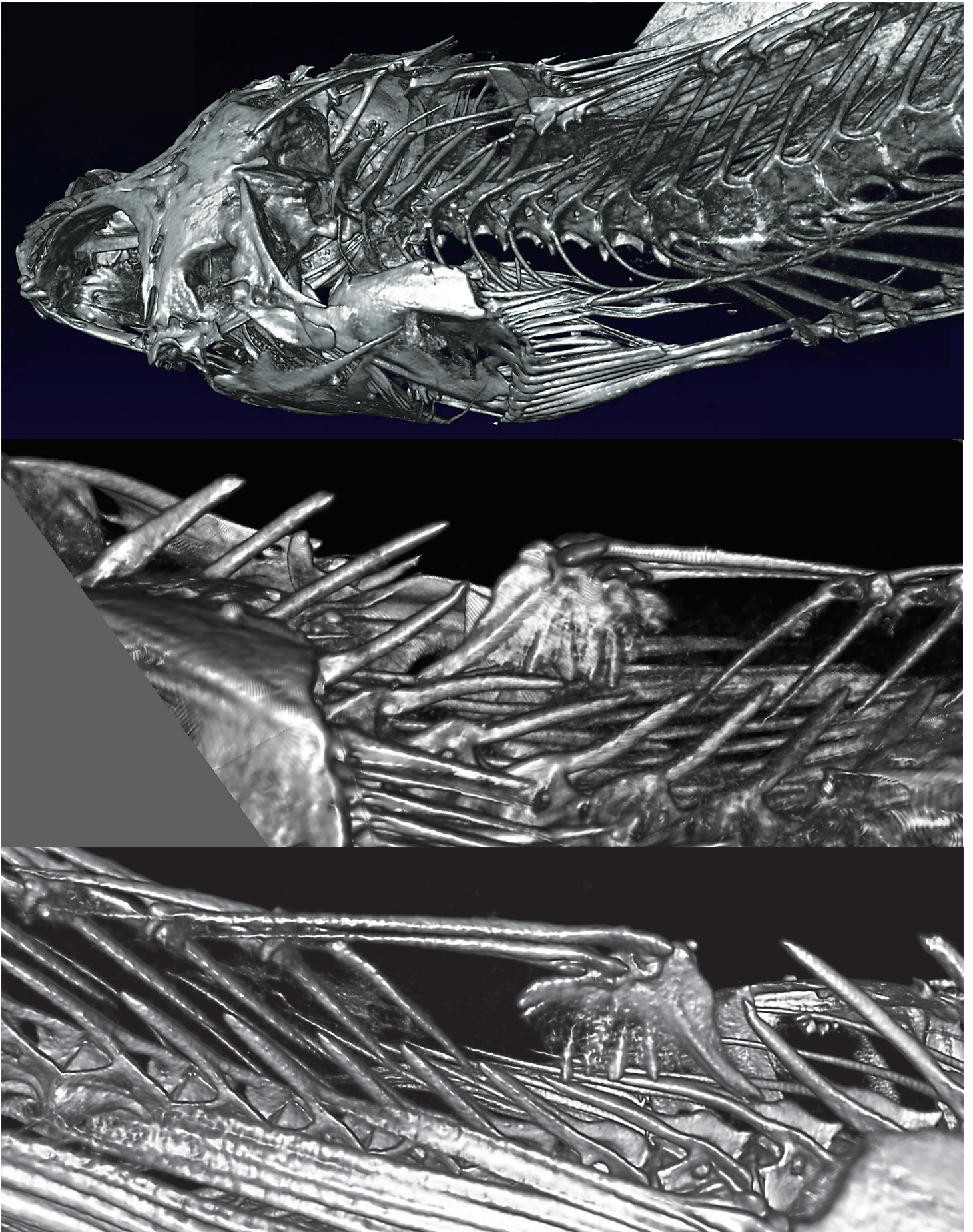


Figure 7. *Pteropsaron indicum*, micro-CT of paratype, DABFUK/FI/305, male, 84 mm SL: upper and middle are left side view, bottom is right side view (courtesy Benjamin Frable).

