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# A new species of longnose skate *Dipturus* (Rajiformes: Rajidae) from the western Indian Ocean, with a redescription of *Dipturus johannisdavisi*

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## Abstract

The longnose skate genus *Dipturus* Rafinesque, 1810 (Rajiformes: Rajidae) is poorly documented in the northern Indian Ocean, where the species diversity and taxonomy remain inadequately resolved. The Travancore Skate, *Dipturus johannisdavisi* (Alcock, 1899), originally described from a single juvenile specimen, has not been formally redescribed, resulting in persistent uncertainty regarding its diagnostic characters and taxonomic status. Recent collections of *Dipturus* skates landed as bycatch from deep-sea trawl fisheries along the southwest coast of India included both *D. johannisdavisi* and an undescribed species of *Dipturus* captured from depths of 400–600 m.

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We describe the new species, the Arabian Skate, as *Dipturus dhritiae*, sp. nov. It can be distinguished from close congeners by a combination of morphological characters, including disc proportions, thorn arrangement, and meristic counts, as well as by a 3.8–6.1% Kimura 2-parameter (K2P) pairwise difference in available mtDNA-barcode sequences. In addition, we present a comprehensive redescription of *D. johannisdavisi* based on the newly collected material from the southeastern Arabian Sea, incorporating detailed morphometric and meristic data together with COI mtDNA sequencing. These comparative morphological and molecular analyses clarify the taxonomic identity of *D. johannisdavisi*. Our findings reveal previously unrecognized diversity within *Dipturus* skates in Indian waters and provide a robust framework for future taxonomic, ecological, and conservation assessments of skates in the region.

**Key words:** taxonomy, fishes, ichthyology, Chondrichthyes, elasmobranch, Arabian skate, India, mtDNA, COI

## Introduction

The longnose skate genus *Dipturus* Rafinesque, 1810 (Rajiformes: Rajidae) represents one of the most species-rich and widely distributed groups of skates, occurring in temperate to tropical waters on continental shelves and slopes worldwide (Last & Yearsley 2002, Ebert & Compagno 2007, Last et al. 2016). Members of the genus are characterized by an elongated, acutely pointed snout and a generally large body size, with several species exceeding 100 cm TL (Last et al. 2016). Despite their global distribution, the diversity and taxonomy of *Dipturus* in the northern Indian Ocean remains poorly understood, with limited regional studies and a history of taxonomic uncertainty.

In Indian waters, the genus is currently represented by a small number of nominal species. Among these, the Travancore skate, *Dipturus johannisdavisi* (Alcock, 1899), is the only well-documented species, originally described from a single juvenile specimen. The absence of additional material and the poor condition of the holotype have hindered detailed morphological comparisons, resulting in ambiguity in the identification and diagnosis of the species. Consequently, *D. johannisdavisi* remains inadequately characterized and is currently listed as Data Deficient on the IUCN Red List (Pollom et al. 2019a). Although the species is regularly encountered as bycatch in deep-sea trawl fisheries along the southwest coast of India, it has not been subjected to comprehensive morphometric or molecular investigation.

The taxonomic status of other *Dipturus* species reported from the region also remains uncertain. Many records of putative *Dipturus springeri* (Wallace, 1967) from the Indian Ocean have been questioned, with suggestions that these specimens may represent undescribed taxa (Pollom et al. 2019b). Despite extensive surveys of deep-sea elasmobranchs along the Indian coast between 2008 and 2026, we have encountered no confirmed specimens of *D. springeri*, and it is likely that reports from Indian waters are based on misidentifications of a large undescribed *Dipturus* species. Notably, Bineesh et al. (2017) DNA-barcoded this unrecognized large-sized skate and identified it as *Dipturus* sp. A, highlighting the need for a detailed taxonomic reassessment using integrative approaches.

During our fish-landing surveys along the southwest coast of India, we obtained multiple specimens of *Dipturus* from deep-sea trawl fisheries operating in the southeastern Arabian Sea. Detailed examination of these specimens revealed the presence of two distinct taxa: one corresponding to *D. johannisdavisi* and the other representing an undescribed species. In the present study, we describe the new species based on morphological and genetic evidence and provide comparisons with congeners occurring in the Indian Ocean. We also provide a comprehensive redescription of *D. johannisdavisi* based on the newly collected material, incorporating detailed morphometric, meristic, and molecular data. This integrative taxonomic assessment clarifies the identity of *D. johannisdavisi* and contributes to a better understanding of the diversity of skates in Indian waters.

## Materials and Methods

**Specimen collection and preservation.** All specimens of *Dipturus* used in this study were collected from Sakthikulangara Fishing Harbour, Kollam, Kerala (8.9319°, 76.5411°), along the southwest Indian coast in the southeastern Arabian Sea, western Indian Ocean. These skates were landed as bycatch in deep-sea trawl fisheries. There were multiple sampling events between April 2022 and March 2025: specimens of the new species were

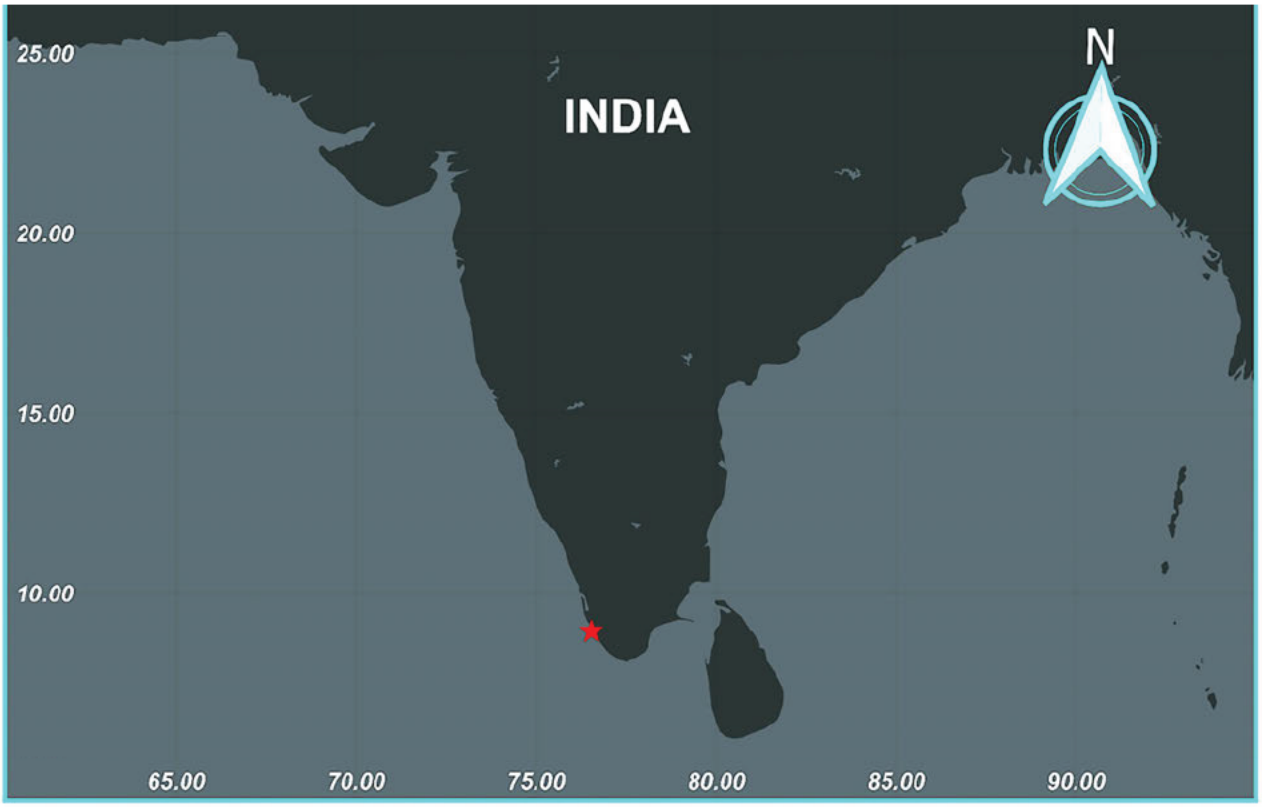


**Figure 1.** Map showing the collection site of *Dipturus dhritiae* sp. nov. & *D. johannisdavisi* at Sakthikulangara Fishing Harbour (8.9319°, 76.5411°), on the southwest coast of India.

collected on 26 April 2022 (n= 3), 23 December 2024 (n= 2), 27 March 2025 (n= 1), and 29 March 2025 (n= 2) while specimens of *D. johannisdavisi* were obtained on 8 April 2024 (n= 1) and 20 December 2024 (n= 4). Fresh specimens were photographed in dorsal and ventral views using Nikon D7500 and D3500 digital cameras. Tissue samples (about 100 mg) of skin and muscle were excised from the ventral surface of the disc and preserved in 95% ethanol for molecular analyses. Specimens were subsequently fixed in 10% formalin and transported to the Marine Biology Regional Centre, Zoological Survey of India (ZSI), Chennai, for further examination. All specimens were registered and deposited in the National Zoological Collections at ZSI, Chennai.

