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Distribution and diversity of needlefishes (Belonidae) and halfbeaks (Hemiramphidae) of the order Beloniformes in India

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Original Article

Abstract

Beloniformes are the common fishes seen in marine, freshwater, and brackish water habitats. They are widely dispersed over diverse temperate and tropical waters. Family Belonidae and Hemiramphidae were considered from diverse inspecting areas from both the east and west coasts containing Lakshadweep and Andaman & Nicobar Islands with the expansion of lakes and riverine bodies of India related with the east and west coasts. Sampling was done from 2019 to 2022, the study discovered that there are 19 species in 9 genera. The Belonidae family comprises four genera- *Ablennes*, *Strongylura*, *Tylosurus*, and *Xenentodon*. *Ablennes* and *Tylosurus* are dominant genera and are restricted to marine habitats. *Strongylura* is seen on both marine and brackish water. *Xenentodon* is the only freshwater genus in the family Belonidae. Family Hemiramphidae represents 10 species under five genera, *Euleptorhamphus*, *Hemiramphus*, *Hyporhamphus*, *Oxyporhamphus*, and *Rhynchorhamphus*. The sole freshwater species *Hyporhamphus xanthopterus* is exclusive to Vembanad Lake of Kerala and all remaining are marine. This study sheds insight into a neglected group of fish that are as valuable as food sources and biological indicators.

Keywords: *Beloniformes*, *Belonidae*, *Hemiramphidae*, *Diversity and distribution*, *East coast*, *West coast*

Introduction

The order Beloniformes comprises freshwater and marine epipelagic fishes, with 285 species and six families recorded globally, (Froese and Pauly, 2024) are the Rice and Duck-billed Fishes (*Adrianichthyidae*; Weber, 1913), Needlefishes (*Belonidae*; Bonaparte, 1832); Sauries (*Scomberosocidae*; Bleeker, 1859); Halfbeaks (*Hemiramphidae*; Gill, 1859); Flying

fishes (*Exocoetidae*; Risso, 1827); and Viviparous halfbeaks (*Zenarchopteridae*). From Indian waters, a total of 56 species from 5 families have been documented (Froese and Pauly, 2024). Family Belonidae is composed of 10 genera forming 34 valid species all over the world. Among the 10 genera, *Petalichthys* is monotypic. *Belone* is both brackish and marine; *Tylosurus* and *Ablennes* are marine. Three freshwater genera- *Belonion*, *Potamorhaphis*, and *Pseudotylosurus* are found in South America. (Froese and Pauly, 2024). There are two recognized species in the Asian freshwater genus *Xenentodon*. *Strongylura* genera contain the highest 14 species, which are mostly marine, few estuarine, and three are limited to freshwater (Collette, 2003). Their outstanding flavour makes them valuable commercial resources for the pelagic fishing industry. These species are primarily caught with hook and line and gill nets throughout the Indian coastline, including the islands. They are sold in three different states: fresh, frozen, and smoked (Collette, 2003).

The family Hemiramphidae is known as the halfbeaks which includes freshwater, estuarine, and marine species (Collette *et al.*, 1984). It has 61 valid species worldwide, divided into 8 genera. Of them, five genera and fifteen species have been found in Indian waters thus far (Froese and Pauly, 2024). This family include 8 genera *Arrhamphus*, *Euleptorhamphus*, *Chriodorus*, *Hemiramphus*, *Hyporhamphus*, *Melapedalion*, *Oxyporhamphus*, and *Rhynchorhamphus*. They can be found throughout the coastal continents of the Pacific, Indian, and Atlantic oceans. *Melapedalion* and *Chriodorus* are the two monotypic genera with small or no beaks. Both offshore genera of *Euleptorhamphus* and *Oxyporhamphus* contain two species. *Rhynchorhamphus* is limited to the Indian Ocean, while *Hemiramphus* and *Hyporhamphus* are

found the world over. *Hyporhamphus* is the most diversified genus in the family.

The taxonomy of Indian beloniform fishes has been restricted to a few checklists or reports of regional significance; these studies only provided information on the distribution of fishes and lacked colour photos or in-depth taxonomic analysis (Behera *et al.*, 2020). There hasn't been much research done in India on Belonidae and Hemiramphidae despite their significance to the economy and ecology. Effective management and sustainable exploitation require comprehensive data on the diversity of these genera. Therefore, the purpose of the current study was to investigate the distribution and diversity in Indian waters.

Material and methods

Sampling was done from major coasts, rivers and lakes associated with coastal states and selected stations of all the maritime states. (North-West regions include Gujarat and Maharashtra; South-West regions include Goa, Karnataka, and Kerala; South-East regions include Tamil Nadu and Andhra Pradesh; North-East regions include Orissa and West Bengal) including Lakshadweep and Andaman & Nicobar Islands during the year 2019 to 2022 (Fig. 1 and Table 1). The random sampling of fish specimens from major harbours and landing centres was done and stored in an insulated ice box to preserve their quality until they were transported to the laboratory. For future taxonomy studies, fish specimens were cleaned, photographed, and preserved in 10% formalin. The morphometric measurements and meristic counts were obtained using the standard procedure outlined by Hubbs and Lagler (1958). The species was identified using identification keys taken from the literature by Collette and Su (1986). Fresh specimens were used to record the colour pattern. Tissue samples from uncertain taxonomic identity were obtained and preserved in 70% ethanol solution. The identified species were deposited and catalogued at the Marine Biodiversity Museum, ICAR-Central Marine Fisheries Research Institute (ICAR-CMFRI) Kochi.

