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SPECIES COMPOSITION, COMMERCIAL LANDINGS, DISTRIBUTION AND SOME ASPECTS OF BIOLOGY OF GUITARFISH AND WEDGEFISH (CLASS PISCES: ORDER RHINOPRISTIFORMES) FROM PAKISTAN

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ABSTRACT

Guitarfish and wedgefish are commercially exploited in Pakistan (Northern Arabian Sea) since long. It is estimated that their commercial landings ranged between 4,206 m. tons in 1981 to 403 metric tons in 2011. Analysis of the landing data from Karachi Fish Harbor (the largest fish landing center in Pakistan) revealed that seven species of guitarfish and wedgefish are landed (January 2019-February 2020 data). Granulated guitarfish (*Glaucostegus granulatus)* contributed about 61.69 % in total annual landings of this group followed by widenose guitarfish (*G. obtusus*) contributing about 23.29 % in total annual landings of guitarfish and wedgefish. Annandale's guitarfish (*Rhinobatos annandalei*) and bowmouth guitarfish (*Rhina ancylostoma*) contributed 7.32 and 5.97 % in total annual landings respectively. Spotted guitarfish (*R. punctifer*), Halavi ray (*G. halavi*), smoothnose wedgefish (*Rhynchobatus laevis*) and Salalah guitarfish (*Acroteriobatus salalah*) collectively contributed about 1.73 % in total annual landings. Smoothnose wedgefish (*R. laevis*) is rarest of all the members of Order Rhinopristiformes. *G. granulatus*, *G. obtusus*, *R. ancylostoma*, *G. halavi* and *R. laevis* are critically endangered according to IUCN Red List whereas *A. salalah* is near threatened and *R. annandalei* is data deficient. There are no aimed fisheries for guitarfish and wedgefish in Pakistan but these fishes are mainly caught as by-catch of bottom-set gillnetting and shrimp trawling. Some aspects of biology of these species are also presented in the paper.

Key word: Seasonal variation, *Rhina ancylostoma, Rhynchobatus laevis Glaucostegus granulates, G. obtusus, G. halavi Rhinobatos annandalei, R. punctifer, Acroteriobatus salalah*, IUCN Red List, CITES Appendix-II.

INTRODUCTION

Guitarfish and wedgefish belonging to order Rhinobatiforme) are exploited on commercial scale for local consumption of meat and for export of dry fins. There is no aimed fishery for guitarfish and wedgefish in Pakistan but these are mainly caught as bycatch of bottom set gillnet and trawl fisheries. There is no dedicated study dealing with guitarfish and wedgefish in Pakistan except Fatima *et al.* (2016), Gore *et al.* (2019), Kyne *et al.* (2019) and Nasir and Afsar (2020) who have studied shark and guitarfish landings at Karachi Fish Harbour. Kyne *et al.* (2019) while describing the threat of extinction being faced by wedgefish and guitarfish also gave an account of their fisheries (1999-2011) from Sindh and Balochistan, Pakistan. Some aspects of the fisheries of these species in Pakistan were also included in studies carried out by Jabado (2018, 2019), Jabado and Spaet (2017) and Jabado *et al.* (2017). Gore *et al.* (2019) in his recent work on the elasmobranch fisheries of Balochistan also covered some aspects of fisheries guitarfish and wedgefish in province of Balochistan.

Guitarfish and wedgefish have been included in checklist of fishes of Pakistan (Bianchi (1985), Hoda, 1985, 1988; Hussain, 2003; Jalil and Khaliluddin, 1972, 1981; Misra, 1952; Sorley, 1932). A few studies on elasmobranchs of Pakistan also listed species of guitarfish and wedgefish (Ahmad and Niazi, 1975; Khan and Quadri, 1986; Misra, 1969; Niazi, 1994; Qureshi, 1953). Qureshi (1972) in his review of elasmobranchs have covered guitarfish and wedgefish of Pakistan in detail.