**Morphological analysis.** A total of 43 morphometric measurements (Table 1) were taken and meristic characters recorded from formalin-fixed specimens following Last et al. (2008), with each specimen measured individually. Vertebral counts were obtained from radiographic images, also following Last et al. (2008).

**Molecular analysis.** Genomic DNA was extracted using the QIAGEN DNeasy Blood and Tissue Kit following the manufacturer's protocol. A partial fragment of the mitochondrial cytochrome c oxidase subunit I (COI) gene was amplified using the universal primers FishF1 (5′–TCA ACC AAC CAC AAA GAG ATT GGC AC–3′) and FishR1 (5′–TAG ACT TCT GGG TGG CCA AAG AAT CA–3′) (Ward et al. 2005). PCR amplification was performed in a 25 µL reaction volume under standard conditions. The thermal cycling profile consisted of an initial denaturation at 94°C for 5 min, followed by 35 cycles of denaturation at 94°C for 30 s, annealing at 50°C for 30 s, and extension at 72°C for 1 min, with a final extension at 72°C for 10 min. PCR products were visualized on a 1% agarose gel and purified using the QIAGEN PCR Purification Kit. Sequencing was carried out on an ABI 3730 DNA sequencer. All sequences generated in this study were deposited in GenBank (accession numbers: PV361261–PV361263, PX411173–PX411174, PV366400–PV366403, PX446552–PX446553).

**Sequence analysis and phylogenetics.** COI sequences were aligned and edited using BioEdit v7.0.5.2 (Hall 1999). All sequences were manually checked in both the forward and reverse directions to ensure accuracy. Reference sequences of congeneric species were retrieved from GenBank for comparative analyses. Pairwise genetic distances were calculated using the Kimura 2-parameter (K2P) model with uniform rates among sites in MEGA12 (Kumar et al. 2024). A Neighbor-Joining (NJ) tree was reconstructed under the K2P model in MEGA12, and node support was assessed using 1,000 bootstrap replicates. The resulting NJ tree was visualized and edited using FigTree v1.4.4 (Rambaut 2018).

## *Dipturus dhritiae* sp. nov.

Arabian Skate

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Figures 2–8, Table 1

**Holotype.** ZSI/MBRC/F/3079, 1064 mm TL, mature male, India, Kerala, Kollam, Sakthikulangara Fishing Harbour, 8.9319°, 76.5411°, landing from deep-sea trawling, 200–600 m depth, 26 April 2022.

**Paratypes.** MZSI/MBRC/F/3080, 1315 mm TL, female; ZSI/MBRC/F/3318, 1022 mm TL, mature male, collected with holotype. ZSI/MBRC/F/3372, 1219 mm TL, female; ZSI/MBRC/F/3373, 1264 mm TL, female, same location as holotype, 23 December 2024. ZSI/MBRC/F/3374, 992 mm TL, mature male, same location as holotype, 27 March 2025. ZSI/MBRC/F/3375, 1095 mm TL, female; ZSI/MBRC/F/3376, 1004 mm TL, mature male, same location as holotype, 29 March 2025.

**Diagnosis.** A large species of *Dipturus*, distinguished by following combination of characters; single, median, dorsal thorn row present on disc; 5 thorn rows along tail. Preorbital snout length 18.9% TL (16.9–22.1%); preoral

**Figure 2.** *Dipturus dhritiae* n. sp., fresh holotype, ZSI/MBRC/F/3079, 1064 mm TL, mature male, dorsal view (upper left) and ventral view (lower right), Kerala, India (K.K. Bineesh).

snout length 16.0% TL (15.5–19.7%); interorbital distance 0.2 (0.2–0.5) times orbit length; posterior edge of nasal curtain fringed; dorsal and caudal fins bearing small spinules; tail gradually tapering posteriorly; interdorsal space longer than base length of first dorsal fin; dorsal and ventral surfaces of disc generally prickly, except for a smooth region near rostrum; dorsal rostrum with a band of developed prickles, denser anteriorly on snout; anteriormost dorsal and ventral tips of rostrum devoid of prickles; interorbital and branchial regions prickly with a few well-developed dermal denticles. Intestinal spiral valve with 11 turns. Pectoral fins with 90 radials: 31 propterygial, 21 mesopterygial, and 38 metapterygial; pelvic fins with 1+20 radials. Vertebral count: 22 trunk vertebrae, 82 predorsal caudal vertebrae, 22 caudal vertebrae, and 13 vertebrae between origins of dorsal fins, totaling 117 vertebrae.

**Description.** (data for holotype (range for paratypes)) Disc quadrangular and relatively broad, 1.25 times wide as long in holotype and 1.23–1.28 in paratypes; disc width 73.8% TL (70.8–75.3%); disc slightly broader and more rounded posteriorly in females; disc comparatively narrower with more angular pectoral apices in males; snout angle in front of spiracles 70.9° (69.6°–75.1°); distance from snout to maximum disc width 34.2% TL (32.2–39.9%); disc with angular to narrowly rounded apices; anterior margin weakly concave, posterior margin broadly convex; margin anterior to spiracles weakly convex with a short concavity near snout tip, weakly concave from spiracles to apices of pectoral fins; apices rounded; posterior margin of disc strongly convex; free rear tips broadly rounded (Figs. 2 & 3).

**Figure 3.** *Dipturus dhritiae* n. sp., fresh female paratype, ZSI/MBRC/F/3373, 1264 mm TL, female, dorsal view (upper left) and ventral view (lower right), Kerala, India (K.K. Bineesh).

Head very long; head length (ventral) 2.8 (2.7–3) in TL and 1.6 (1.5–1.7) in disc length (DL);snout strongly produced and narrowly pointed; preorbital snout length 9.3 (6.3–13.1) times orbit diameter, 2.4 (2.6–3.3) times interorbital space, 32.3% DL (29.2–37.4%) and 18.9% TL (16.9–22.1%); preoral length 1.8 (1.7–2.0) times internarial distance, 21.7% of disc width (DW) (21.9–26.2%) and 16.0% TL (15.5–19.7%); snout tip pointed, lacking a distal process or filament; slightly broader in females. Eyes smaller than spiracles; orbit diameter 0.2 (0.2–0.5) times interorbital distance. Spiracle large, length 1.4 (1.3–1.8) times orbit diameter; opening sub-rhomboidal; distance between spiracles 1.2 (1.0–1.3) times in distance between orbits. Nostril subcircular to oval; anterior nasal flap forming an open, posterolaterally directed tube, mostly unobscured by a nasal curtain; posterior nasal lobes well developed, meeting medially to form a nasal curtain, produced posterolaterally and distal ends sub-rectangular with a posterior fringe; internarial distance 1.9 (1.8–1.9) times in distance between first gill slits and 1.0 (0.9–1.0) times in distance between fifth gill slits. Mouth width almost equal to internarial distance and 1.0 (0.8–1.0) times in internarial distance in both holotype and paratypes; lateral teeth obscured by posterior nasal flaps; teeth in quincunx pattern, dentition sexually dimorphic: blunt and flat in females, pointed and sharp in adult males (Fig. 4).