Results and discussion

Sampling was conducted at four locations on India's northwest coast, seven locations on the southwest coast, six locations on the southeast coast, four locations on the northwest coast, two locations on the Andaman and Nicobar Islands, and two locations on the Lakshadweep Islands. Samples were also collected from the seven riverine sites from all the coastal states except Goa and Karnataka (Fig. 1) (Table 1). Twenty species were found from nine genera of the two families (Belonidae and Hemiramphidae). Nine

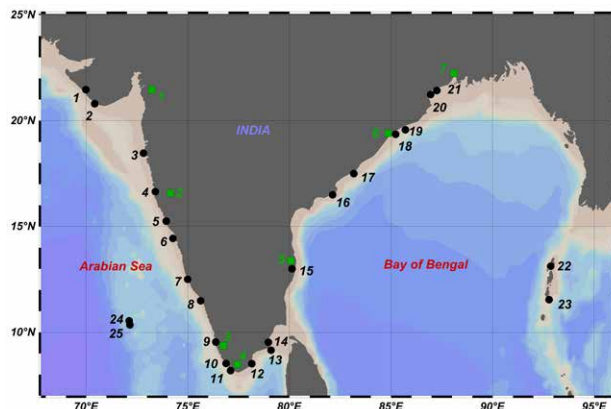


Fig 1. Map showing the sample collection sites of the study

species under four genera were found from the Belonidae family and eleven species under five genera were found from the Hemiramphidae family (Table 2).

Family Belonidae Bonaparte 1832

Family Belonidae are classified as surface feeders; they are coloured blue or green on the back and silvery white on the belly and lower sides to protect themselves. Fishes that are elongated and range in size from small to large (up to 2 m), with both jaws extended into long beaks that contain sharp teeth. Some species can be found in freshwaters, but the majority of species are marine (Collette *et al.*, 2016).

Six species from the three genera (*Ablennes*, *Strongylura* and *Tylosurus*) were discovered during the current investigation from the coastal regions, and three species from two genera (*Strongylura* and *Xenentodon*) from the riverine regions (Table 2).

Genus *Ablennes*, Jordan and Evermann 1896

The *Ablennes* genus is distinguished by an elongated, slender, and slightly compressed body and a series of vertical bars. Both jaws are extended as beaks, and a band of small, sharp teeth is armed in each jaw, without teeth on the palate or vomer. Gill rakers are absent, caudal short, unequally lunate or forked (Fig. 2). Large voracious fishes inhabit mostly tropical and subtropical seas (Collette and Carpenter, 2003).

Ablennes hians (Fig. 2b) has been reported from subtropical and tropical waters in the following regions: the Pacific Ocean (Collette, 1966; Carpenter and Niem, 1999); the Atlantic (Collette and Parin, 1970; Sabrah *et al.*, 2018; Alshawy *et al.*, 2019); the Indian Ocean (Carpenter, 1997; Akash *et al.*,

Table 1. Details of the study area where the sampling was done for the present study

No.	Collection site	State	Code	Lat. / Long.
A	Coastal sites			
1	Porbandar	Gujrat	GJ 1	21°38'20.7"N 69°35'43.1"E
2	Veraval	Gujrat	GJ 2	20°54'07.9"N 70°21'52.4"E
3	Mumbai	Maharashtra	MH 1	18°54'45.5"N 72°49'32.2"E
4	Ratnagiri	Maharashtra	MH 2	16°59'47.8"N 73°16'26.0"E
5	Benaulim	Goa	GA 1	15°15'56.9"N 73°54'50.4"E
6	Karwar	Karnataka	KA 1	14°50'16.2"N 74°08'01.7"E
7	Mangalore	Karnataka	KA 2	12°51'21.5"N 74°49'58.8"E
8	Kannur	Kerala	KL 1	11°56'40.4"N 75°18'39.1"E
9	Kochi	Kerala	KL 2	9°58'55.6"N 76°14'34.5"E
10	Kollam	Kerala	KL 3	8°56'19.6"N 76°32'27.8"E
11	Trivandrum	Kerala	KL 4	8°22'40.2"N 76°59'21.0"E
12	Tuticorin	Tamilnadu	TN 1	8°53'18.3"N 78°10'26.3"E
13	Mandapam	Tamilnadu	TN 2	9°16'48.2"N 79°12'22.9"E
14	Thondi	Tamilnadu	TN 3	9°44'17.1"N 79°01'05.7"E
15	Chennai	Tamilnadu	TN 4	13°07'24.6"N 80°17'50.9"E
16	Kakinada	Andhra Pradesh	AP 1	16°57'26.4"N 82°16'09.2"E
17	Vizag	Andhra Pradesh	AP 2	17°41'44.8"N 83°18'08.8"E
18	Puri	Odisha	OD 1	19°48'06.2"N 85°51'00.2"E
19	Astaranga	Odisha	OD 2	19°58'23.3"N 86°20'19.2"E
20	Balramgadi	Odisha	OD 3	21°28'25.6"N 87°03'14.7"E
21	Digha	West Bengal	WB 1	21°37'33.4"N 87°31'55.5"E
22	Diglipur	A&N Islands	AN 1	13°16'08.6"N 93°02'24.9"E
23	Port Blair	A&N Islands	AN 2	11°39'33.0"N 92°43'31.7"E
24	Agatti	Lakshadweep	LK 1	10°52'20.9"N 72°12'17.6"E
25	Kavaratti	Lakshadweep	LK 2	10°33'43.7"N 72°37'57.4"E
B	Riverine sites			
1	Karjan river	Gujrat	GJR 1	21°51'20.1"N 73°29'23.0"E
2	Warna river	Maharashtra	MHR 1	16°52'42.6"N 74°24'35.9"E
3	Vembanadu lake	Kerala	KLR 1	9°35'30.2"N 76°26'14.6"E
4	Thamirabarani river	Tamilnadu	TNR 1	8°42'15.2"N 77°42'27.3"E
5	Pulicat lake	Andhra Pradesh	AP R 1	13°35'23.3"N 80°01'59.7"E
6	Chilka lake	Odisha	ODR 1	19°44'25.4"N 85°12'35.4"E
7	Hooghly river	West Bengal	WBR 1	22°34'26.7"N 88°20'42.7"E