Considering that a majority of elasmobranch species are being overfished and some cases species have been fished to extinction or their numbers are dwindling considerably, a number of initiatives have been taken. These include placing sharks, rays and guitafishes on CITES Appendices or on IUCN Red List (Dulvy *et al.*, 2014; Jabado *et al.*, 2018; Last *et al.*, 2016). There has been a surge on the studies focused on fisheries of elasmobranch in the Arabian Sea and contiguous sea (Chen, 1996; Dent and Clarke, 2015; Dulvy *et al.*,2014; Haque *et al.*, 2018; Henederson *et al.*, 2004; Jabado, 2018, 2019; Jabado and Ebert, 2015; Jabado and Spaet, 2017; Jabado *et al.*, 2014, 2015, 2017, 2018; Karnard *et al.*, 2020; Kyne *et al.*, 2019; Moore, 2017). Some of these studies specifically dealt with fisheries guitarfish and wedgefish (Jabado, 2018; 2019; Jabado and Spaet, 2017; Kyne *et al.*, 2019; Moore, 2017). Jabado and Spaet (2017) have given a detailed description of shark fisheries of the Arabian Sea including

Pakistan. Jabado (2018) dealt specifically on the fisheries of guitarfish and wedgefish of the Arabian Sea which also provided some information about this group from Pakistan.

Considering that there are serious lacunae in the information about guitarfish and wedgefish of Pakistan, present paper deals with species composition, landings, fisheries and some aspects of biology of Rhinopristiformes from Pakistan.

MATERIALS AND METHODS

Published scientific literature was examined for the records of various guitarfish and wedgefish species occurrence from Pakistan coast (Fig.1). In addition, specimens of fishes belonging to Order Rhinopristiformes collected between 2003 and 2020 from Karachi Fish Harbour which is the largest fish landing centre for domestic fleet operating along coastal and offshore waters of Pakistan. No foreign vessel is allowed to land their catch at this fish harbour. Samples collected from the harbour, were photographed and salient features and measurement are recorded, before, their preservation in 5 % neutralized formalin.

Historical data of landings of fishes of Order Rhinopristiformes was obtained from Anonymous (2012) and also from archive of Marine Fisheries Department, Government of Pakistan. In order to obtain information about seasonal changes in the landings and some biological aspects of guitarfish and wedgefish, observations were recorded at Karachi Fish Harbor on daily basis from 1 January, 2019 to 29 February 2020. During this period estimated catch of members of Order Rhinopristiformes was recorded. In the collection of this data staff of Fishermen's Cooperative Society based in Karachi Fish Harbour has also provided support which is greatly acknowledged.

RESULTS

Commercial Landings

There is no target fishery for guitarfish and wedgefish in Pakistan and it is caught mainly as bycatch of bottom-set gillnetting and trawl fisheries. This group of fishes is considered as important component of shark fisheries of Pakistan. Bottom-set gillnetting is the main fisheries through which guitarfish and wedgefish are landed in Pakistan. There are two maritime provinces (Sindh and Balochistan) in Pakistan. It is estimated that there are 3,500 fishing vessels of various sizes use bottom-set gillnets in Balochistan Province whereas there are about 2,200 such vessels based in Sindh Province. Gillnet vessels based in two provinces employ bottom-set gillnets for catching demersal fishes which include guitarfish and wedgefish. In addition to these, there are about 2,500 shrimp/fish trawlers which are based in Sindh which also contribute to the total landings of guitarfish and wedgefish of Pakistan. There are no trawlers registered in Balochistan. Although extent of contribution of two fisheries in the landings of guitarfish and wedgefish has not been calculated but it is roughly estimated that about 92 to 95 % of the guitarfish and wedgefish are contributed by bottom-set gillnetters whereas 5 to 8 % is contributed by trawlers.

