

AN ACCOUNT OF FISHES OF THE FAMILIES SCOMBROLABRACIDAE (BLACK MACKEREL), GEMPYLIDAE (SNAKE MACKEREL) AND TRICHIURIDAE (CUTLASSFISHES) FROM PAKISTAN

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ABSTRACT

Families Scombridae, Gempylidae and Trichiuridae are represented by 1, 4 and 7 species respectively in Pakistan. All these species are benthopelagic and found on the continental shelf and slope areas. Two species Savalani hairtail (*Lepturacanthus savala*) and largehead hairtail (*Trichiurus lepturus*) are two common and commercially important species contributing substantially to the landings and export in Pakistan. *L.savala* is reported to be more abundant on the Sindh coast whereas *T. lepturus* is more common

on Balochistan coast. Both species are harvested throughout the year in Pakistan using handline, longline, bottom-set gillnets and trawling. *Tentoriceps cristatus* is also rarely represented in commercial catches. Remaining species of three families are of rare occurrence. The paper are review the status of stocks of commercially important species of Family Trichuridae and made management advice.

Key-words: Families Scombridae, Gempylidae, Trichiuridae, *Lepturacanthus savala*, *Trichiurus lepturus*, commercial landings, stocks, management advice

INTRODUCTION

Fishes belonging to the families Scombridae, Gempylidae, and Trichiuridae are benthopelagic in nature. They are considered to be voracious predators and distributed circumglobally in tropical and subtropical sea between 20 to 1,500 m in depth. Members of Family Trichiuridae are called ribbonfish and are important commercial species that support large fisheries in Pakistan and are a major source of export earnings. These ribbonfishes are known locally as “chind” in Sindhi and “tinji” in Balochi. Ribbonfish inhabits continental shelf as well as entering creek areas. They are caught mainly by trawls, estuarine set bag nets, gillnets and line gears. Species belonging to families Scombridae and Gempylidae are seldom caught by tuna gillnet vessels and are of no commercial value in Pakistan

According to Nakamura and Parin (1993), trichiurids are benthopelagic (they inhabit the waters close to and some distance above the ocean bottom) whereas gempylids are either benthopelagic or mesopelagic (inhabiting the deeper waters of the open ocean). These habitat types are correlated with body form, body colour and markings, and shape of the lateral line, jaw teeth tongue, nostrils, and, olfactory rosettes (Nakamura and Parin, 1993). Nakamura (1990) identified two primary morphological and ecological forms in these fishes. Those which have elongated body, slow-swimming and adapted to mesopelagic and benthopelagic habitats includes family Trichiuridae and trichiurid-like Gempylidae) and those fishes which have fusiform body (streamlined), fast swimming and are adapted to epipelagic life (Scombridae and scombrid-like Gempylidae). Of these, the ribbonfishes (Family Trichiuridae) have an extreme ecological-morphological continuum as they are elongate and exclusively benthic. The snake mackerels (Gempylidae) are intermediate with both elongate and fusiform body shapes and are both benthopelagic and mesopelagic (Nakamura and Parin, 1993). In trichiurids, their lateral line is situated mostly on the lower sides which presumably is an adaptation to detecting sensory stimuli near the bottom of the ocean. Trichiurid fishes have dentition, tongues, and nasal organs adapted to more sedentary benthic habits. Their teeth are long, sharp, and often fang-like for seizing and holding prey during ambush predation. Their tongues are more slender and rounded and therefore not adapted to funneling water over gills during swimming.

Parin and Becker (1972) recognized three main ecological groups of trichiurid fishes. Most species are neritic or benthopelagic, dwelling above the bottom on continental shelves and slopes. The hairtails of the genera *Eupleurogrammus*, *Lepturacanthus* and *Tentoriceps* are usually found in shallow water between 20 and 200 m.

Species belonging to *Lepidocybium*, *Neoepinnula*, *Rexea* and *Ruvettus* (Family Gempylidae), and *Lepidopus* and *Trichiurus* (Family Trichiuridae) are mostly confined to depths of 100 to 500 m at the continental shelf margin and at the upper part of the slope. Some are characteristically found on seamounts in the open sea, including the commercially important species of trichiurids, *Trichiurus lepturus* and *Lepidopus caudatus*. Some species found on the continental slope from 200 to 1,000 m include the trichiurid genus *Benthodesmus* is found at depths deeper than all other trichiurid fishes, having been reported from 1,350 to 2,000 m.

Information about ribbonfish from Pakistan is limited and usually included in the list of described species occurring in Pakistan (Ahmad, 1988; Ahmad *et al.*, 1973; Anonymous, 1955; Bianchi, 1985; Hoda, 1985, 1988; Hussain, 2003; Jaleel and Khalil, 1973, 1981; Majid, *et al.*, 1992; Psomadakis *et al.*, 2015; Qureshi, 1969). Osmany *et al.* (2019) reported *Gempylus serpens* from the Pakistan coast whereas Zohra *et al.* (2020) reported *Lepidocybium flavobrunneum* from the Pakistan coast. Only limited studies have been made on any other aspects of biology of the ribbonfish along the coast of Pakistan. Arshad (1987) has worked on the catch rates of ribbonfish (*Lepturacanthus savala* and *Trichiurus lepturus*). Mirza and Baquer (1994) and Mahmood *et al.* (1999) studied fish fauna of the Indus Delta which included ribbonfish species whereas Niazi (2001) studied the distribution of trawl fishes including ribbonfishes along the Karachi coast. Memon *et al.* (2016) have studied the growth and mortality of ribbonfish (*Lepturacanthus savala*) from the Pakistan coast whereas Muhammad *et al.* (2017) studied the commercial landings of *Trichiurus lepturus* along the Makran coast. Tabassum *et al.* (2013) studied the condition factor of two species of ribbonfish occurring in Pakistan whereas Yusuf and Tabassum (2011) studied the food and feeding habits of *Trichiurus lepturus* from Pakistan. The present paper provides a review of the species belonging to the families Scombridae, Gempylidae, and Trichiuridae occurring in Pakistan.