2021); Indian waters (Rajan *et al.*, 2013, Barman *et al.*, 2000, 2004, 2011, 2012; Bijukumar and Raghavan, 2015; Roul *et al.*, 2019). *A. hians* were gathered for the current study from all around the Indian coast. (Table 2). Two new species were recently discovered in Indian waters (Toji *et al.*, 2024) and were named *A. gracalii* and *A. joseberchmansis* (east coast). *A. joseberchmansis* is recorded from Tamilnadu, Andhra Pradesh, and Andaman and Nicobar Islands. *A. gracalii* is reported only from the Tamilnadu region (Fig. 2) (Table 2).

Ablennes gracalii (Toji, 2024)

Scale rows on upper head 26–28, dorsal fin rays 24–25, anal fin rays 26–28, predorsal scales 431–446, vertebrae 91–92. The dorsal, anal, and pelvic fins are longer. The longest ray of the posterior dorsal fin is 50% of the dorsal height, whereas the front half of the fin has a large falcate lobe and the posterior part lacks noticeable dark lobes (Fig. 2a)



Fig 2. Images of Genus *Ablennes*. a) *Ablennes gracalii*, b) *Ablennes hians* and c) *Ablennes joseberchmansis*

Ablennes hians (Valenciennes, 1846)

Scale rows on the upper head 40–43; dorsal fin rays 23–25; anal fin rays 25–26; predorsal scales 655–694; vertebrae 86–87. Anterior parts of dorsal and anal fins with high falcate lobes; caudal fin deeply forked (Fig. 2b)

Ablennes joseberchmansis (Toji, 2024)

Scale rows on upper head 19–21, dorsal fin rays 24–25, anal fin rays 26–27, predorsal scales 528–565, vertebrae 87–88. The dorsal, anal, and pelvic fins are not very long. The dorsal fin's posterior region lacks noticeable dark lobes (Fig. 2c). About 44% of the dorsal height is made up by the posterior dorsal fin's longest ray.

Genus *Strongylura*, van Hasselt 1824

A noticeable dark blue line along the sides and black pigment

Table 2. List of Beloniformes fishes (family Belontiidae and Hemiramphidae) from India during the present study

No.	Genus	Species	N	East side	West side
A Family Belontiidae					
1	<i>Ablennes</i>	<i>Ablennes hians</i>	53	All coastal sites	All coastal sites
		<i>Ablennes joseberchmansis</i>	9	TN1, TN2, AP1& AP2	Nil
		<i>Ablennes gracalii</i>	3	TN1	Nil
		<i>Strongylura incisa</i>	3	TN 1,2&3	Nil
2	<i>Strongylura</i>	<i>Strongylura leiura</i>	49	All coastal sites	All coastal sites
		<i>Strongylura strongylura</i>	57	All coastal sites	All coastal sites
		<i>Tylosurus</i>			
3	<i>Tylosurus</i>	<i>Tylosurus crocodilus</i>	68	All coastal sites	All coastal sites
		<i>Tylosurus melanotus</i>	64	All coastal sites	All coastal sites
4	Xenentodon	<i>Xenentodon cancila</i>	50	All riverine sites	All riverine sites
B Family Hemiramphidae					
1	<i>Euleptorhamphus</i>	<i>Euleptorhamphus viridis</i>	9	TN-1&2	Nil
2	<i>Hemiramphus</i>	<i>Hemiramphus archipelagicus</i>	289	All coastal sites	All coastal sites
		<i>Hemiramphus far</i>	320	All coastal sites	All coastal sites
		<i>Hemiramphus lutkei</i>	415	All coastal sites	All coastal sites
3	<i>Hyporhamphus</i>	<i>Hyporhamphus limbatus</i>	300	All coastal sites Except AN 1&2	All coastal sites except LK 1&2
		<i>Hyporhamphus quoyi</i>	179	All coastal sites	Nil
		<i>Hyporhamphus xanthopterus</i>	367	Nil	KLR 1
4	<i>Oxyporhamphus</i>	<i>Oxyporhamphus micropterus</i>	10	TN- 1,2,3&4 and AP-1&2	Nil
5	<i>Rhynchorhamphus</i>	<i>Rhynchorhamphus georgii</i>	78	Nil	All coastal sites except LK 1&2
		<i>Rhynchorhamphus malabaricus</i>	59	Only in TN- 1,2,3&4.	Nil