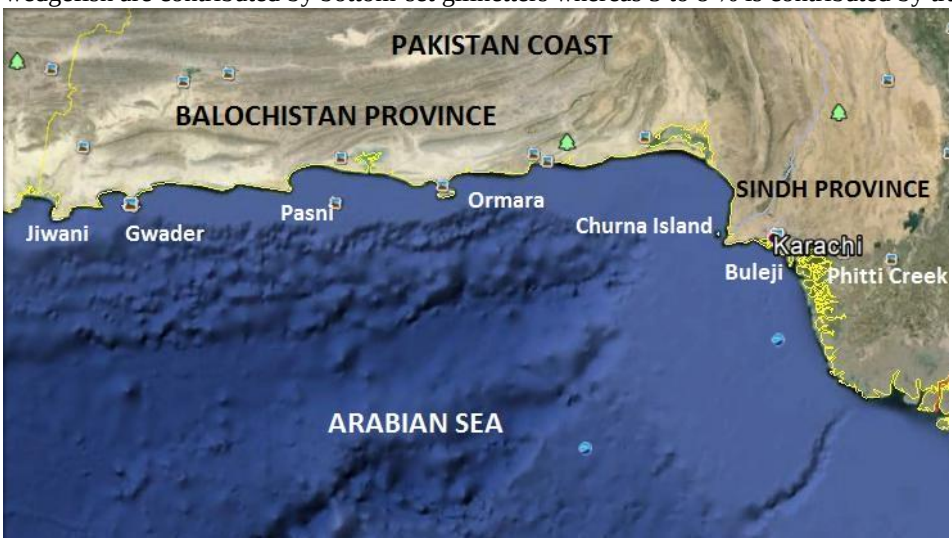

Fig. 1. Pakistan coast.

The annual landings of fishes of Order Rhinopristiformes were observed to be 2,185 m. tons in 2000 whereas it

was observed to be 450 m. tons in 2010 (Fig. 2). Annual landings of guitarfish and wedgefish started to increase to a level of 6,689 m. tons in 2011 and achieved a peak of 7,570 m. tons in 2014. Annual landings of these fishes dropped to an annual level of 1.664 m. tons in 2016, 1,228 m. tons in 2017 and 1,455 m. tons in 2018. The variation in the landings guitarfish and wedgefish since 1987 and 2018 is attributed to change in the fishing pattern in Pakistan (Anonymous, 2012). Unprecedented increase in their landings during 2011 and 2015 is attributed to increase of the fleet engaged in bottom-set gillnetting. The decrease in their catches since 2016 is attributed to restriction on the catch and landings due to promulgation of the legislations of fishes of Order Rhinopristiformes in 2016. Since guitarfish and wedgefish are caught as bycatch of demersal fisheries by bottom-set gillnetters and trawlers, therefore, some of the fishermen who catch them and continue to land these species alongwith other fishes, despite ban.

Species Composition

Guitarfish and wedgefish belonging to Order Rhinopristiformes are represented by three families in Pakistan including Rhinidae (wedgefish), Glaucostegidae (giant guitarfish) and Rhinobatidae (guitarfish). These three families are also known to be commonly occurring in Arabian Sea (Jabado, 2019). Only one member of family Rhinidae i.e. *Rhina ancholostoma* occur in Pakistan whereas family Glaucostegidae is represented by 4 species belonging to 2 genera whereas Rhinobatidae is represented by only 2 species (Psomadakis *et al.* 2015). There are a few other species that have been recorded from Pakistan but their presence in Pakistan requires further studies.