MATERIAL AND METHODS

Published scientific literature was examined for the records of groupers and allied species from the Pakistan coast. In addition, specimens of Scombridae, Gempylidae, and Trichiuridae were collected between 2003 and 2024 from Karachi Fish Harbour. Samples collected from the harbour; were photographed and salient features and measurements were recorded, before, their preservation in 5 % neutralized formalin. Historical data on landings of fishes of Family Trichiuridae was obtained from the Handbook of Fisheries Statistics (1978-2011) and also extracted from archives of the Marine Fisheries Department, Government of Pakistan.

RESULTS

A total of 12 species belonging to 10 genera are reported during the present study. Of these Family Scombridae is represented by 1 species and 1 genus, Family Gempylidae by 4 species and 4 genera whereas Family Trichiuridae is represented by 7 species belonging to 5 genera. These species were either recorded in the historical scientific literature or collected from Karachi Fish Harbour between 2003 and 2024.

Systematic and Distributional Information

Family Scombridae (Black mackerel)

A single species, *Scombrax heterolepis*, is recognized in this family which closely resembles the family Gempylidae, but differs from the other scombroids in having a protrusible upper jaw, serrated preopercle and opercle. *S. heterolepis*, was formerly placed in the family Gempylidae (snake mackerels) by Grey (1960) and Gosline (1968) but based on molecular phylogeny Miya *et al.* (2013) placed it in the family Scombridae which is related to families Scombridae, Trichiuridae and Gempylidae.

Genus *Scombrax* Roule, 1921
Scombrax heterolepis Roule 1921

This mesopelagic species is commonly known as longfin escolar or black mackerel because of uniform dark-brown colour of its head and body and in having darker fins. It was originally collected from South of Madeira, eastern Atlantic (Roule, 1921). Its holotype (MOM 0091-1226) is housed in Musée Océanographique de Monaco (Frickle *et al.*, 2024). This is a circumglobal species which is found in all tropical and subtropical seas, except eastern Pacific and southeastern Atlantic. It is an epipelagic and mesopelagic found in the open ocean between a

depth of 100 and 900 m. In the western Indian Ocean, it is known from the Arabian Sea, Mozambique Channel, South Africa, Seychelles Bank and Saya de Malha Bank (Froese and Pauly, 2024; Heemstra, 2022a; Higgins, *et al.*, 1970). GBIF (2024) reported it from Arabian Sea off the coast of Pakistan (26°00'N; 62°00'E) collected in 1979. From India, a single specimen measuring 188.5 mm standard length was collected from a commercial deep-sea shrimp trawl by-catch operated at 220 to 350 m depths in the Arabian Sea off Trivandrum in October 2010 (Bineesh, *et al.*, 2012). No specimen of this species was examined during the present study.

Material Examined:

– None

Family Gempylidae (Snake mackerels, Barracoutas, Escolars, Oilfishes)

Genus *Gempylus* Cuvier, 1829

Gempylus serpens Cuvier, 1829

(Fig. 1)



Fig. 1. *Gempylus serpens* collected from offshore waters of Pakistan. (a) Specimen collected from Pasni; (b) specimen collected from off Sapat, Balochistan.

This species is commonly known as snake mackerel. It was described from Jamaica by Cuvier (1829). Its holotype (MNHN A-0808) is housed in Museum National d'Historie Naturelle, Paris, France (Frickle *et al.*, 2024). It was reported from Pakistan by Osmany *et al.* (2019), Froese and Pauly (2024), and from Exclusive Economic Zone (Nakamura and Parin, 1993). This species is known as circumglobal in tropical and subtropical seas (Heemstra, 2022b). It is a commonly occurring epipelagic and mesopelagic fish that is found between the surfaces to 200 m. Along the Pakistan coast, it is occasionally caught by tuna gillnet vessels operating in the offshore waters of Pakistan. Characteristically, its body is elongated and strongly compressed. Its mouth is large with fang-like teeth. There are two lateral lines on its body, both originating below the first spine of the dorsal fin. The upper lateral line follows the dorsal contour of the body to the end of the first dorsal fin base. The lower descends gradually posterior to about the tip of the pectoral fin and runs mid-laterally. Its head, body, and fins are dark brown whereas fins have margins.

Material Examined:

- 1 specimen collected from off Pasni, Balochistan (24°52.754'N; 63°29.423'E- 819 m) on 01 March 2013 (96 cm TL)
- 1 specimen collected from off Ormara, Balochistan coast (24°58.188' N; 64°45.454'E- 775 m) on 13 December 2016 (79 cm TL)
- 1 specimen collected from off Sapat, Balochistan (24°57.110'N; 65°31.922'E- 459 m) on 27 October 2017 (92 cm TL)

- 1 specimen collected from Indus Swatch (220 m) on 14 February 2019 (83 cm TL)

Genus *Lepidocybium* Gill, 1862
Lepidocybium flavobrunneum (Smith, 1843)
 (Fig. 2)



Fig. 2. *Lepidocybium flavobrunneum* collected from offshore waters of Pakistan

It is commonly known as escolar and reported from Pakistan by the Exclusive Economic Zone (Nakamura, 1984), Hoda (1988) and Zohra *et al.* (2020). It was originally described as *Cybiium flavobrunneum* from Cape of Good Hope, South Africa by Smith (1843). Its holotype (BMNH 1848.2.28.20) is housed in British Museum of Natural History, London, U. K. (Frickle *et al.*, 2024). This species is circumglobal in tropical to subtropical seas including the Western Indian Ocean (Kenya to South Africa, Madagascar and Mascarenes Islands) and the Arabian Sea. Elsewhere known from Australia, Japan, Hawaii, Peru, California, the Gulf of Mexico, the Caribbean and Canada (Haemstra, 2022b). It is an epipelagic and mesopelagic species that is found between 200 to 1,000 m. It is rarely caught by tuna gillnetters that operates in the Exclusive Economic Zone of Pakistan.