behind the eyes, which often do not reach below the middle of the eyes. They have elongated bodies with rounded cross-sections. Both jaws are very extended and have pointed teeth. Gill rakers are not present. The anterior dorsal and anal fin parts are not forming prominent lobes. Caudal peduncle deeper than broad. The caudal fin emarginate (Fig. 3).

They are widely distributed along the Pacific Ocean, Atlantic Ocean, and Indian Ocean (Collette, 1974; Lovejoy, 2000; Al-Salim and Ali, 2007). Of the 15 valid species only 3 of them are known to the Indo-Pacific region *S. incisa*, *S. leiura* and *S. strongylura* (Lovejoy, 2000; Banford *et al.*, 2004; Akash *et al.*, 2021; Astakhov, 2023). All three species reported from Indian waters, *S. incisa* (Roul *et al.*, 2018, 2019 a,b), *S. leiura* (Aneesh *et al.*, 2013; Kayalvizhi *et al.*, 2018; Roul *et al.*, 2018, 2019 a,b) and *S. strongylura* (Rameshkumar *et al.*, 2014; Sahadevan, 2016; Karna *et al.*, 2017; Kayalvizhi *et al.*, 2018; Roul *et al.*, 2018, 2019 a,b). These have been recorded from several sample locations in the current investigation. (Table 1) *S. strongylura* and *S. leiura* are seen in freshwater, brackish and marine water. *S. incisa* is a reef-associated fish only seen in Tamilnadu (Fig. 3) and (Table 2).

Strongylura incisa (Valenciennes, 1846)

Dorsal: 18-20 soft rays; anal: 21-23 soft rays; absence of black spot at the caudal fin base; absence of scales on anal and dorsal fin base (Fig. 3a).

Strongylura leiura (Bleeker, 1850)

Laterally compressed, pectoral fins do not falcate; pectoral fin rays 10 or 11 dorsal fin rays 17 to 21; anal fin rays 23 to 25. The dorsal fin originates over the 7th to 10th anal fin ray; moderately small predorsal scales, 130-160; scutes covering the bases of the anal and dorsal fins. Caudal peduncle without lateral keels; caudal fin emarginate (Fig. 3b).

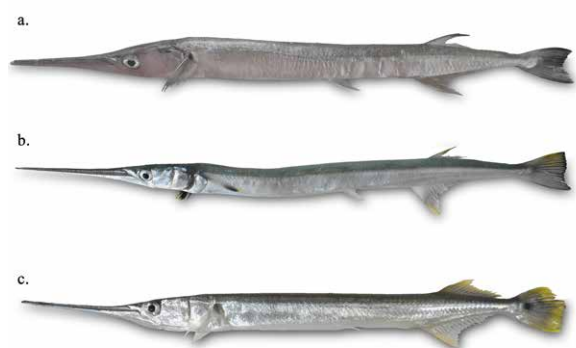


Fig 3. Images of Genus *Strongylura*. a) *Strongylura incisa*, b) *Strongylura leiura* and c) *Strongylura strongylura*

Strongylura strongylura (van Hasselt, 1823)

12-15 dorsal fin rays; 15-18 anal fin rays; dorsal and anal fin base covered with scales. The caudal peduncle lacks lateral keels; the presence of a prominent round black spot at the caudal fin base, caudal fin truncates or rounded. Predorsal scales are few and relatively large, 100 to 130 (Fig. 3c).

Genus *Tylosurus* Cocco, 1833

The genus *Tylosurus* is characterized by an elongated body with a rounded cross-section, both jaws greatly elongate with pointed teeth. The body has a dark blue stripe running along the sides and is silvery white below and dark blue above. Gill rakers are absent. On each side of the caudal peduncle is a weak, darkly pigmented lateral keel. There is a deeper-than-wide caudal peduncle. According to Collette and Carpenter (2003), the caudal fin has a deep fork, and the lower lobe is significantly longer than the upper lobe (Fig. 4).