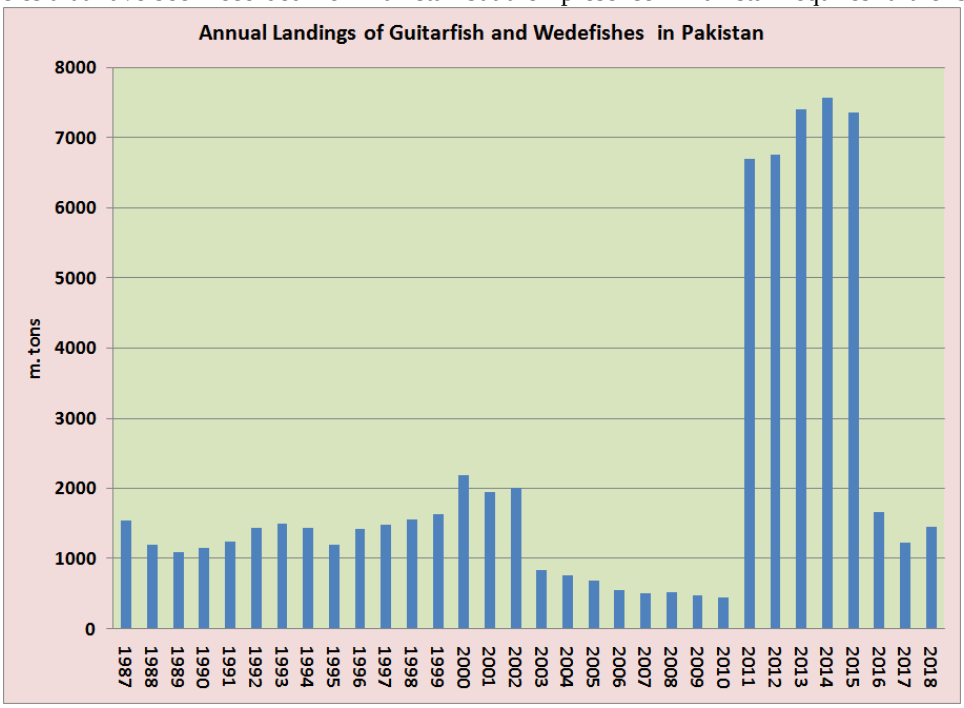

Fig. 2. Annual landings of guitarfish and wedgefish in Pakistan

Analysis of the landing data from major fish landing centre at Karachi revealed that seven species of guitarfish and wedgefish are landed (January 2019-February 2020 data). Granulated guitarfish (*Glaucostegus granulatus)* contributed about 61.69 % in total annual landings of this group followed by widenose guitarfish (*G. obtusus*) contributing about 23.29 % in total annual landings of guitarfish and wedgefish (Fig. 3). Annandale's guitarfish (*Rhinobatos annandalei*) and bowmouth guitarfish (*Rhina ancylostoma*) contributed 7.32 and 5.97 % in total annual landings respectively. Spotted guitarfish (*R. punctifer*), Halavi ray (*G. halavi*), Smoothnose wedgefish (*Rhynchobatus laevis*) and Salalah guitarfish (*Acroteriobatus salalah*) collectively contributed about 1.73 % in total annual landings. Smoothnose wedgefish (*R. laevis*) is rarest of all the members of Order Rhinopristiformes. According to the traditional knowledge, this species used to be the most dominating in the landings before 1990's, however, its landings started declining and now it is extremely rare in commercial landing (Badal Bux Baloch, Personal Communications). *Acroteriobatus salalah* and *Rhynchobatus laevis* are not reflected in the pie diagram because of their landings in small quantities at Karachi Fish Harbor.