This species has an oblong, slightly compressed body. Its peduncle has a prominent fleshy mid-lateral keel, flanked by smaller keels on a caudal-fin base. Its scales are small, each surrounded by a network of tubules bearing pores. Its body is uniformly dark brown, becoming almost black with age. Since its taste is not good and meat has purgative properties, therefore, usually it is discarded by fishermen.

Material Examined:

- 1 specimen collected from off Gwadar, Balochistan (27°51.621'N; 62°38.237'E- 3,274 m) on 11 February 2015 (117 cm TL)
- 1 specimen collected from off Sonmiani Bay, Balochistan coast (24°50.073'N; 65°43.149'E- 1,234 m) on 11 November 2016 (72 cm TL)
- 5 specimens collected from Karachi Fish Harbour on 23 March, 20129 (75, 76, 76,77,77 cm TL)

Genus *Neopinnula* Matsubara and Iwai, 1952
Neopinnula orientalis (Gilchrist and von Bonde, 1924)
 (Fig. 3)

This species is commonly known as sackfish. It was reported from Pakistan by Froese and Pauly (2024), Hoda (1985, 1988), Hussain (2003), Hussain and Kidwai (1994), Nakamura (1984) and Nakamura and Parin (1993). It was originally described as *Epinnula orientalis* from South Africa, Pickle stations 291 and 292 by Gilchrist and von Bonde (1924), however, no type is known (Frickle *et al.*, 2024). This species is widely distributed in the Indo-Pacific area including Flores, Banda, Arafura Sea, Sulawesi, Sulu seas, off Ryukyu Islands and southern Japan, Fiji, Tuvalu, the Philippines, Australia and western and northern Indian Oceans including off East Africa (Kenya to Natal, South Africa), Saya de Malha Bank, Madagascar, Saudi Arabia, Arabian Sea (Oman, Pakistan, India), Maldives (Froese and Pauly, 2024; Hamestra, 2022b). It is benthopelagic species found between 200 and 600 m and usually found on the outer continental margin. Along the coast of Pakistan, it is widely distributed in offshore waters, however, because of their benthic nature, this species is rarely caught by tuna gillnets that operate in the Exclusive Economic

Zone of Pakistan (Moazzam, *et al.*, in press).



Fig. 3. *Neoepinnula orientalis* (taken onboard Firdows-1 in November, 2009)

This species has an oblong and compressed body and has two lateral lines on the sides, both originating from above the upper angle of the gill opening. It is greenish brown to dark brown in colour whereas the buccal and branchial cavities are usually black.

Material Examined:

- 1 specimen collected from Karachi Fish Harbour on 09 October 2010 (75 cm TL)
- 1 specimen collected from Karachi Fish Harbour on 11 March 2013 (72 cm TL)
- 1 specimen collected from Karachi Fish Harbour on 31 May 2020 (68 cm TL)

Genus *Ruvettus* Cocco, 1833
Ruvettus pretiosus Cocco, 1833

This species is commonly known as oilfish. It was reported from Pakistan by Hoda (1988) and Nakamura (1984). It was originally described from Messina, Italy by Cocco (1833), however, no type is known (Frickle *et al.*, 2024). This species is known to be a circumglobal in tropical to temperate seas including the Mediterranean Sea. In the Indian Ocean it is known from Mozambique, South Africa, Madagascar, Comoros, Seychelles, Reunion, India, and Maldives (Froese and Pauly, 2024; Heemstra, 2022b).

This species is oblong with rough skin. Its scales are minute and cycloid, interspersed with rows of spinous bony tubercles; belly has low midventral ridge between pelvic fins and anus. There is a single lateral line, often obscure. Its body is dark bronzy brown to charcoal, without distinguishing marks. Its flesh is very oily and the meat can be purgative. No specimen of this species was examined during the present study.

Material Examined:

- None

Family Trichiuridae (Cutlassfishes)
Genus *Eupleurogrammus* Gill, 1862
Eupleurogrammus glossodon (Bleeker, 1860)

This species is commonly known as longtooth hairtail. It was reported from Pakistan by GBIF (2024) (based on its collection from Pakistan housed in Los Angeles Country Museum, USA) as *Eupleurogrammus intermedius*, Nakamura and Parin (1993) and Froese and Pauly (2024). This species was originally described as *Trichiurus glossodon* from Soengidoeri in Bangkayang, Western Borneo by Bleeker (1860). Its holotype is not known, however, its lectotype of this species (RMNH 6031) is housed in Rijksmuseum van Natuurlijke Historie, Leiden (Frickle *et al.*, 2024). This species is known from the Indo-West Pacific including the Persian Gulf (Qatar), Pakistan, India, Sri Lanka, the Bay of Bengal, Malaysia, Singapore, Indonesia, and Thailand (Froese and Pauly, 2024; GBIF, 2024). It is a benthopelagic species found in the coastal waters, up to a depth of 80 m which migrates to near the surface at night.