Dorsal fins medium-sized; first-dorsal-fin height 1.9 (1.7–2.3) times length of base of fin; first dorsal fin taller than second, but with equal base lengths; dorsal fins strongly raked with long bases; anterior margins convex; first-dorsal-fin apex rounded; second dorsal fin apex angular; inner margins posterodorsally directed; dorsal fins separated by an interdorsal distance 5.6 (7.7–14.4) times in distance from first-dorsal-fin origin to caudal-fin tip. Caudal fin well demarcated; caudal-fin length 2.8 (2.7–3.7) times in distance from first-dorsal-fin origin to tail tip and 1.4 (1.0–1.6) times length of base of first dorsal fin (Fig. 5).

Pelvic fins large; anterior lobes long and well developed with deeply incised lateral margins; posterior lobes elongate; anterior lobe length 13.0% TL (10.8–13.9%), with narrowly rounded to bluntly pointed tips; posterior lobe 1.2 (1.1–1.2) times anterior lobe length; lateral margins convex, inner margins weakly convex, tips rounded distally; male pelvic fins associated with well-developed claspers; posterior region slightly more robust; claspers in adult males elongate and moderately slender, extending well beyond posterior margins of pelvic fins when adpressed; clasper shaft narrow, slightly widening distally; glans moderately developed, weakly expanded laterally and only slightly dorsoventrally flattened distally, lacking a distinct spatulate terminal expansion; external surface smooth with weak longitudinal ridges; hypopyle opening distinct on ventral surface; inner surface of glans with well-differentiated terminal components, including a prominent shield and associated marginal structures; slit and cleft form defined grooves along sperm channel; rhipidion and sentinel present; distal lobe simple, narrow, and tapering, forming an unexpanded terminal extremity; claspers absent in females.

Tail slender, not strongly depressed, not tapering from base to first dorsal fin; tail base slightly more robust in males than females; tail width at pelvic-fin insertion 1.1 (1.4–2.7) times width at first-dorsal-fin origin; tail length 45.5% TL (43.4–46.8%); tail width at mid-length 1.7 (1.3–1.9) times height at pelvic-fin insertion; width at first-dorsal-fin origin 0.9 (0.8–1.0) times height at first-dorsal-fin origin; lateral tail folds present but not well

**Figure 4.** *Dipturus dhritiae* n. sp., oronasal region: male (left) paratype, ZSI/MBRC/F/3374, 992 mm TL; female (right) paratype, ZSI/MBRC/F/3375, 1095 mm TL, Kerala, India (K.K. Bineesh).

developed, visible from below first dorsal fin extending to tail tip and broadest below and behind second dorsal fin (Fig. 5).

Dorsal surface with rostral, orbital, postorbital, nuchal, median, and tail thorns; orbital thorns 17–25, regularly spaced in a semicircle from preorbit to anterior spiracle margin; unequal in size, well developed, and posteriorly

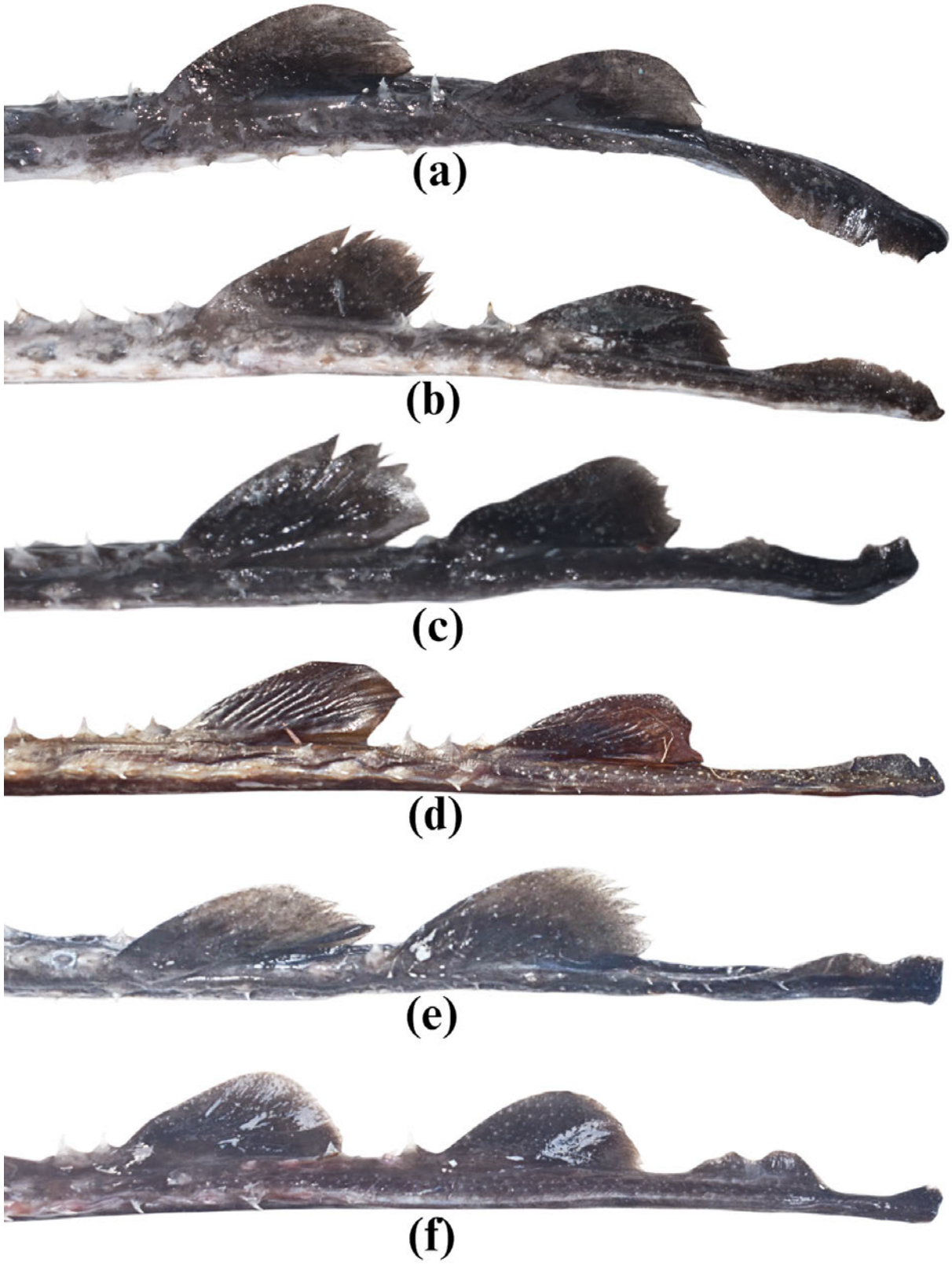


**Figure 5.** *Dipturus dhritiae* n. sp., dorsal and caudal fins: (a) holotype, ZSI/MBRC/F/3079, 1064 mm TL, mature male; (b) paratype, ZSI/MBRC/F/3080, 1315 mm TL, female; (c) paratype, ZSI/MBRC/F/3318, 1022 mm TL, mature male; (d) paratype, ZSI/MBRC/F/3373, 1264 mm TL, female; (e) paratype, ZSI/MBRC/F/3376, 1004 mm TL, mature male; (f) paratype, ZSI/MBRC/F/3375, 1095 mm TL, female; Kerala, India (K.K. Bineesh & A. Kasinath).

directed; postorbital (spiracular) thorns 11–19, located immediately behind last orbital thorn; nuchal thorns variable, holotype bears seven thorns with expanded bases, paratypes have 5–9 thorns; midback thorns also variable, holotype male has 13, male paratypes 13–16, and female paratypes 20–28, arranged in a single median row and directed posterolaterally; a small patch of thornlets present between posterior and inner disc margins; spinulation sexually dimorphic; adult males with well-developed alar and malar thorns, variably developed in juveniles, females lack alar and malar thorns and have reduced and inconspicuous dermal denticles; holotype with 5 rows of tail thorns (two irregular); median row larger than others; all thorns strongly recurved and posteriorly directed, with some staggering, equal in size across rows; middorsal tail thorns 30 and 31 (including small thorns) and lateral tail thorns 20 and 21 in paratypes, both counted from anterior end near pectoral-fin insertion; interdorsal thorns 4, two larger and two smaller (Fig. 6).