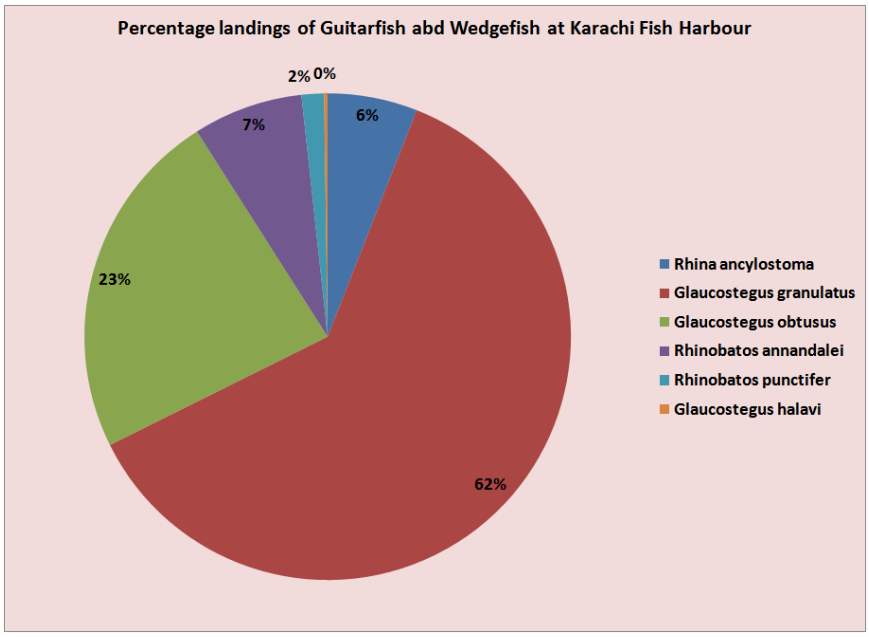

Fig. 3. Percentage landings of guitarfish and wedgefish at Karachi Fish Harbour

Fatima *et al*. (2016) have recorded the dominating species of guitarfishes in the landings of Karachi Fish Harbor during August 2015 to May 2016 and noted *G. halavi* to the dominating species mostly caught in April and May, followed by *G. granulatus, R. annandalei* and *R. punctifer*. The disparity in species composition with present study may be attributed mainly to no restriction on its fishing due to Government legislations during 2015 and 2016. Nasir and Afsar (2020) have studied the landings of guitarfish and wedgfish (referred them as "skate"!) from Karachi Fish Harbour during March 2014 to April 2019 and observed *G. granulates* to be the dominating species (contributing 33.85 %). *Rhina ancylostoma* was observed to be contributing 22.92 % followed by *Rhinobatos horkelii!* (17.19 %) and *G. halavi* (13.02 %). Identification of some of the species made by Nasir and Afsar (2020) are questionable.

Species Description

Family Rhinidae (Wedgefish)

Rhina ancylostoma Bloch and Schneider, 1801

(Fig. 4)

Material Examined:

- One Female – Karachi Fish Harbor, commercial catch collected on November 21, 2005 (Not measured),
- One Specimen – Karachi Fish Harbor, commercial catch collected on December 2009 (46 cm TL),
- One Specimen – Karachi Fish Harbor, commercial catch collected on April 1, 2014 (88 cm TL),
- One Specimen – Karachi Fish Harbor, commercial catch collected on April 30, 2014 (104 cm TL),
- One specimen -Offshore waters of Pakistan (25°00.413'N; 63°21.700'E) on October 10, 2015 (depth 148m) (165 cm TL).
- One Specimen – Offshore water, commercial catch collected on May 20, 2016 (60 cm TL).

Distribution

This species is mostly found in warm temperate and tropical inshore continental seas and rarely occur deeper than 400 m (Jabado, 2019). They have a primarily Indo-Pacific distribution including East Africa to Red Sea, Persian Gulf Sea and to Papua New Guinea, north to Japan, south to New South Wales, Australia (Froese and Pauly, 2019). This species is commonly known bowmouth guitarfish and in Pakistan, it is known as "bhuth-khair" in Sindh and "kobayyadri" or "baradri" in Balochistan. It is recorded from Pakistan by Ahmad (1988), Ahmad and Niazi (1975), Bianchi (1985), Hoda (1985, 1988), Hussain (2003), Jalil and Khalil (1972, 1981), Khan and Quadri

(1986), Misra (1952, 1969), Nasir and Afsar (2020), Niazi (1994), Psomadakis *et al*., (2015), Qureshi (1953, 1972), Sorley (1932).


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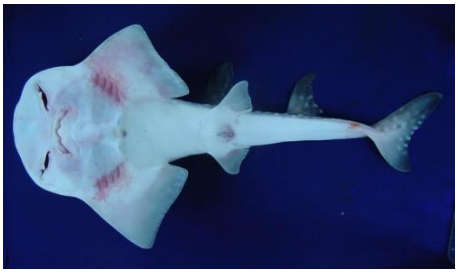
(b) 

(c)

Fig. 4. *Rhina ancyclostoma* landed at Karachi Fish Harbor (commercial catch) collected on November 21, 2005. (a) Lateral view, (b) ventral view, (c) dorsal view.

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is landed throughout the year with peak landings in January to March and May and September (Fig 4). Its landings were noted to be 1,240 kg in March 2019 whereas in the rest of study period, its landings remained less than 930 kg in any month. Its main landing season, therefore, is during January and May (although there was decrease in April 2019). According to Nasir and Afsar (2020), this species is found during March, April, May, June, November and December.

Biological Information

The species may attain a size of 300 cm (Froese and Pauly, 2019; Vidthayanon, 2005), however, during the present study only a few specimens exceeding 200 cm were observed whereas most of specimens examined during the present study were between 46 and 165 cm. Nasir and Afsar (2020) observed a maximum length of 102.8 cm TL. This species has characteristic broad and rounded snout. It has large, high pectoral fins and heavy ridges of spiky thorns over the eyes and on the back and shoulders. Upper surface bluish grey to brownish covered with white spots and line whereas there are dark brown bands between eyes (Last *et al.*, 2016). Jaws of a specimen of 104 cm was dissected which was observed to have heavily ridges and crushing teeth in undulating rows (Fig. 5).