Color when fresh. (Figs. 1 & 2) Head and body a pale grayish pink, criss-crossed with dark margins of large scale pockets. Dorsal fin with a thick, bright-yellow band running along basal membrane of both dorsal fins and widening onto caudal fin and likely continuing out along extended caudal-fin filament off uppermost branched caudal-fin ray; a second thick, bright-yellow band running along lateral line from below upper operculum, ending abruptly about 8 scales before caudal-fin base; and a third thick, bright-yellow band ventrally on body from abdomen well behind pectoral-fin base, along lower body adjacent to anal-fin insertion, to base of caudal fin; remaining dorsal-fin spines and rays dark and membranes of all median fins dusky or pinkish, pectoral-fin membranes clear. Head with three thick, short, and oblique bright-yellow bars, one under orbital rim to corner of jaw, second over mid-operculum, and third on opercular flap overlying pectoral-fin base. Branchiostegal rays and anterior isthmus bright yellow.

Color in ethanol. (Fig. 3) Head and body a uniform yellowish brown with a network of thin dark lines outlining scale pockets; yellow stripes and bars visible as areas without shading; fins translucent.

Etymology. The specific epithet refers to the origin of the species from Indian waters and is a neuter singular adjective in the nominative case.

Distribution. The new species is known only from the type location in the Lakshadweep Sea (Laccadive Sea) off Kerala, southern India. The type specimens were reportedly taken in a trawl at about 70 m depth.

Comparisons. The new species possesses a set of features in a unique combination that does not naturally group with any other species in the complex. It shares the most characters with *P. formosensis*, but still differs in fundamental features (number of dorsal-fin spines and fin-ray numbers, shapes, and lengths). It shares the reduced number of three dorsal spines only with *P. springeri* and *P. longipinnis*; the former has a singular placement of the dorsal-fin-pterygiophore complex far forward near the occiput and the latter has extremely elongated pelvic fins on which it perches on the bottom (Allen & Erdmann 2012). The extended upper caudal-fin ray is shared apparently only with *P. dabfar* (Iwamoto 2014). Both *P. formosensis* and *P. heemstrai* have somewhat elongated dorsal-fin soft rays, but they are much shorter than the extreme elongation in *P. indicum* (Smith & Johnson 2007). Two species have greatly elongated anal-fin soft rays, *P. evolans* and *P. heemstrai*, and they are unbranched (also *P. incisum*); however *P. indicum* has short anal-fin soft rays and they are branched. The lateral-line scales of *P. indicum*, with large pointed crenulations, are unlike those illustrated for *P. levitoni* (Iwamoto 2014: Fig. 5), or the scales with prongs illustrated for *P. heemstrai* (Nelson 1982: Fig. 1), or the scales with a single notch reported for *P. springeri* (Smith & Johnson 2007). The dorsal operculum on the iris is shared with *P. dabfar*, *P. formosensis*, *O. karlik*, *P. levitoni*, *P. natalensis*, and *P. springeri*. The prominent thick, bright-yellow bars on the head and pectoral-fin base and a mid-lateral stripe of the same color are shared with *P. formosensis* (Suzuki et al. 1996: Fig. 1), but the latter does not have the upper and lower additional stripes of the new species; *P. dabfar* also has prominent mid-lateral, bright-yellow markings, but as a row of large rounded spots (Iwamoto 2014: fig. 1). The remaining species all have relatively short dorsal-fin spines and rays: i.e. *P. incisum*, *O. karlik*, *P. natalensis*, and *P. verecundum*.

Pteropsaron indicum, at over 80 mm SL, is much larger than most species which reach a maximum of less than about 30 mm SL, with a couple reaching about 50 mm SL, and only one, *P. evolans*, as large as 70 mm SL. The vertebral count of 37+1 is greater than any species other than *P. longipinnis*, which shares the count, and the count of 40 lateral-line scales is higher than all congeners. In addition, *P. indicum* has more, often many more, dorsal-fin and anal-fin rays than the other species of the complex.

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