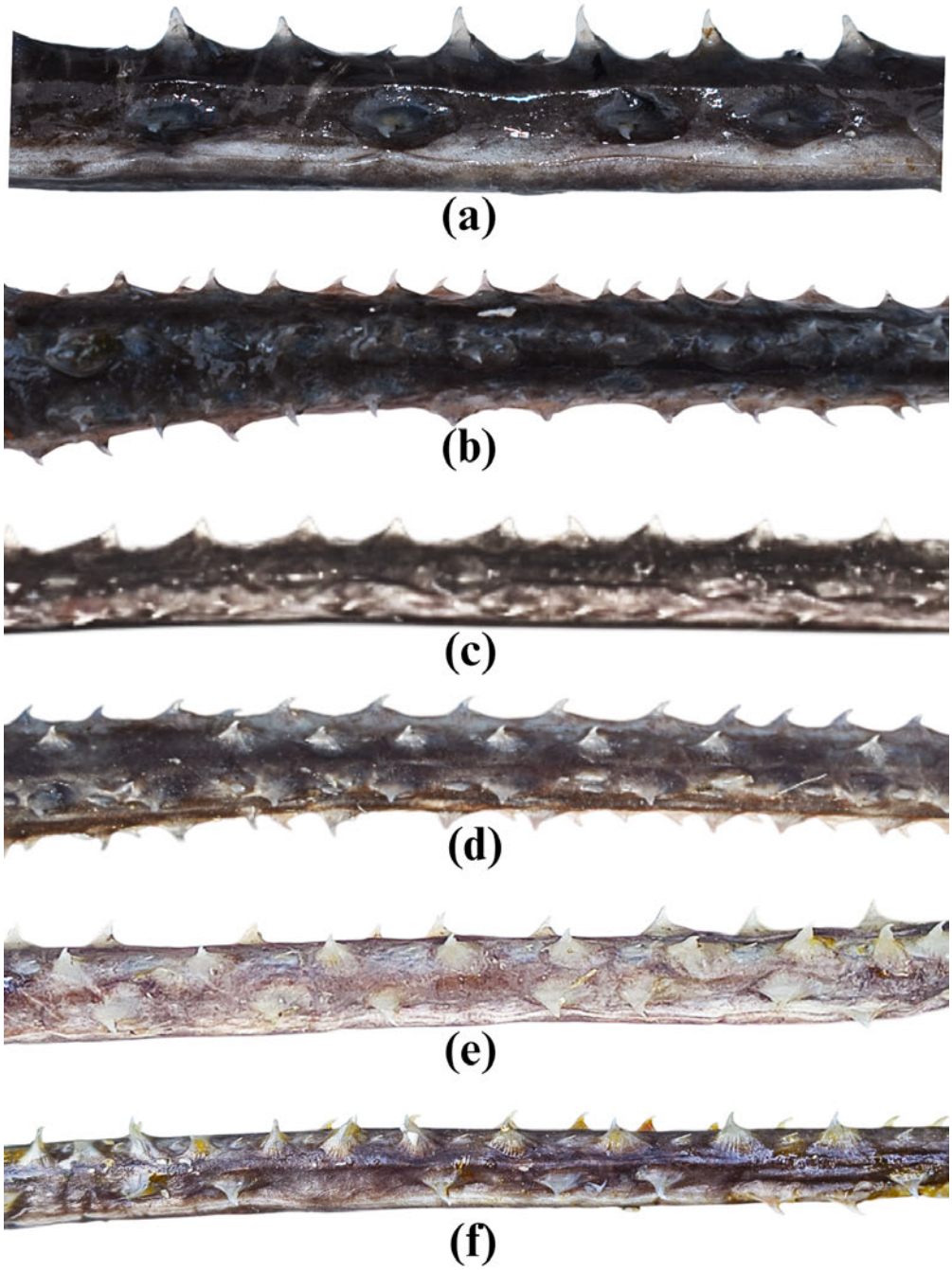


**Figure 6.** *Dipturus dhritiae* n. sp., thorns at midlength of tail: (a) holotype, ZSI/MBRC/F/3079, 1064 mm TL, mature male, lateral view; (b) paratype, ZSI/MBRC/F/3080, 1315 mm TL, female, dorsal view; (c) paratype, ZSI/MBRC/F/3375, 1095 mm TL, female, lateral view; (d) paratype, ZSI/MBRC/F/3373, 1264 mm TL, female, dorsal view; (e) paratype, ZSI/MBRC/F/3376, 1004 mm TL, mature male, dorsal view; (f) paratype, ZSI/MBRC/F/3374, 992 mm TL, mature male, dorsal view; Kerala, India (K.K. Bineesh & A. Kasinath).

**Meristic summary.** Total tooth counts: upper jaw 36 (36–37), lower jaw 38 (38–41). Pectoral fins with 90 radials: 31 propterygial, 21 mesopterygial, and 38 metapterygial. Pelvic fins with 1+ 20 radials. Vertebral count includes 22 trunk vertebrae, 82 predorsal caudal vertebrae, 22 caudal vertebrae, and 13 vertebrae between origins of dorsal fins, i.e. total count of 117 vertebrae. Intestinal spiral valve with 11 turns.

**Color when fresh.** (Figs. 1–3) Dorsal surface uniformly blackish brown, with a distinct black spot on pectoral fin; disc margin lighter and pale. Dorsal fins and margins of caudal fin dark black. Ventral surface uniformly pale brownish, with upper lobe of pelvic fins dark blackish.

**Size.** The maximum recorded size is a female reaching 131.5 cm TL; adult males range from 99.2–106.4 cm TL, while females range from 109.5–131.5 cm TL.

**Distribution.** Presently known only from the continental slope, off the southwest coast of India, eastern Arabian Sea, Indian Ocean, at a depth range of 400 to 600 m.

**Etymology.** The species is named *dhritiae* (pronounced dhri-ti-ae) in honor of Dr. Dhriti Banarjee, director of the Zoological Survey of India, for her great contributions to the development of the research sector of the country. The English common name is Arabian skate, referring to the locality from which the species was described.