Stomach contents of a few specimens were examined and it consisted of crushed pieces of crabs *Arcania cornuta*, unidentified portunid crab, unidentified polychaete and partially digested pieces of unidentified fish. Compagno and Last (1999) and Froese and Pauly (2019) reported that bowmouth guitarfish feeds mainly on bottom crustaceans and mollusks. According to Last *et al.* (2016) it feeds on bony fish (like croakers) crabs, prawns, bivalves and cephalopods.

This species is known to be ovoviviparous (Dulvy and Reynolds, 1997) and produces a liter of 2-11 (Froese and Pauly, 2019; Last *et al*., 2016). During the present study, one female (175 cm TL) with developing fetuses was observed in April 2019 to have 7 pups with a size range of 33.0 to 46.0 cm TL (Fig. 6). The liter consists of 4 males (33.0, 37.0, 41.0, 46.0 cm TL) and 3 females (42.0,43.0,44.0 cm TL). Last and Stevens (2009) reported a female with 9 pups ranging between 27 and 31 cm TL whereas Last *et al*. (2016) reported 2-11 pups (having a size of 46-48 cm TL) in a liter.

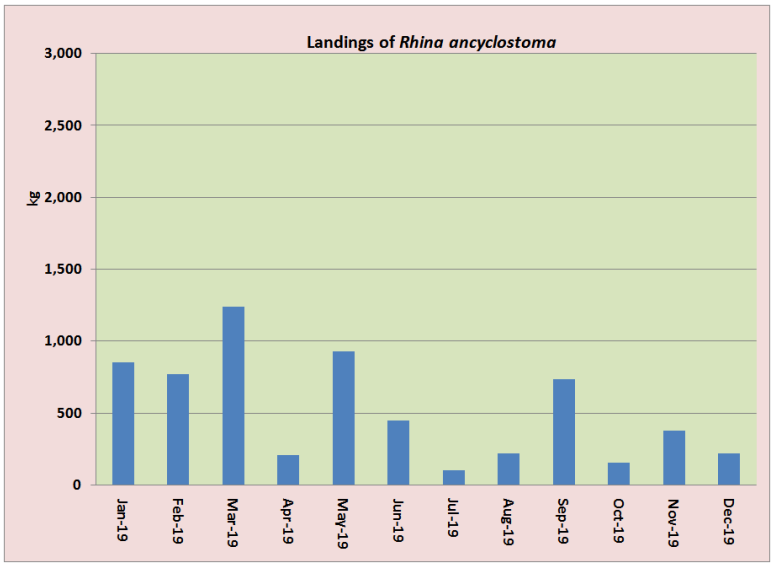


Fig. 4. Landings of *Rhina ancyclostoma* at Karachi Fish Harbour

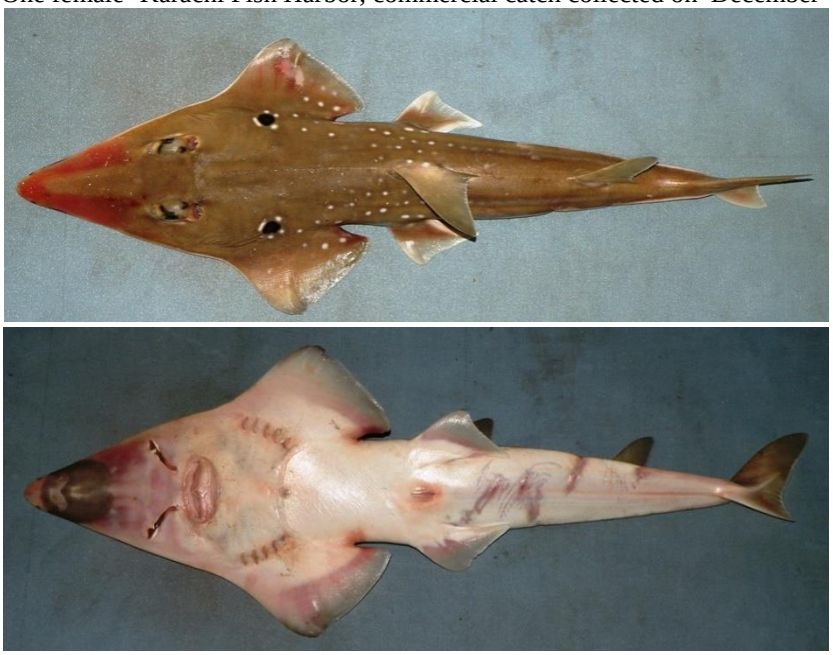
Fig. 5. Jaws of *Rhina ancyclostoma* showing ridges and crushing teeth in undulating rows.