This species has an elongated and extremely compressed, ribbon-like body which is tapering to a point. Its

pelvic fins are reduced to scale-like spines and the lateral line is almost straight. Its body is steely blue with metallic reflections, becoming silvery after death; the dorsal-fin membrane is slightly tinged with black along the spines whereas there is a black blotch on the base of the anterior margin of pectoral fins and a black spot just behind the dermal process on the bottom of the lower jaw. No specimen of this species was examined during the present study.

Material Examined:

- None

Eupleurogrammus muticus (Gray, 1831)

It is commonly known as smallhead hairtail. Sorley (1932) reported this species (as *Trichiurus muticus*) from the water of Sindh whereas Froese and Pauly (2024), GBIF (2024) (based on its collection from Pakistan housed in Los Angeles Country Museum, USA) and Nakamura and Parin (1993) reported this species from Pakistan coast. It was originally described as *Trichiurus muticus* from India by Gray (1831) and its holotype (BMNH 1955.5.13.2) is housed in the British Museum of Natural History, London, U.K. (Frickle *et al.*, 2024). This species is known from the Indo-West Pacific area including the Persian Gulf (Kuwait, UAE), India, Sri Lanka, Bangladesh, Myanmar, Malaysia, Singapore, Indonesia, Gulf of Thailand, Vietnam, China, southern Korean Peninsula, and Australia. (Froese and Pauly, 2024; GBIF, 2024). It is a benthopelagic species found in the coastal waters, up to a depth of 80 m, and may enter estuaries. It also migrates to near-surface at night

This species also has an elongated and extremely compressed, ribbon-like body which is tapering to a point. Its pelvic fins are reduced to scale-like spines and the lateral line is almost straight. Its body is steely blue with metallic reflections, becoming silvery grey after death. There are small blackish spots present at the base of the pectoral-fin spine (no such spot in *E. glossodon*). The dermal process of the upper jaw in this species is black but there is no black spot on the bottom of the lower jaw (the dermal process at the tips of both jaws is black, and black spot just behind the dermal process on the bottom of the lower jaw in *E. glossodon*). No specimen of this species was examined during the present study.

Material Examined:

- None

Genus *Lepidopus* Goüan 1770
Lepidopus caudatus (Eupharsen, 1788)

This species is commonly known as silver scabbardfish. It was reported from Pakistan in larval form by Aftab and Ali-Khan (1992), however, according to Nakamura and Parin (1993) this species is found in the East Atlantic, South Indian Ocean, and Southwest Pacific, therefore, its occurrence in Pakistan is doubtful and may be based on misidentification. Fanning *et al.* (2016) mentioned that in 1977 cruises of R/V Dr. Fridtjof Nansen 1977 large quantities of this species were reported which may also be based on misidentification. Originally it was described as *Trichiurus caudatus* from Cape of Good Hope, South Africa by Eupharsen (1788), however, no type is known (Frickle *et al.*, 2024).

This species characteristically has an elongated and compressed body with a head with frontal crests converging from just before the middle to behind the rear edge of the eyes and eyes are large which are placed close to the dorsal profile. Its body is uniformly silvery and dorsal fin with melanophores on membranes between the first 3 or 4 spines, and a narrow black margin on most of the fin length. No specimen of this species was examined during the present study.

Material Examined:

- None

Genus *Lepturacanthus* (subgenus of *Trichiurus*) Fowler, 1905
Lepturacanthus savala (Cuvier, 1829)
(Fig. 4)

This species is commonly known as Savalai or Savalani hairtail. It was reported from Pakistan by several workers including Ahmed *et al* (1973), Anonymous (1955), Misra (1962), Murray (1880) and Sorley (1932) have

reported it from the waters of Sindh whereas it was reported from Dabbo Creek by Mirza and Baquer (1994), from Indus Delta by Mahmood *et al* (1999), Karachi by Ahmed *et al* (1973), Anonymous (1955), Hureau (1991), Misra (1962) and Niazi (2001) and from Paradise Point by Moazzam and Rizvi (1980). From Balochistan, it was reported by Ahmed *et al* (1973), Anonymous (1955) and Misra (1962). Ahmed (1988), Arshad (1981), Bianchi (1985), Froese and Pauly (2024), Hoda (1985, 1987, 1988), Hussain (2003), Iqbal *et al* (1999), Jalil and Khalil (1972, 1981), Majid *et al* (1992), Memon *et al.* (2016), Qureshi (1952, 1969), Siddiqi (1956) and Tabassum *et al.* (2013) reported this species from Pakistan coast without mentioning any specific location. Originally this species was described as *Trichiurus savala* from Pondicherry, India by Cuvier (1829). Its holotype is not known, however, syntypes or neotypes are housed in Museum National d' Historie Naturelle, Paris, France (Frickle *et al.*, 2024) This species was referred as *Trichiurus savala* by Ahmed *et al* (1973), Anonymous (1955), Cuvier (1829), GBIF (2014), Hoda (1987), Misra (1962), Murray (1880), Qureshi (1952, 1969) and Siddiqi (1956). Elsewhere this species was reported from Indo-West Pacific area including India and Sri Lanka, Bay of Bengal, Thailand, Malaysia, Indonesia, Philippines, China, New Guinea, and northern Australia (Froese and Pauly, 2024; Holleman, 2022). It is benthopelagic in coastal waters, to a depth of 100 m. Juveniles are abundantly found inside the estuary and along the shallow coastal waters.