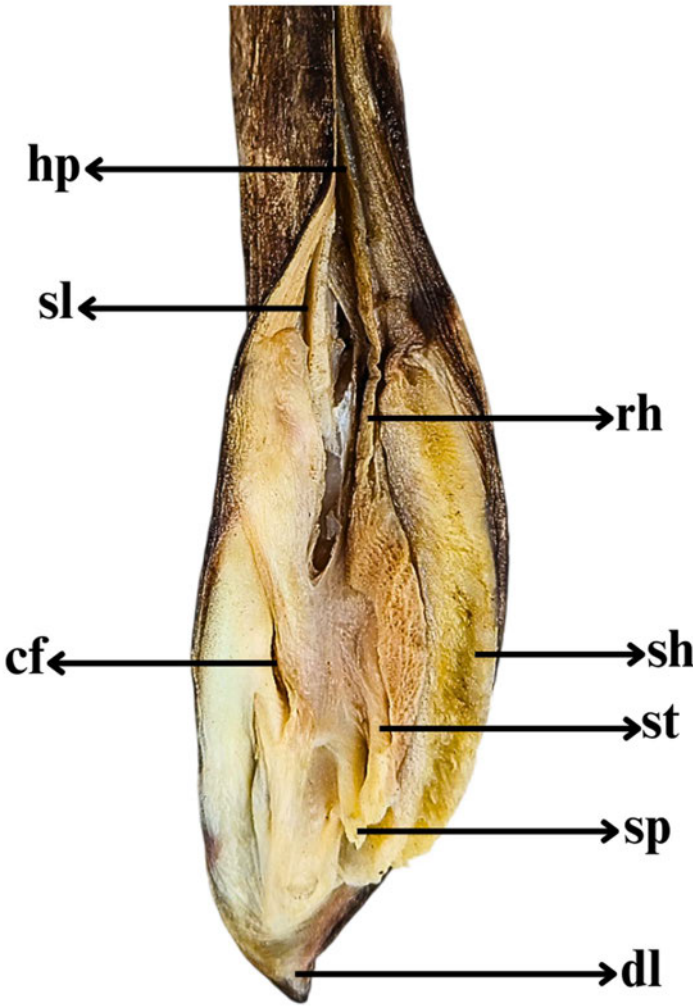


**Figure 7.** *Dipturus dhritiae* n. sp., lateral view of right clasper, holotype, ZSI/MBRC/F/3079, 1064 mm TL, mature male. cf, cleft; dl, distal lobe; hp, hypopyle; rh, rhipidion; sl, slit; st, sentinel; sh, shield; sp, spike, Kerala, India (A. Kasinath).

**Remarks on clasper morphology.** (Fig. 7) The distal portion of the clasper in *D. dhritiae* shows moderate lateral expansion of the glans, but lacks a distinctly spatulate terminal structure. A non-spatulate distal lobe has been identified as a diagnostic feature of *Dipturus*, distinguishing it from *Zearaja* (Figueroa et al. 2024). The observed clasper morphology is therefore consistent with its placement in *Dipturus*, and, in our phylogenetic analysis based on mitochondrial COI sequences, the new species falls firmly within *Dipturus*.

**Comparisons.** *Dipturus dhritiae* differs from all other known species of *Dipturus* from the western Indian Ocean, including *D. johannisdavisi*; ; *D. springeri; Dipturus crosnieri* (Séret, 1989); *Dipturus doutrei* (Cadenat, 1960); *Dipturus pullopunctatus* (Smith, 1964); *Dipturus lanceorostratus* (Wallace, 1967); *Dipturus stenorhynchus* (Wallace, 1967); and *Dipturus campbelli* (Wallace, 1967), in possessing a well-developed series of tail thorns arranged in 5 distinct rows. The median row is more prominent, bearing strongly recurved and posteriorly directed thorns, whereas the remaining rows are staggered, but similar in size and curvature. This condition is not observed in other western Indian Ocean congeners, which typically exhibit a single or reduced number of tail-thorn rows (Last et al. 2016).

Only two congeners, *D. johannisdavisi* and *D. springeri*, have previously been reported from India (Last et al. 2016), although the occurrence of the latter in Indian waters remains uncertain (type location South Africa). *Dipturus dhritiae* differs from *D. johannisdavisi* in several characters, including a larger size (to 131.5 cm TL vs. ~64 cm TL), a greater number of nuchal thorns (7 vs. one), and having a distinct median row of 13 dorsal thorns vs. none in *D. johannisdavisi*. In addition, *D. johannisdavisi* exhibits a single median tail thorn row in males (with females bearing an additional lateral row), whereas *D. dhritiae* possesses 5 well-developed tail-thorn rows.

*Dipturus springeri* is a much larger species (up to 192 cm) than the new species (males range from 99.2–106.4 cm TL, while females range from 109.5–131.5 cm TL).

In morphology, *D. springeri* is readily distinguished from *D. dhritiae* by having a single median tail thorn (vs. 5 rows), a higher number of pectoral-fin radials (105–106 vs. 90), and a relatively broader disc (disc width 1.3–1.4 times disc length vs. 1.2 times disc length). The tail in *D. springeri* is shorter (0.8–0.9 times precloacal length) compared to the length of the tail of *D. dhritiae* (1.1–1.3 times precloacal length) (Last et al. 2016).

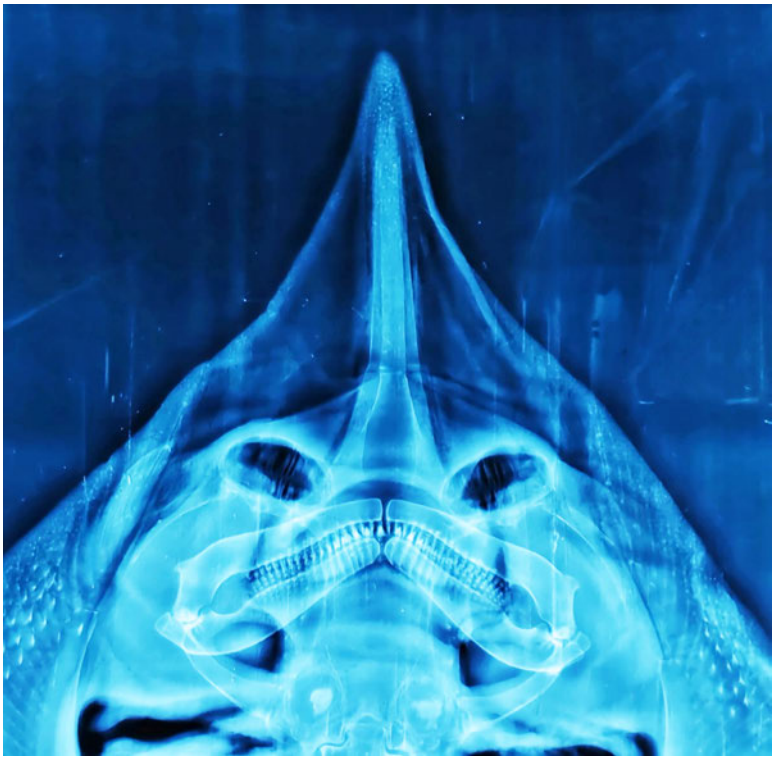

**Figure 8.** *Dipturus dhritiae* n. sp., Radiograph of head, holotype, ZSI/MBRC/F/3079, 1064 mm TL, mature male. Kerala, India (A. Kasinath).

TABLE 1

Proportional measurements of type specimens of *Dipturus dhritiae* sp. nov. vs. range for *Dipturus johannisdavisi* as percentages of total length

(n=7 paratypes and n=5 *D. johannisdavisi*)