There have been numerous reports of the genus *Tylosurus* from the Pacific, Indian, and Atlantic oceans (Collette, 1974; Moravec and Ali, 2005; Sinis, 2005; Sabrah *et al.*, 2018). Of the 10 valid species only 2 of them are known to the Indo-Pacific region, *T. crocodilus* and *T. melanotus* (Lovejoy, 2000; Banford *et al.*, 2004; Liao and Chang, 2011; Al-Mamry and Javed, 2018). Both species were reported from Indian waters, *T. crocodilus* (Kayalvizhi *et al.*, 2018; Roul *et al.*, 2018; Shahul *et al.*, 2018; Barik *et al.*, 2018; Rajkumar *et al.*, 2021; Toji *et al.*, 2022), and *T. melanotus* (Kayalvizhi *et al.*, 2018; Roul *et al.*, 2018; Shahul *et al.*, 2018; Toji *et al.*, 2022). In this study, *T. crocodilus* and *T. melanotus* (Fig. 4) have been documented from various sample sites (Table 2) of all Indian coastal sites, including islands.

Tylosurus crocodilus (Peron and Lesueur, 1821)

Pectoral and pelvic fins are relatively long; anal-fin rays range from 18-22; a small black lateral keel is present on



Fig 4. Images of Genus *Tylosurus*. a) *Tylosurus crocodilus*, b) *Tylosurus melanotus*

the caudal peduncle; dorsal and anal fin lobes are relatively high about body length; tiny and abundant predorsal scales, 240-290 (Fig. 4a).

Tylosurus melanotus (Bleeker, 1850)

Anal-fin rays 22-24, dorsal-fin rays 24-27; some specimens have a prominent appendage at the tip of the lower jaw; air bladder with lots of air bubbles; caudal fin without an upper lobe elevation; posterior portion of anal fin rays typically black in colour (Fig. 4b).

Genus *Xenentodon* Regan, 1911

Body significantly elongated, cylindrical or subcylindrical. Caudal peduncle compressed, more profound than wide. The head is long. Premaxillaries and mandible prolonged into a beak. Jaw featuring a row of canines and a band of tiny, fine teeth. The palate is free of teeth. Gills open widely. No rakers of gills. Low lateral line on caudal peduncle without keel. Dorsal and anal origins are opposite slightly rounded or truncated caudal fins (Fig. 5).

Xenentodon cancila is reported from Keenjhar Lake of Pakistan (Khosro *et al.*, 2018). Southwestern (Sarower *et al.*, 2019) and Northwestern Bangladesh (Hossain *et al.*, 2013). Also recorded from different regions of India, North eastern states (Lovejoy, 2000; Dhanze *et al.*, 2018) Northern Western Ghats (Patil *et al.*, 2018), Narmada River (Khedkar *et al.*, 2014), and Kerala (Athira and Jaya, 2020; Sahadevan, 2016; Ansar *et al.*, 2017). *Xenentodon cancila* (Fig. 5) was observed in the current study at various sampling sites (Table 2) in India's riverine regions.

Xenentodon cancila (Hamilton, 1822)

Anal (16-18) and dorsal (15-18) rays without spines; dorsal fin inserted usually anteriorly through the origin of the anal fin; green-silvery dorsally, fading to whitish below; a darkly margined, silvery band running along the side; four or five blotches (missing in juvenile specimens) on the flanks between the anal and pectoral fins; extremities of dorsal and anal fins with dark pigmentation (Fig. 5).



Fig 5. Images of Genus *Xenentodon*, *Xenentodon cancila*

Family Hemiramphidae Gill, 1859

The family Hemiramphidae is characterized by a long lower jaw and a short triangular upper jaw (except in *Oxyporhamphus*). Spines are not present in fins. Moderately large scales, cycloid, easily detached. Mostly marine, but some inhabit freshwaters. (Collette *et al.*, 2016). In the present study, from the family Hemiramphidae, eleven species from the five genera (*Euleptorhamphus*, *Hemiramphus*, *Hyporhamphus*, *Oxyporhamphus* and *Rhynchorhamphus*) were recorded from the coastal regions and one species from one genus (*Hyporhamphus*) from the riverine regions.

Genus *Euleptorhamphus* Gill, 1859

The body is very elongated, strongly compressed laterally, and almost ribbon-shaped. T-shaped lacrimal canal. There are no superficial head canals (Parin and Astakhov, 1982). Simple and one-chambered swim bladder (Collette *et al.*, 2018). Pelvic fins are short, but pectoral fins are very long, and no scales on the fins. The lower lobe of the caudal fin noticeably expanded (Fig. 6)

Euleptorhamphus viridis (Fig. 6) is an oceanic species, widespread in the tropical and subtropical waters of the Indo-Pacific region (Collette, 1974). Reported from Thailand and Malaysia (Vidthayanoon, 1999), no further studies from India. In the present study, *E. viridis* has been recorded only from (Table 2) the coastal regions of Tamilnadu.

Euleptorhamphus viridis (van Hasselt, 1823)

There are no dorsal or anal spines, dorsal soft rays (21-25), anal soft rays (20-25), and vertebrae (70-75). The body is incredibly long. Longer lower jaw and shorter, triangular, scaly upper jaw; teeth on the tongue and vomer; long pectoral fins (eight or nine rays); back iridescent blue-green; belly silvery; fins unpigmented (Fig. 6).