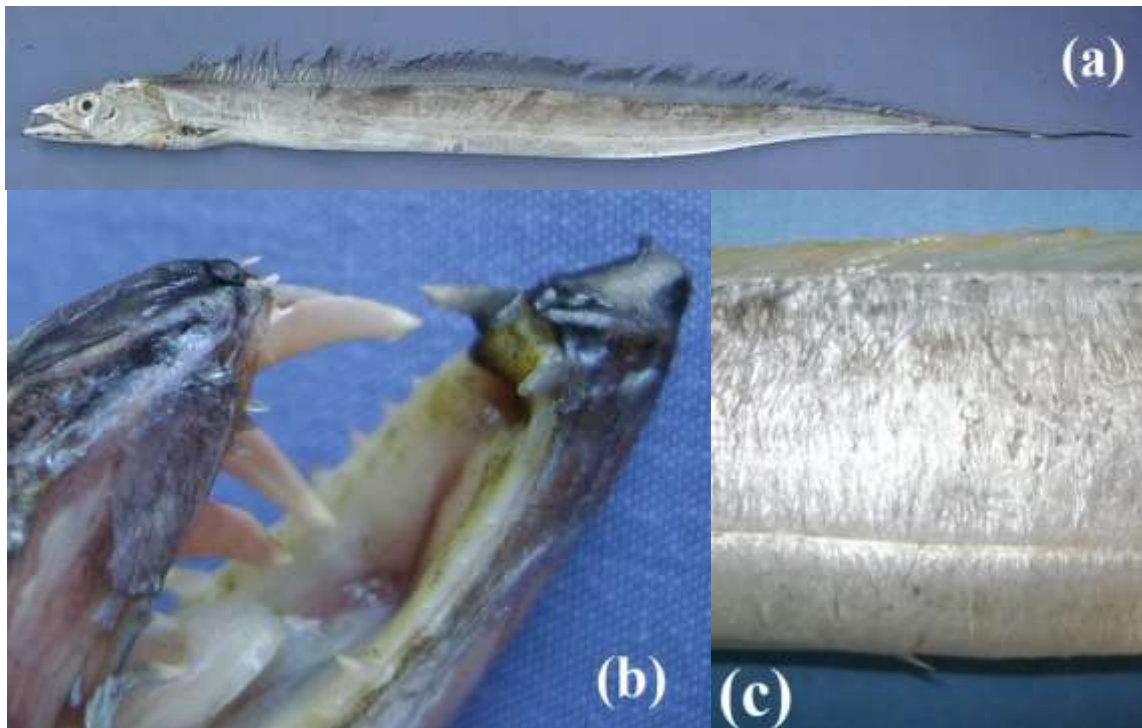


Fig. 4 *Lepturacanthus savala*. (a) Lateral view; (b) Upper jaw showing two canine teeth along with fangs; and (c) Anal fin.

The body in this species is extremely elongated and strongly compressed, ribbon-like, and tapering to a point. It lacks pelvic fins and caudal fins. Its anal-fin spinules breakthrough skin (Fig. 4c). There are two pairs of small forward-pointing canine teeth in the upper jaw (Fig. 4b) whereas anterior most fangs are very long and protrude through a slit in the lower jaw. Its colour is steely blue with metallic reflections and the tapering part is white. The margin of the anus in this species is pale. The tip of both jaws is black.

Azadi and Ullah (2009) have analyzed the food and feeding habits of *Lepturacanthus savala* (Cuvier, 1829) from the Bay of Bengal, Bangladesh whereas Tabassum *et al.* (2013) studied condition factor in this species from the Pakistan coast. Surveys carried out along the coast of Pakistan including by R/V Dr. Fridtjof Nansen in 2010 indicated that this species is dominating along the Sindh coast whereas *Trichurus lepturus* was more common in Gwader-Jiwani area (Fanning *et al.*, 2011).

Material Examined:

- 1 specimen collected from Karachi Fish Harbour on 11 January 2001 (111 cm TL)
- 1 specimen collected from Karachi Fish Harbour on 22 May 2007 (66 cm TL)
- 1 specimen collected onboard R/V Dr. Fridtjof Nansen (24° 32'N; 66° 43'E- 62 m) on 13 October. 2010 (82 cm TL)
- 1 specimen collected onboard R/V Dr. Fridtjof Nansen (24° 56'N; 61° 42'E- 20 m) on 05 November. 2010 (102 cm TL)
- 1 specimen collected from Karachi Fish Harbour on 28 October 2013 (63 cm TL)

Genus *Tentoriceps* Whitley, 1948
Tentoriceps cristatus (Klunzinger, 1884)
 (Fig. 5)



Fig. 5. *Tentoriceps cristatus*. (a) Lateral view; (b) Head showing profile and teeth.

This species is commonly known as crested hairtail. It was reported from the Exclusive Economic Zone of Pakistan between Karachi and Bombay (Anonymous, 2001) and offshore waters of Pakistan by GBIF (2024) (based on its collection from Pakistan housed in Los Angeles Country Museum, USA). Many specimens of this species are caught along the coast of Pakistan but it is of rare occurrence. This species was originally described as *Trichiurus cristatus* from Qusair, Red Sea, Egypt, and Red Sea. By Klunzinger (1884), however, its holotype is not known (Frickle *et al.*, 2024). This benthopelagic species is known from the Indo-West Pacific area including the Red Sea, Mozambique Channel, Saya de Malha Bank, St Brandon Shoals, Chagos Islands, Andaman Sea, northern and southeastern Australia, South China Sea, East China Sea, Indonesia, Tasman Sea, Philippines, Korea and southern Japan (Froese and Pauly, 2024; Holleman, 2022).