| | holotype | paratypes | *D. johannis davisi* | | holotype | paratypes | *D. johannis davisi* |
|---|---|---|---|---|---|---|---|
| **Total length (TL)** | **1064** | **992–1315** | **581–642** | Width of first gill opening | 1.8 | 1.9–2.6 | 1.8–2.0 |
| Disc width (DW) | 73.8 | 70.8–75.3 | 65.2–71.1 | Width of fifth gill opening | 1.5 | 1.3–1.9 | 1.7–1.9 |
| Disc length (Direct) | 58.7 | 54.9–59.0 | 51.5–55.2 | Distance between first gill openings | 16.9 | 16.0–17.6 | 13.5–15.5 |
| Snout to maximum width | 34.2 | 32.2–39.9 | 32.3–36.3 | Distance between fifth gill openings | 8.8 | 8.3–9.4 | 7.5–9.1 |
| Snout length (preorbital direct) | 18.9 | 16.9–22.1 | 15.1–17.7 | Clasper (post cloacal length) | 24.0 | 24.5–26.0 | 23.2–24.4 |
| Snout to spiracle | 23.5 | 22.1–26.6 | 20.2–22.5 | Length of anterior pelvic lobe | 13.0 | 10.8–13.9 | 14.1–17.1 |
| Head (dorsal length) | 22.9 | 22.7–26.3 | 20.3–23.2 | Length of posterior pelvic lobe | 16.3 | 12.9–16.6 | 15.1–19.5 |
| Orbit diameter | 2.0 | 1.6–3.7 | 2.7–3.3 | Pelvic base width | 9.2 | 6.1–10.9 | 6.9–8.5 |
| Orbit and spiracle length | 4.8 | 4.7–5.8 | 5.1–5.9 | Tail at axil of pelvic fins (width) | 2.4 | 2.4–3.1 | 3.2–3.6 |
| Spiracle length (main aperture) | 2.8 | 3.1–3.7 | 3.0–3.3 | Tail at axil of pelvic fins (height) | 2.2 | 1.8–2.6 | 1.7–2.2 |
| Distance between orbits | 7.7 | 6.4–10.2 | 6.3–6.7 | Tail at midlength (width) | 1.2 | 1.0–1.5 | 1.5–1.8 |
| Distance between spiracles | 6.2 | 5.7–6.2 | 5.5–6.0 | Tail at midlength (height) | 1.4 | 1.2–1.5 | 1.3–1.7 |
| Snout to cloaca (1st hemal spine) | 55.1 | 53.4–56.6 | 51.0–54.2 | Tail at D1 origin (width) | 1.1 | 0.9–1.2 | 1.1–1.9 |
| Distance-cloaca to caudal-fin tip | 45.5 | 43.4–46.8 | 45.1–48.3 | Tail at D1 origin (height) | 1.1 | 0.9–1.4 | 1.1–1.5 |
| Ventral snout length (pre upper jaw) | 16.0 | 15.5–19.7 | 14.8–17.9 | D1 base length | 3.3 | 3.4–3.5 | 4.6–5.4 |
| Prenasal length | 15.8 | 13.9–19.0 | 13.3–15.3 | D1 height | 1.7 | 1.5–1.9 | 2.3–2.9 |
| Ventral head length (to fifth gill) | 35.2 | 32.8–36.5 | 28.4–31.9 | D1 origin to caudal-fin tip | 14.1 | 12.5–16.0 | 17.3–19.7 |
| Mouth width | 8.6 | 8.6–10.2 | 8.3–9.2 | D2 origin to caudal-fin tip | 9.1 | 8.0–10.4 | 11.0–12.7 |
| Distance between nostrils | 8.6 | 8.2–9.6 | 8.2–8.8 | Caudal-fin length | 4.8 | 3.8–5.7 | 6.3–8.1 |
| Nasal curtain length | 4.4 | 3.5–4.6 | 3.6–4.3 | Cloaca to pelvic-clasper insertion | 10.4 | 9.8–11.2 | 9.7–11.3 |
| Nasal curtain (total width) | 9.8 | 9.4–11.0 | 9.2–9.8 | | | | |

**Phylogenetic analysis.**

Molecular analyses based on mitochondrial COI sequences supported the distinctiveness of *Dipturus dhritiae*, showing Kimura 2-parameter (K2P) sequence divergences of 3.8–4.7% from *D. johannisdavisi*, 4.9–5.2% from *D. springeri*, 5.4–6.0% from *D. pullopunctatus*, 5.6–6.1% from *D. campbelli*, 4.9–5.5% from *Dipturus trachyderma* (Krefft & Stehmann, 1975), 5.3–6.0% from *Zearaja brevicaudata* (Marini, 1933), and 4.0–4.7% from *Dipturus* sp. B (Fig. 9). The intraspecific K2P divergence within *D. dhritiae* ranged from 0.2–0.7%, whereas the minimum interspecific divergence was 3.8%, indicating a clear barcode gap between the new species and its congeners. A Neighbor-Joining (NJ) tree reconstructed under the K2P model with 1,000 bootstrap replicates recovered *D. dhritiae* as a distinct lineage, clustering with the 5 other species in the clade. Any sister relationship to *D. johannisdavisi* (or *Dipturus* sp. B or the others) for the new species was not supported (bootstrap value 0.46). Additional comparative sequences from the Atlantic Ocean of *D. trachyderma* and *Z. brevicaudata* were included to provide broader taxonomic context. Genetic divergence values fall within the range typically reported for interspecific differences in elasmobranch COI barcoding studies. The barcode analysis also indicated *Dipturus* sp. B to represent a distinct, currently undescribed taxon, for which a formal description is in preparation.

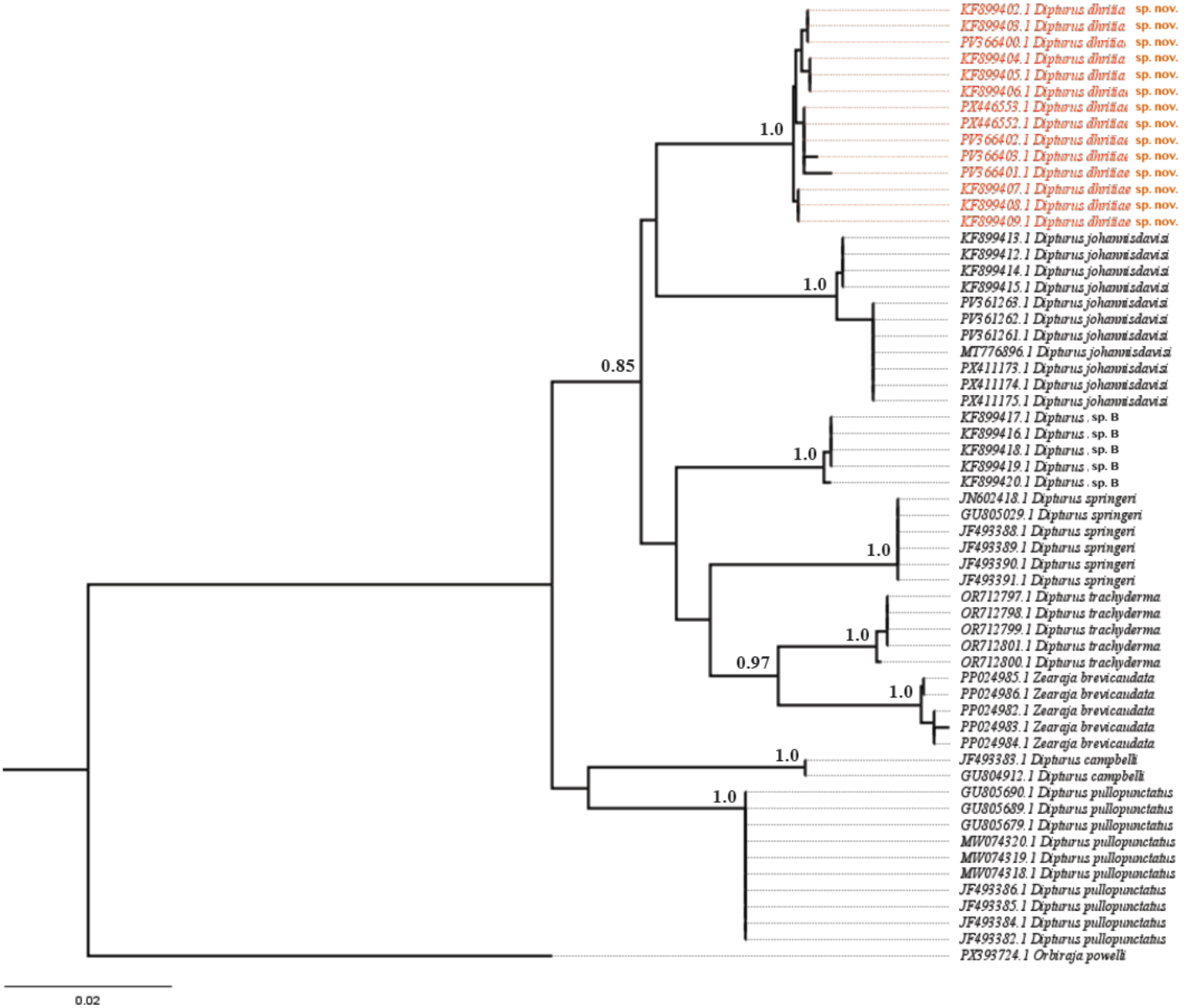


**Figure 9.** Neighbor-Joining (NJ) tree based on mitochondrial COI sequences of *Dipturus* species reconstructed using the Kimura 2-parameter (K2P) model. Numbers at the nodes indicate bootstrap support values based on 1,000 replicates, only values >0.70 are shown. *Dipturus dhritiae* sp. nov. (shown in red) is recovered as a distinct lineage. *Orbiraja powelli* was used as the outgroup.