Fig. 6. Pups of *Rhina ancyclostoma* dissected from a female (175cm TL) on April 11, 2019

Rhynchobatus laevis (Bloch & Schneider, 1801)
(Fig. 7)

Material Examined

- One female- Jiwani Fish landing Center Harbor, commercial catch collected on July 13, 2008 (117 cm TL)
- One female–Karachi Fish Harbor, commercial catch collected on April 29, 2013 (95 cm TL)
- One male- Karachi Fish Harbor, commercial catch collected on March 19, 2014 (56 cm TL)
- One female- Karachi Fish Harbor, commercial catch collected on April 26, 2014 (85 cm TL)
- One Female- Karachi Fish Harbor, commercial catch collected on April 26, 2014 (130 cm TL)
- One female- Karachi Fish Harbor, commercial catch collected on December 4, 2014 (56 cm TL)



(a)

(b)

Fig. 7. *Rhynchobatus laevis* collected from Karachi Fish harbor on December 4, 2014 (56 cm TL). (a) Dorsal view, (b) ventral view.

Distribution

This species has Indo-West Pacific distribution extending between Oman through Persian Gulf, Pakistan, India extending to Japan (Froese and Pauly, 2019; Last *et al.*, 2016). This species is commonly known as Smoothnose wedgefish and in Pakistan, it is known as "kair", "Kairi" and "Patari manger" in Sindh and "Khail" or "Roope" in Balochistan. It was reported from Pakistan by Psomadakis *et al*., (2015). In addition, Ahmad (1988), Ahmad and Niazi (1975), Ahmad *et al* (1973), Anonymous (1955, 1999), Bianchi (1985), Froese and Pauly (2019), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Khan and Quadri (1986), Misra (1952, 1969), Murray (1880), Nasir and Afsar (2020), Qureshi (1952, 1953, 1972) and Siddiqi (1956) as *Rhynchobatus djiddensis*.

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is landed rarely. However, the specimens of this species were landed during March, April, July and December. It used to be a dominating species in 1970's to 1990's but now is rarely caught in Pakistan. According to Nasir and Afsar (2020) wedgefish (identified as *Rhynchobatus djiddensis*) is found in May.

Biological Information

The species may attain a size of >200 cm TL (Last *et al*., 2016), however, during the present study collected specimens ranged between 56 and 130 cm TL. According to Nasir and Afsar (2020) wedgefish (identified as *Rhynchobatus djiddensis*) has a size of 98.2 cm. This species has narrowly wedge shaped snout and has rounded thorn on back and around eyes. Its pectoral markings are ocellated and surrounded by 4 to7 white spots. Underside

of snout usually have dark blotch. Dorsal side of body has 4-5 rows of white spots along each side beneath first dorsal fin (Jabado, 2019; Last *et al.*, 2016).

Stomach content of a number of specimens were examined which contained semi-digested polychaetes, shrimp, crabs and some parts of bony fishes. According to Last *et al.* (2016), this species feed on bottom dwelling crustaceans and fishes. This species is known to be ovoviviparous (Dulvy and Reynolds, 1997). No information about liter or pup size is available.