Its body is elongated and strongly compressed, ribbon-like and tapering to a point. Its eyes are large and laterally placed. Its mouth is small and does not reach the front edge of its eyes. The dermal process is present at the tips of both jaws; 3 pairs of fangs in the upper jaw, and 2 pairs of fangs in the lower jaw. Its body is silvery white, becoming silvery grey with dark cloudlike patches after death; jaws and dorsal fin dusky; bases of dorsal fin and anal fin sooty.

Material Examined

- 1 specimen collected from Karachi Fish Harbour on 11 October 2004 (76 cm TL)
- 1 specimen collected from R/V Dr. Fridtjof Nansen (24° 32'N; 66° 43'E-52 m) on 13 October. 2010 (66 cm TL)
- 1 specimen collected onboard R/V Dr. Fridtjof Nansen (24° 07'N; 66° 42'E- 65 m) on 14 October. 2010 (64 cm TL)

Genus *Trichiurus* Linnaeus, 1758
Trichiurus auriga Klunzinger, 1884

This species is commonly known as pearly hairtail. It was reported from Pakistan by Nakamura and Parin (1993). It was originally described from Kosseir, Egypt, Red Sea by Klunzinger (1884), however, no type is known (Frickle *et al.*, 2024). This benthopelagic species is found in deeper waters between a depth of 250 to 350 m in the Western Indian Ocean including East Africa to northern Mozambique, Red Sea, Persian Gulf, west coast of India, Sri Lanka, Maldives, Indonesia to Timor Sea and northern Australia (Froese and Pauly, 2024; Holleman, 2022).

This species has an elongated, extremely compressed, and tapering to a point. Its dorsal fin is long and continuous whereas anal-fin spinules are mostly buried in skin. Its mouth is large with a small dermal process at the tips of both jaws with 2 or 3 pairs of fangs at the front of the upper jaw, and 1 pair of fangs at the front of the lower jaw, and all fangs without barbs. Its body is pearly white which is slightly dusky dorsally. No specimen of this species was examined during the present study.

Material Examined:

- None

Trichiurus lepturus Linnaeus, 1758
(Fig. 6)



Fig. 6. *Trichiurus lepturus*

This species is commonly known as largehead hairtail. It is reported from the waters of Sindh by Anonymous (1955), Brandhorst (1994), Misra (1962), Murray (1880) and Sorley (1932). It was also reported from Karachi (Anonymous, 1955, 1999; Misra, 1962; Niazi, 2001) and Paradise point, Karachi (Moazzam and Rizvi 1980). From Balochistan, it was recorded by Anonymous (1953, 1955), Brandhorst (1994), Misra (1962), Qureshi (1952) and Zugmayer (1913). It was also reported from Gwader by Abildgaard *et al* (1994). In addition, Ahmed (1988), Arshad (1987), Bianchi (1985), Froese and Pauly (2024), Hoda (1985, 1988), Hussain (2003), Hussain and Kidwai (1994), Iqbal *et al* (1999), Jalil and Khalil (1972, 1981), Majid *et al* (1992), Nakamura (1984), Nakamura and Parin (1993) and Qureshi (1969) reported this species from Pakistan without mentioning any specific location. It was originally described from America and China by Linnaeus (1758). Its holotype is not known, however, syntypes are housed in Naturhistoriska Riksmuseet, Stockholm, Sweden (Frickle *et al.*, 2024). Anonymous (1953, 1955, 1999), Hoda (1985), Hussain (2003), Jalil and Khalil (1972, 1981), Misra, (1962), Moazzam and Rizvi (1980). Qureshi (1952, 1969), Sorley (1932) and Zugmayer (1913) reported this species as *Trichiurus haumela*. It is a found in circumtropical and warm temperate seas including Gulf of Mexico, Caribbean Sea, Mediterranean Sea, Sea of Marmara, Red Sea, Persian Gulf and coastal waters of all Asian and western Indian Ocean countries (Holleman, 2022).

Like other trichurids, its body is extremely elongated, compressed, and tapering to a point. Its mouth is large with a dermal process at the tip of each jaw. Dorsal fin is relatively high; the anal fin is reduced to minute spinules usually embedded in the skin or slightly breaking through. Its colour is steely blue with silvery reflections, becoming uniformly silvery gray sometime after death

Trichurus lepturus is a well-studied species in the regional countries. In India it was studied by Abdussamad *et al.* (2006), Avinash, *et al.* (2014), Azeez, *et al.* (2016), Chakraborty (1990), Ghosh, *et al.* (2009, 2014, 2024), Mohite and Biradar (2001), Narasimham (1976, 1983, 1994), Nair *et al.* (1996), Rajesh *et al.* (2015), Reuben *et al.* (1997), Somvansh and Joseph (1989), Thiagarajan *et al.* (1992) and Udupa *et al.* (2022). Al-Nahdi *et al.* (2009) studied size composition, reproductive biology, age, and growth of this species from Oman. Khervi *et al.* (2021) studied this species from the waters of the Persian Gulf whereas Taghavimotlagh and Shojaei (2018) and Taghavimotlagh *et al.* (2011) studied its population dynamics and biology in the Persian Gulf and Oman Sea.

Surveys carried out along the coast of Pakistan including by R/V Dr. Fridtjof Nansen in 2010 indicated that this species is dominating along the Gwader-Jiwani area whereas *Lepturacanthus savala* was more common along the Sindh coast (Fanning *et al.*, 2011). Some of the previous surveys indicated the abundance of *Trichurus lepturus* on both the Sindh and Balochistan coasts which is because of *Lepturacanthus savala* and *T. lepturus* are merged as *T. lepturus* (Brandhorst, 1994).