## *Dipturus johannisdavisi* (Alcock, 1899)

Travancore Skate

Figures 10–17, Table 1

*Raja Johannis-Davisi* Alcock 1899: 21 (Laccadive Sea, off Travancore coast, India, 410–520 m); Alcock 1900: pl. XXVII, figs. 2 & 2a (illustration of holotype).

**Holotype.** ZSI F477/1, juvenile male, 209.5 mm TL, Western Indian Ocean, southeastern Arabian Sea, off Travancore coast, Investigator station 246, 1.242°, 74.954, depth 410–520 m.

**Material examined.** ZSI/MBRC/F/3276, mature male, 585 mm TL, 760 g, India, Kerala, Kollam, Sakthikulangara Fishing Harbour, 8.9319°, 76.5411°, landing from deep-sea trawling, 200–600 m depth, 8 April 2022; ZSI/MBRC/F/3272, mature male, 605 mm TL, 818 g; ZSI/MBRC/F/3273, female, 642 mm TL, 1160 g; ZSI/MBRC/F/3274, mature male, 594 mm TL, 830 g; ZSI/MBRC/F/3275, mature male, 581 mm TL, 780 g; all collected from same location, 20 December 2024.

**Diagnosis.** A medium-sized species of *Dipturus* (up to 64 cm TL), distinguished by following combination of characters: disc wide and rhombic, disc width 1.24–1.28 times disc length; snout elongated, narrowly pointed,

**Figure 10.** *Dipturus johannisdavisi,* ZSI/MBRC/F/3272, mature male, 605 mm TL, fresh, dorsal view (upper left) and ventral view (lower right), Kerala, India (K.K. Bineesh).

and supported by firm rostral cartilage; snout length 4.7–5.9 times orbit length; interorbital width narrow, 0.4–0.5 times orbit diameter. A single nuchal thorn in male, two in female, a small rosette of orbital thorns surrounding the orbital rim. Upper jaw with 41 and lower jaw with 39 rows of teeth. Tail relatively short, 45.1–48.3% of TL, with a bluntly pointed tip in both sexes. Tail with a single median row of thorns extending from just behind pelvic girdle to second dorsal fin in both sexes and females additionally have a lateral row of thorns along tail. Pelvic fins with a long posterior lobe, exceeding length of anterior lobe in adult males, opposite in females; dorsal fins rounded, upright, and closely positioned near tail tip; pectoral fins with 76 radials. Predorsal vertebrae 75. When fresh, dorsal surface dark brownish-black with blackish margins on pectoral fins and ventral surface dark greyish-brown; dorsal and caudal fins blackish.

**Description.** Disc rhomboidal, wider than long, disc width 1.24–1.28 times disc length; snout angle from 67° to 71°; distance from snout to maximum disc width 32.3–36.3% of TL; anterior margin of disc double concave, with narrowly rounded apex; disc in males appearing more angular; in females broader and more rounded (Figs. 10 & 11). Head elongated with a pointed snout supported by firm cartilage; preorbital snout length 4.7–5.9 times orbit length and 2.3–2.6 times interorbital width; pre-upper-jaw length 1.7–2.0 times internarial distance; snout tip to cloaca 1.0–1.2 times longer than cloaca to tail tip; orbit small, orbit diameter 0.4–0.5 times interorbital width; spiracle oval-shaped, 1.0–1.2 times length of orbit diameter; nostrils semi-circular, nasal curtain skirt-shaped; internarial distance 1.6–1.8 times distance between first gill slits and 0.8–1.1 times distance between fifth gill slits. Mouth arched, curvature more pronounced in males; teeth unicuspid, with subcircular bases, arranged

**Figure 11.** *Dipturus johannisdavisi,* ZSI/MBRC/F/3273, female, 642 mm TL, preserved, dorsal view (upper left) and ventral view (lower right), Kerala, India (K.K. Bineesh).

**Figure 12.** *Dipturus johannisdavisi*, oronasal region: male (left), ZSI/MBRC/F/3272, 605 mm TL; female (right), ZSI/MBRC/F/3273, 642 mm TL, Kerala, India (K.K. Bineesh).

in longitudinal rows in both sexes; medial teeth cusps sub-conical, long, bluntly pointed posteriorly, directed lingually in both upper and lower jaws; lateral teeth cusps nearly flat and oblique, male cusps longer and narrower (Fig. 12).

Pelvic fins medium-sized and deeply forked; anterior pelvic lobe in males relatively shorter than posterior lobe, in females anterior lobe longer; anterior pelvic lobe 0.7–0.8 times posterior pelvic-lobe length in males and 1.1 times in females; in males anterior pelvic lobe 14.1–16.6% TL and posterior pelvic lobe 17.6–19.5% TL; in females, anterior and posterior pelvic lobes 17.1% and 15.1% TL, respectively. Claspers present only in males (Fig. 13), elongate, 23.2–24.4% TL, moderately robust proximally, becoming distally depressed with a rounded tip; glans complex with well-differentiated terminal elements: hypopyle (hp) forming proximal opening of sperm groove; shield (sh) prominent, plate-like laterally; rhipidion (rh) developed and fan-shaped; sentinel (st) elongate, positioned centrally within glans; spike (sp) present near distal region; slit (sl) and cleft (cf) forming distinct grooves associated with sperm transfer; distal lobe (dl) short and narrow, weakly developed, not elongate, and lacking a distinct distal projection.

Tail moderately long, length from cloaca to tail tip 45.1–48.3% TL; tail narrows posteriorly, tail width at pelvic-fin axil 3.7–5.5 times tail width at mid-length and 3.6–7.3 times tail width at first-dorsal-fin origin and 1.4–2.1 times tail height at pelvic-fin axil and 0.8–1.1 times tail height at mid-length and 0.7–1.5 times tail height at first-dorsal-fin origin; tail progressively more slender posteriorly ending as a bluntly pointed tip in both sexes; dorsal tail with a row of scutes extending from mid-tail to end; full-length lateral tail fold, similar in both sexes.

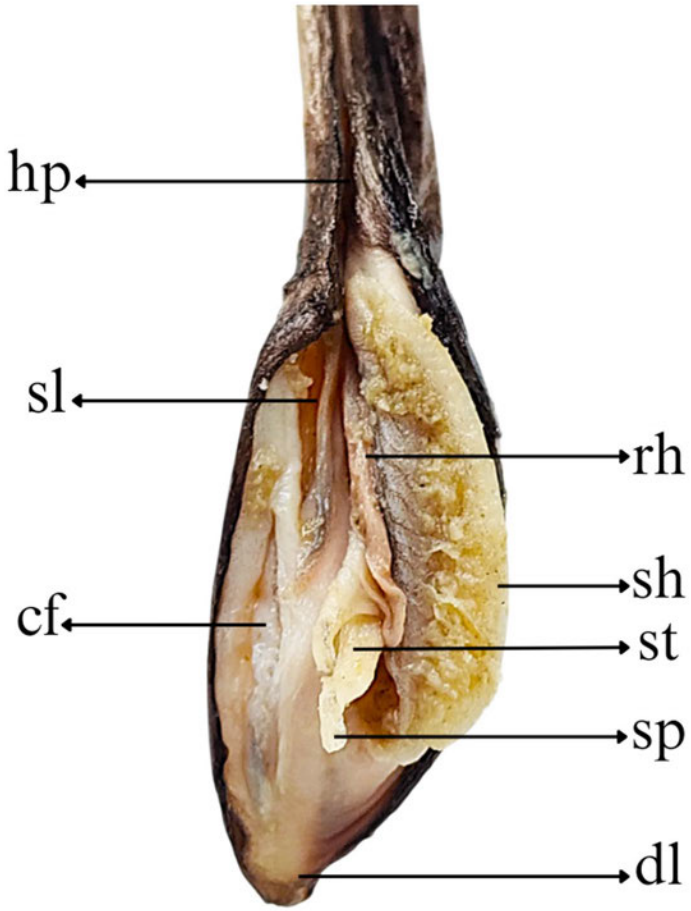


**Figure 13.** *Dipturus johannisdavisi*, lateral view of right clasper, ZSI/MBRC/F/3272, mature male, 605 mm TL. cf, cleft; dl, distal lobe; hp, hypopyle; rh, rhipidion; sl, slit; st, sentinel; sh, shield; sp, spike, Kerala, India (A. Kasinath).