Genus *Hemiramphus* Cuvier, 1816

Elongate body; compressed or sub-cylindrical. Teeth are tiny, conical, and bi-, or tricuspid; arranged in bands in both jaws.



Fig 6. Images of Genus *Euleptorhamphus*, *Euleptorhamphus viridis*

Wide gill openings with a few, well-developed gill rakers. Presence of a fused third upper pharynx, and a simple air bladder. The abdominal pelvic fins are located closer to the caudal base than the maxillary tip. Caudal fin forked or emarginate. Cycloid, moderate, or large scales (Fig. 7).

Genus *Hemiramphus* has been recorded from the Atlantic Ocean and the Pacific Ocean (Kara *et al.*, 2012; Falautano *et al.*, 2014). Only three of the eleven recognized species are found in the Indo-Pacific area. (Vidhayanon, 1999; Kim *et al.*, 2014; Tabassum *et al.*, 2017; Hata *et al.*, 2018; Zhu *et al.*, 2018; Talakua *et al.*, 2022, 2023). *H. archipelagicus* (Aleyamma and Kuruvila, 2005; Kayalvizhi *et al.*, 2018; Toji *et al.*, 2022; Behera *et al.*, 2020, 2023) *H. far* (Aleyamma and Kuruvila, 2005; Gopalakrishnan *et al.*, 2010; Kayalvizhi *et al.*, 2018; Mohanty *et al.*, 2020; Toji *et al.*, 2022; Behera *et al.*, 2020, 2023) and *H. lutkei* (Aleyamma and Kuruvila, 2005; Kayalvizhi *et al.*, 2018; Toji *et al.*, 2022; Behera *et al.*, 2020, 2023) have been recorded from India. In the present study, three *Hemiramphus* species named *H. archipelagicus*, *H. far* and *H. lutkei* (Fig. 7) have been recorded (Table 2) from all the coastal regions of India. *H. far* and *H. lutkei* are seen in both the eastern and western regions including islands. *H. archipelagicus* is not seen in the Andaman and Nicobar Islands.

Hemiramphus archipelagicus (Collette and Parin, 1978)

10-13 anal soft rays; 25-32 gill rakers overall on the first-gill arch; lack of a fully formed anterior lobe in the dorsal fin; when folded forward, the short pectoral fins do not extend past the nasal pit; absence of vertical bars on sides (Fig.7a).

Hemiramphus far (Forsskal, 1775)

Anal soft rays 10-12; 25-36 gill rakers overall on the first-gill arch; When folded forward, the short pectoral fins do not



Fig. 7. Images of Genus *Hemiramphus*. a) *Hemiramphus archipelagicus*, b) *Hemiramphus far* and c) *Hemiramphus lutkei*

extend past the nasal pit; the presence of 3-9 vertical bars on the sides; bluish dorsally, silvery on sides; Predorsal scales, 36-41; Dorsal and anal fins are situated posteriorly; lower lobe of the caudal fin is longer than upper lobe (Fig. 7b)

Hemiramphus lutkei (Valenciennes, 1847)

Soft rays on the anal region 10-13; 52-57 vertebrae, and 33-46 gill rakers on the first-gill arch. When folded forward, the long pectoral fins extend beyond the anterior margin of the nasal pit absence of vertical bars on the sides (Fig. 7c)

Genus *Hyporhamphus* Gill, 1859

The long body that gradually tapers down to the dorsal. Extended head that is large, conical, and flattened above. Longer lower jaw with a slender, depressed bill; sharply rounded and with a short upper jaw. Teeth small and scales large. The anal and dorsal fins are simple, oblong, and located posteriorly and opposite one another. Caudal fin, emarginate. Moderate pectoral fins. Subcentral, tiny, or moderate ventral fins (Fig. 8).

Hyporhamphus has been recorded worldwide from the Pacific, Atlantic and Indian Ocean (Collette and Su, 1986; Blaber *et al.*, 1995; Cui *et al.*, 2018; Johan *et al.*, 2020). *Hyporhamphus affinis*, *Hyporhamphus balinensis*, *Hyporhamphus dussumieri*, *Hyporhamphus limbatus*, *Hyporhamphus quoyi*, *Hyporhamphus sindensis*, *Hyporhamphus unicuspis*, *Hyporhamphus unifasciatus*, and *Hyporhamphus xanthopterus* are nine of the 38 recognized species were reported from India. (Nair *et al.*, 1983; Aleyamma and Kuruvila, 2005; Chaudhuri *et al.*, 2014; Madhusudhana and Krishna, 2014; Bhat *et al.*, 2014; Reddy and Parameshwar, 2015; Sahadevan, 2016; Karna *et al.*, 2017; Ansar *et al.*, 2017; Bhakta *et al.*, 2019; Ramulu *et al.*,