Yusuf and Tabassum (2011) studied the food and feeding habits of this species and observed that its diet consisted of cephalopods, crustaceans, euphausiid, Mysidacea, copepods and stomatopods. They observed that the smallest specimens (40-70cm) fed mainly on euphausia, the medium-sized individuals (70-90cm) fed on *Euphausia*, small fish, and cephalopods whereas individuals of length more than 90 cm fed mainly on fishes and cephalopods.

Material Examined:

- 1 specimen collected from Karachi Fish Harbour on 11 January 2001 (111 cm TL)
- 1 specimen collected from Karachi Fish Harbour on 22 May 2007 (66 cm TL)
- 1 specimen collected onboard R/V Dr. Fridtjof Nansen (24° 85'N; 62° 27'E- 22 m) on 28 October. 2010 (82 cm TL)
- 1 specimen collected onboard R/V Dr. Fridtjof Nansen (24° 56'N; 61° 42'E- 20 m) on 05 November. 2010 (102 cm TL)
- 1 specimen collected from Karachi Fish Harbour on 28 October 2013 (63 cm TL)

Commercial Fisheries, Landings, Stocks and Management Advice

Ribbonfish are benthopelagic fish primarily associated with near-bottom depths and found generally over muddy bottoms of shallow coastal waters. Juveniles feed mostly on planktonic crustaceans and small fish, while adults feed mainly on fish and occasionally on squids and crustaceans. Two species, *Lepturacanthus savala* and *Trichiurus lepturus*, are considered commercially important in Pakistan and regional countries. These species commonly grow to lengths greater than 70 and 100 cm.

Ribbonfishes have been harvested in Pakistan for a long period, however, it aimed commercial harvesting and export were started in 1982 when deep sea fishing in the Exclusive Economic Zone of Pakistan was introduced under a Joint Venture Programme (Fig. 7). Before the deep sea fishing, ribbonfish was caught as a bycatch of trawl and bottom-set gillnet fisheries and used as raw material for fishmeal production. Local fishermen of Pakistan also started target harvesting of ribbonfish using handline and longline fisheries and its packaging was started by processing plants and export was initiated. Joint venture fishing operations were closed in 1986, which is evident from the decrease in landings from 1986 onward. Only three deep-sea fishing vessels were operated between 1986 and 1992, thus landings remained low during this period. Aimed fishing for ribbonfish using handline and bottom-set longlines was started by local fishermen in Balochistan and also reasonably large fisheries for bottom-set gillnets were started in both Sindh and Balochistan which resulted in a steady increase in the landing of ribbonfish between 1992 and 1998. Both the local fish industry and deep-sea vessels contributed to the increase of landings and export of ribbonfish during this period.

The highest number of deep-sea fishing vessels (>20) operated between 1998 and 2000 which is evident from

achieving maximum landings of ribbonfish in Pakistan during this period (Fig.7). A ban on deep-sea fishing was imposed in 2000 and no such vessel operated in Pakistan till 2002 and only a small fleet of deep-sea vessels operated during 2002 and 2005 which is also evident from an increase in the landings. Operation of deep-sea fishing vessels in the Exclusive Economic Zone of Pakistan was closed in May 2005 and since then no fishing vessels have been operating in Pakistan. Since 2000, local fishing trawlers have installed winches in their boats and started operating in comparatively deeper waters on the continental shelf of Pakistan and started a major contribution in total landings of the ribbonfish in Pakistan.



Fig. 7: Annual landings of Ribbonfish from Pakistan (Source: Handbook of Fisheries Statistics, MFD).

Since at least 2005, the catches of ribbonfish was made entirely by the domestic fleet using trawl nets, gillnets and line gears. After the decline of shrimp catches in the 2000s, ribbonfish became a key group in the fishing industry. Ribbonfish (whole) are mainly exported to China, Korea, and Japan in frozen form whereas headless and tailless ribbonfish are exported mainly to China. Headless/tailless and definned ribbonfish are mainly exported to Korea and Japan. Ribbonfish caught by handline and longline fetches comparatively higher prices in local and export markets whereas those caught with gillnet and trawl do not get high prices.

In the early 1980s, ribbonfish were commonly observed to weigh 1.0 kilogram or more. While some specimens of this size are still found, particularly in Balochistan, they are now very rare and the majority are less than 500 grams. Ribbonfish, particularly small ones, also make up 9% of the trash catches at Karachi Fish Harbour and 6 % in the Indus Creek areas.

The last stock assessment surveys for the stocks of ribbonfish were carried out under the Fisheries Department/FAO Research Project "Fisheries Resource Appraisal Programme (FRAP)" from 2007 to 2016 (Fanning et al., 2016). During this period, several demersal survey cruises were carried out. The combined average bias-corrected biomass of the ribbonfish (*Lepturacanthus savala* and *Trichiurus lepturus*) was observed to be 75% lower than the surveys carried out in 1983 and 1984 (Table I). The mean individual weights of ribbonfish in earlier surveys (1983-84) were at least twice as big as in the recent surveys. There were very few length frequency samples collected during the earlier standard surveys however they were collected during the 1984 survey series which showed a large abundance of small fish (<20 cm) as well as abundant numbers at larger sizes including a scattering

of samples over 100 cm. The recent surveys are dominated by smaller sizes, especially in 2015 where a very large mode of small fish is seen but very low frequencies for larger specimens.