**Figure 14.** *Dipturus johannisdavisi,* dorsal and caudal fins, ZSI/MBRC/F/3273, female, 642 mm TL, preserved, Kerala, India (K.K. Bineesh).

Dorsal fins moderately sized, similar in shape and size (Fig. 14); first-dorsal-fin-base length 1.6–2.2 times first-dorsal-fin height; anterior margin of both fins long and weakly convex, apices broad and rounded; posterior margins shorter, free rear tip broadly rounded; distance from first-dorsal-fin origin to tail tip 2.5–3.0 times interdorsal distance and 2.4–2.8 times caudal-fin length; caudal fin long and slender, 6.3–8.1% TL and 1.2–1.6 times first-dorsal-fin-base length.

Males with a single nuchal thorn; two in females; a rosette of 10–13 orbital thorns surrounding orbit in both sexes (Fig. 15); tail with a single median row of 25–27 thorns extends from just behind pelvic girdle to second dorsal fin in both sexes (Fig. 16); females additionally have a lateral row of thorns along tail; adult males with 23 or 24 well-developed alar thorns on pectoral fins and malar thorns present; alar and malar thorns absent in females.

**Figure 15.** *Dipturus johannisdavisi,* dorsal view, orbital thorns, ZSI/MBRC/F/3272, mature male, 605 mm TL, preserved, Kerala, India (K.K. Bineesh).

**Figure 16.** *Dipturus johannisdavisi,* thorns at midlength of tail, male (upper), ZSI/MBRC/F/ 3272, 605 mm TL; female (lower), 3273, female, 642 mm TL, preserved, Kerala, India (K.K. Bineesh).

**Meristic summary.** Total tooth counts: upper jaw 41, lower jaw 39. Pectoral fins with 76 radials: 30 propterygial, 16 mesopterygial, and 30 metapterygial. Pelvic fins with 15 radials. Vertebral count includes 20 monospondylous and 55 diplospondylous vertebrae, 75 predorsal caudal vertebrae, 17 caudal vertebrae, and 12 vertebrae between origins of dorsal fins, totaling 104 vertebrae.

**Color.** (Figs. 1–3) When fresh, dorsal surface blackish brown, with darker edges on pectoral fins. Dorsal-fin margin blackish and tip of caudal fin blackish. Ventral surface darker greyish brown, with pelvic fins light brownish with a black margin. When preserved, dorsal surface fades to brownish-black; pectoral fin edge becomes whitish, head; pelvic region becomes light brownish; ventral surface becomes pale greyish brown.

**Size.** The maximum recorded size is a female of 64 cm TL; adult males range from 58 to 60 cm TL.

**Distribution.** In the Western Indian Ocean, the Travancore Skate is found off Tanzania, the Gulf of Aden, and the southwest coast of India; in the Eastern Indian Ocean, it occurs specifically in the Bay of Bengal off Myanmar (Last et al. 2016).

**Comparisons.** *Dipturus johannisdavisi* can be distinguished from *D. crosnieri* and *D. springeri* which occur in the western Indian Ocean (Last et al. 2016) by a combination of characters: disc width is about 1.2 times disc length vs. 1.3 in *D. crosnieri* and 1.3–1.4 in *D. springeri*; snout length is 4.7–5.9 times orbit length vs. 4.4–4.5 in *D. crosnieri* and about 7 times in *D. springeri*; males possess a single nuchal thorn and females have two vs. one or two in *D. crosnieri* and none in *D. springeri*; lower-jaw tooth rows are 38 or 39 vs. 29–36 in *D. crosnieri* and 35–43 in *D. springeri*; males have the anterior pelvic-fin lobe shorter than the posterior lobe and females have the anterior lobe longer vs. subequal lobes in *D. crosnieri* and a relatively elongate anterior lobe in *D. springeri*; 76 total pectoral-fin radials vs. 84–91 in *D. crosnieri* and 105 or 106 in *D. springeri*; and a maximum size of about 64 cm TL vs. 61 cm TL in *D. crosnieri* and up to 192 cm in *D. springeri* (Last et al. 2016).

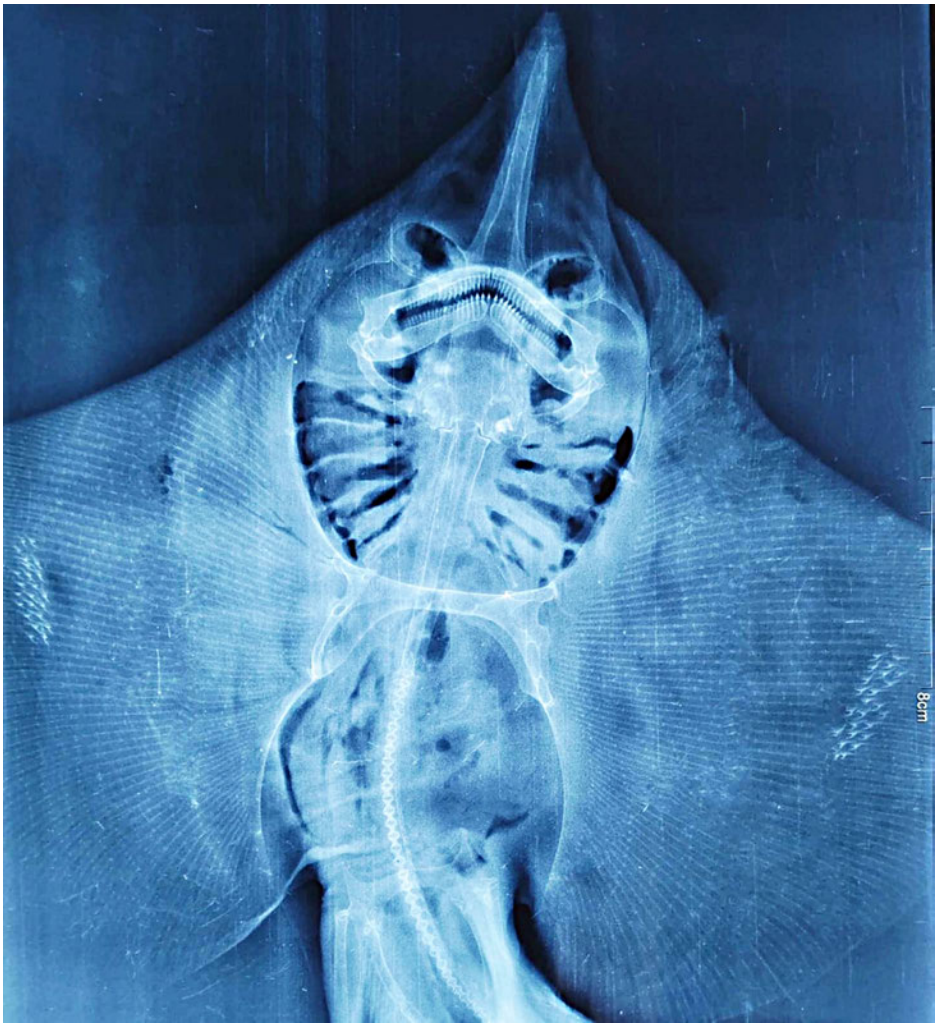


**Figure 17.** *Dipturus johannisdavisi*, radiograph of head & body, ZSI/MBRC/F/3272, mature male, 605 mm TL, Kerala, India (A. Kasinath).

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