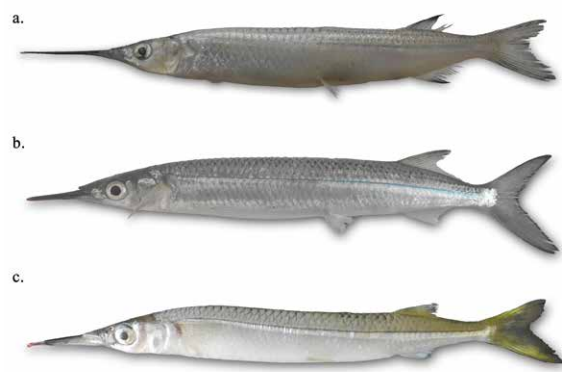


Fig 8. Images of Genus *Hyporhamphus*. a) *Hyporhamphus limbatus*, b) *Hyporhamphus quoyi* and c) *Hyporhamphus xanthopterus*

2022; Toji *et al.*, 2022; Behera *et al.*, 2023). Three species of *Hyporhamphus*- *H. limbatus*, *H. quoyi*, and *H. xanthopterus* have been identified (Table 2) in this study from every coastal region and riverine site in India (Fig. 8). The sole location of *H. xanthopterus* was Vembanadu Lake. Whereas *H. limbatus* was found throughout India's coastal regions, *H. quoyi* was only found in the eastern coastal regions, which included the Andaman and Nicobar Islands.

Hyporhamphus limbatus (Valenciennes, 1846)

An elongated fish with a short, triangular, scaly upper jaw and a greatly prolonged, beak-like lower jaw that is equal to or longer than the head length. Preorbital distance is 0.75 to 1.2 times the length of the upper jaw and 1.3 to 2.1 times the diameter of the orbit. A total of 13 to 16 dorsal and anal fin rays, and 23 to 37 gill rakers on the first gill arch. An emarginate caudal fin that is not sharply forked (Fig. 8a).

Hyporhamphus quoyi (Valenciennes, 1847)

Anal soft rays: 13–17, dorsal soft rays: 14–17; dorsal and anal spines absent; vertebrae: 51–56. The prolonged beak-like lower jaw is shorter than the head length, upper jaw is short, scaly, blunt and rounded. Gill rakers on the first arch: 26–39; forked caudal fin, the lower lobe of the caudal fin is longer than the upper (Fig. 8b).

Hyporhamphus xanthopterus (Valenciennes, 1847)

Absence of spines, anal fin rays 14–16, and dorsal fin rays 13–15. Presence of rounded nasal papilla, Gill rakers 41–53 on the first arch, Upper jaw: short, triangular, and scaly; 0.8–1.0 times longer than the wide fleshy tip of the beak having red colouration, all fins with yellowish pigmentation (Fig. 8c).

Genus *Oxyporhamphus* Gill, 1863

Genus *Oxyporhamphus* is unique to the rest of the halfbeaks in its form of the upper jaw, being short and lacking a triangular projection along its anterior margin. The fact that the lower jaw does not elongate sets it apart from the majority of other genera. Laterally compressed and elongated body, single pectoral branch of the lateral line. Elongated Pectoral fins (2.6–3.2 times in SL), hardly make it to the pelvic fin's origin. Short Pelvic fins (7.3–10.6 times in SL). In the caudal fin, the lower lobe greatly elongates. No scales on the fins. Jaw teeth with supplementary cusps, frequently tricuspid (Fig. 9).



Fig. 9. Images of Genus *Oxyporhamphus*, *Oxyporhamphus micropterus*

O. micropterus occurs in the waters of Barbados, St. Lucia, and the eastern Caribbean (Bruun, 1935), Caribbean Sea, Western Atlantic (Breder, 1938), Pacific (Yacapin, 1991), Atlantic Ocean (Davenport, 1992; Macedo-Soares *et al.*, 2012) and Indonesia (Rosana and Muminin, 2019). In Asia, it occurs in Chagos Island, China, India, Indonesia, Japan, Malaysia, Maldives, Philippines, and Vietnam (Collette, 1986).

In the present study, only one *Oxyporhamphus* species named *O. micropterus* (Fig. 9) has been recorded from the south-east region including Tamil Nadu and Andhra Pradesh (Table 2) from the coastal region of India.

Oxyporhamphus micropterus (Valenciennes, 1847)

Absence of dorsal and anal spines, a single large chamber leading to the swim bladder in adults, an average of 24–28 gill rakers on the first arch, and 11–14 branchiostegal rays. The vertebrae count is 47–50 (Fig. 9).

Genus *Rhynchorhamphus* Fowler, 1928

Genus *Rhynchorhamphus* is distinguished by a fimbriate nasal papilla, a big dome-like upper jaw, and several gill rakers 47–78 on the first arch as well as 40–68 on the second arch. The extra branch runs parallel to the pectoral fin base, slightly behind the cleithrum, and ahead of the branch upper jaw scales are present and an intact swim bladder, as opposed to being divided into separate chambers, like *Hyporhamphus* (Fig. 10). The length of the upper jaw is roughly the same as the width, if not longer (Collette, 1976).