Ribbonfish are considered an important commercial species mainly exported to Southeast and Far East Asian countries. Commercial harvesting started in 1979, with catches peaking in 1999 (Fig. 7). Before this, the stocks appear to have been lightly exploited. The catch and effort data from 1999 onwards were used to fit the production model. All total catches before this were incorporated into the model. The initial stock status was set as unexploited due to the lack of landings in the initial period.

Table-I. Combined average bias-corrected biomass (in m. tons) for ribbonfish.

Survey Period	1977		1983		1984-I		1984-II		2010		2015
Research Vessel	R/V Fridtjof Nansen	Dr.	R/V Fridtjof Nansen	Dr.	R/V Fridtjof Nansen	Dr.	R/V Fridtjof Nansen	Dr.	R/V Fridtjof Nansen	Dr.	R/V Firdous-II
Biomass (in m. tons)	14,328		66,668		12,671		21,776		3,372		9,341

Source: Modified from FRAP Final Report (Fanning *et al.*, 2016).

The present landings of ribbonfish are estimated to be 12,074 m. tons whereas Fanning *et al.* (2016) used a figure of 15,016 m. tons for the calculation of the stock biomass which was reported to be below the MSY level, however, they observed that the fishing mortality is within the F_{MSY} limit the uncertainty in the estimates is relatively large and both parameters include 1.0 within the 90% confidence range. The current catch and the figures used by Fanning *et al.* (2016) were low compared to preceding years and are below the replacement yield. The Kobe plot presented by Fanning *et al.* (2016) shows that although the 2014 situation suggests some improvement, the catches in recent years were all considerably higher, and as a result estimated fishing mortality ratio was at or above the limit F ratio. Although the apparent F has never been exceedingly high, the stock has shown a steady decline in biomass which they attributed to an indicative of a substantial unreported catch, the landings in the form of trash.

The projections from the production model made by Fanning *et al.* (2016) suggest that at current levels of effort, the stock is likely to remain below MSY, so a reduction in effort directed at this fishery is likely required to ensure recovery. Memon *et al.* (2016) studied growth and mortality parameters of *Lepturacanthus savala* from Pakistan Waters and obtained results of a maximum sustainable yield (MSY) of 26,983 m. tons in Pakistan which according to them was larger than the commercial landings (20,375 m. tons). It may be pointed out that this study did not include *Trichiurus lepturus* which is also a commonly occurring species. This study confirms the findings of Fanning *et al.* (2016).

It is worth noting that the landings since 2014, generally remained lower than 2014 figures which may further help in stock recovery. The survey biomass estimates are consistent with the substantial level of depletion estimated by the production model. They concluded that Kobe Plot indicates that the ribbonfish were overfished and somewhat depleted but nowhere near as severely as most other demersal resources. They suggested management actions to reduce demersal fishing efforts would be expected to benefit ribbonfish quite quickly, sooner, and faster than most other species of demersal fishes in Pakistan. Considering that the present ribbonfish landings remained below the level of 2014 landings, the same management advice should be adopted to ensure that ribbonfish stocks in Pakistan are not depleted.

CONCLUSION

Of the three families, fishes that belong to Scombrabrachidae and Gempylidae are generally not considered to be of commercial importance in Pakistan mainly because of the rarity of their occurrence. Ribbonfish of Trichiuridae was not commercially exploited before 1982, however, with the start of their export by deep sea fishing vessels operating in the Exclusive Economic Zone, a large local fishery was also established. Between 1985 and 2002, ribbonfish was the most dominating landed and exported species after penaeid shrimp. Since 2003, Indian mackerel become the most dominant landed and exported species, however, ribbonfish remained the second most important because of the decline of the catches of shrimp, and still, the same status persists (Fig. 8).

Of the four species of family Trichuridae, *Lepturacanthus savala* seems to be the most dominating species caught along the coast of Sindh coast and Sonmiani Bay whereas *Trichiurus lepturus* is dominating in the Gwadar-Jiwani area. The other two species of the family Trichuridae are of rare occurrence. Muhammad *et al.* (2017) studied the fishery status of ribbonfish *T.lepturus* from the Balochistan coast (referred to as Makran coast) and reported the main season for fishing for this species is during September and December, although the species is caught throughout the year.



Fig. 8. Ribbonfish are among the dominating species being landed in the Pakistan



Fig. 9. Petrified ribbon at Karachi Fish Harbour destined for fishmeal production

Tabassum *et al.* (2013) have studied the condition factor of ribbonfish (*Trichiurus lepturus* and *Lepturacanthus savala*) from the Karachi coast and found that in both species male specimens have higher condition factors than females. Behera, *et al.* (2021) indicated an abundance of juveniles of ribbonfish off the coast of Visakhapatnam, north Andhra Pradesh, India. A similar observation was observed during the present study and a preponderance of juvenile ribbonfish was observed in the coastal waters along the coast of Pakistan, especially along the mouth and lower ends of creeks in the River Indus Delta.

Ribbonfish are mainly caught with handline, longline, and bottom-set gillnet as well as a bycatch of trawl fisheries. Being a delicate species, the specimens caught by trawl nets are sometimes macerated or bruised. Similar bruises on its body may occur due to poor handling practices onboard local fishing vessels. Such bruised or

macerated specimens are not acceptable for processing and export (Fig. 9). Additionally, juvenile ribbonfish (>40 cm TL) are not exported. These are mishandled and juveniles are allowed to be petrified and end up as raw material for fishmeal production. It is estimated that the quantity of such mishandled ribbonfish accounts for about 20 to 25 % of total catch. There is an immediate need to improve handling practices onboard fishing vessels to minimize post-harvest losses due to mishandling and being of small size. There is a good demand for smaller ribbonfish in some countries where small specimens can be exported.

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