Rhynchorhamphus usually occurs in the Indo-West Pacific and close to shore (Collette, 1976; Collette, 2004). Out of 4 valid species 3 of them are recorded from India, *R. georgii*, *R. malabaricus*, and *R. naga*. In terms of worldwide distribution, *R. malabaricus* occurs between Ceylon and India (Talwar, 1964). *R. georgii* (Valenciennes, 1846) is found throughout a wide range of locations, including the East Indies, New Guinea, Australia, the Philippine Islands, the South China Sea, and the Persian Gulf (Collette, 1976). *R. naga* occurs from the Gulf of Thailand, Malaysia, the South China Sea, at the

northern end of the Straits of Malacca, and the East Indies (Collette, 1976). In India genus *Rhynchorhamphus* is reported from the east and west coasts, *R. georgii* (Talwar, 1962; Toji *et al.*, 2022; Behera *et al.*, 2023) and *R. malabaricus* (Toji *et al.*, 2022). During the present study, only three *Rhynchorhamphus* species named *R. georgii*, *R. malabaricus*, and *R. naga* (Fig. 10) were recorded. *R. georgii* was the only one recorded from the Western coast of India (Gujrat to Kerala). *R. malabaricus* was recorded only from Tamil Nadu and showed an isolated distribution, and *R. georgii* is not seen on the east coast. No more *Rhynchorhamphus* species were seen in both islands (Table 2).

Rhynchorhamphus georgii (Valenciennes, 1847)

Dorsal and anal spines are not present, the domed upper jaw is the longest and most arched, with dorsal soft rays 13-17, anal soft rays 13-16, and vertebrae 54-59 among the four species of *Rhynchorhamphus* (Fig. 10a).

Rhynchorhamphus malabaricus (Collette, 1976)

Presence of preorbital ridge, nasal papilla fimbriate, 57-71 gill rakers overall on the first arch, dorsal fin rays 13-15, typically 14, anal fin rays 12-14, typically 13, dorsal plus anal rays 25-29,



Fig. 10. Images of Genus *Rhynchorhamphus*, a) *Rhynchorhamphus georgii*, b) *Rhynchorhamphus malabaricus*

typically 27 or 28, and a forked caudal fin with two branches of the lateral line going from the fish's ventral outline toward the base of its pectoral fin. Red, fleshy beak tip (Fig. 10b).

In the current study, six species from three genera in the family Belonidae were discovered in coastal locations, and three species representing two genera were discovered in riverine regions (Table 2). The highest species diversity was recorded in the south-east region; while the genus *Strongylura* had the highest diversity from the family Belonidae. All species in Belonidae are common on both the east and west coast except *Strongylura incisa* which is present on the east coast only in Tamilnadu. The Hemiramphidae family was found to have ten species from

Table 3. Number of species recorded from different Coastal and freshwater regions of India

No.	Genus	Total no. of Species	Coastal Region			
			Northeast	Northwest	Southeast	Southwest
A Belonidae						
1	<i>Ablennes</i>	3	1	1	3	1
2	<i>Strongylura</i>	3	2	2	3	2
3	<i>Tylosurus</i>	2	2	2	2	2
B Hemiramphidae						
1	<i>Euleptorhamphus</i>	1	0	0	1	0
2	<i>Hemiramphus</i>	3	3	3	3	3
3	<i>Hyporhamphus</i>	2	2	1	2	1
4	<i>Oxyporhamphus</i>	1	0	0	1	0
5	<i>Rhynchorhamphus</i>	2	0	1	1	1
Riverine Region						
A Belonidae						
1	<i>Strongylura</i>	2	2	2	2	2
2	<i>Xenentodon</i>	1	1	1	1	1
B Hemiramphidae						
1	<i>Hyporhamphus</i>	1	0	0	0	1

the five genera from the coastal sites one species and a genus from riverine sites. Like Belonidae, Hemiramphidae also had the highest species diversity recorded from the south-east region. *E. viridis* and *O. Micropterus* are the only genera that are restricted to the southeast side (Tamilnadu), the remaining species are available on both east and west coastal sites (Table 3).

Conclusion

This study, conducted within a limited timeframe, documented 19 species across two families, Belonidae and Hemiramphidae, along India's coasts and rivers. In Belonidae, nine species in four genera were recorded, including eight coastal and one freshwater species. Coastal species distribution covered both the east and west coasts, with some found in freshwater. In Hemiramphidae, ten species in five genera were identified, primarily in coastal waters, with one freshwater species endemic to Kerala. Some species, such as *Ablennes joseberchmansis* (east coast) and *Hyporhamphus xanthopterus* (Kerala), displayed regional exclusivity. This study highlights Belonidae and Hemiramphidae diversity and calls for further research into their taxonomy, distribution, and ecology in Indian waters.

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Author contributions

Conceptualization: TT; Methodology: TT, ET; Data collection: TT, AAM, TMA; Data Analysis: TT, ET; Writing an original draft: TT; Writing-Review & Editing: EMA, TMA; Supervision: EMA

Data availability

The data are available and can be requested from the corresponding author.

Conflict of interest

The authors declare that they have no conflict of financial or non-financial interests that could have influenced the outcome or interpretation of the results.

Ethical statement

No ethical approval is required as the study does not include activities that require ethical approval or involve protected organisms/ human subjects/ collection of samples/ protected environments.

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