Family Glaucostegidae (Giant Guitarfish)

Glaucostegus granulatus (Cuvier, 1829)

(Fig. 8)

Material Examined:

- One Female – Karachi Fish Harbor, commercial catch collected on September 16, 2009 (45 cm TL),
- One Male – Karachi Fish Harbor, commercial catch collected on October 18 2010 (98 cm TL),
- One Female– Karachi Fish Harbor, commercial catch collected on June 20, 2013 (31 cm TL),
- One female – Karachi Fish Harbor, commercial catch collected on May 16, 2014 (21 cm TL)-Term fetus.
- One Male - Karachi Fish Harbor, commercial catch collected on May 8, 2014 (76 cm TL)

Distribution

This species has primarily Indo-Pacific distribution extending from Persian Gulf to Thailand and Vietnam and may be occurring in China, Indonesia (Sumatra, Borneo), Philippines, New Guinea, and Bougainville Islands (Froese and Pauly, 2019). This species is commonly known granulated guitarfish and in Pakistan, it is known as "seerol", "sail", "siroe" or "cun-daree" in Sindh, "zahro" in Balochistan and in Karachi market it is called "rabba" or "kairi". It is recorded from Pakistan by Fatima *et al.*, (2016), Nasir and Afsar (2020) and Psomadakis *et al.*, (2015). It was also reported as *Rhinobatos grannulatus* from Pakistan by Ahmad (1988), Ahmad and Niazi (1975), Ahmad *et al*., (1973), Anonymous (1953, 1955), Bianchi (1985), Compagno and Last (1999), Day (1889), Froese and Pauly (2019), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Khan and Quadri (1986), Misra (1952, 1969), Murray (1880), Niazi (2001), Qureshi (1952, 1953, 1972), Siddiqi (1956) and Sorely (1932).

(a)

(b)

Fig.8. *Glaucostegus granulatus* collected from Karachi Fish Harbour in May 8, 2014 (76 cm TL). (a) Dorsal view, (b) ventral view.

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is landed throughout the year with peak landings in January and April to June (Fig 9). According to Nasir and Afsar (2020), this species is found during January and March to May. During present study its landings were noted to be 18,858 kg in May 2019 whereas its landings were 31 kg in August 2019. In comparison its landings was 10,850 kg in April 2019. *G. granulatus* is the most dominating species of Order Rhinopristiformes landed at Karachi Fish Harbor. It is also an abundant species in all other landing centers in Pakistan (Ahmad Nadeem, Personal communication).

Biological Information

The species may attain a size of 229 cm (Last *et al.*, 2016), however, during the present study only a few specimens exceeding 130 cm have been observed. The specimens examined during the present study were predominantly between 31 and 75 cm. Nasir and Afsar (2020) reported a maximum length of 103.1 cm. This species has a narrowly wedge-shaped disc, very long and narrow triangular snout with pointed tip and oblique nostrils with narrow anterior opening.

Stomach contents of a few specimens were examined and it consisted of crushed pieces of unidentified crabs, polychaete, bivalves and gastropods. Froese and Pauly (2019) and Vidthayanon (2005) reported that it is a carnivore fish which feed on large benthic shellfish. This species is known to be ovoviviparous (Dulvy and Reynolds,1997). Females with developing fetuses were observed in May. During the present study a female was dissected and it was observed to have pups having a size range of 17.5 to 23 cm TL (Fig. 10). The liter size of this female was 17 including 9 males (17.5, 19.0, 20.5, 20.5 21.0, 21.0, 21.0, 21.0, 21.5, cm TL) and 8 females (20.0, 20.5, 20.5, 22.0, 21.0, 21.5, 22.5, 23.0 cm TL). Froese and Pauly (2019) and Last *et al.* (2016) reported 6-10 pups in a liter in this species.

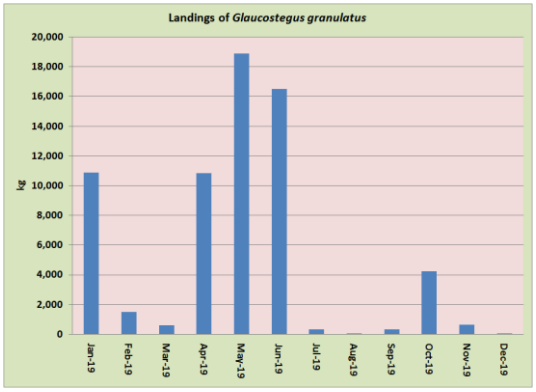


Fig. 9. Landings of *Glaucostegus granulatus* at Karachi Fish Harbour

Fig. 10. Pups of *Glaucostegus granulatus* dissected from a female (132 cm TL) on May 23, 2013.

***Glaucostegus obtusus* (Müller** & Henle**, 1841)**

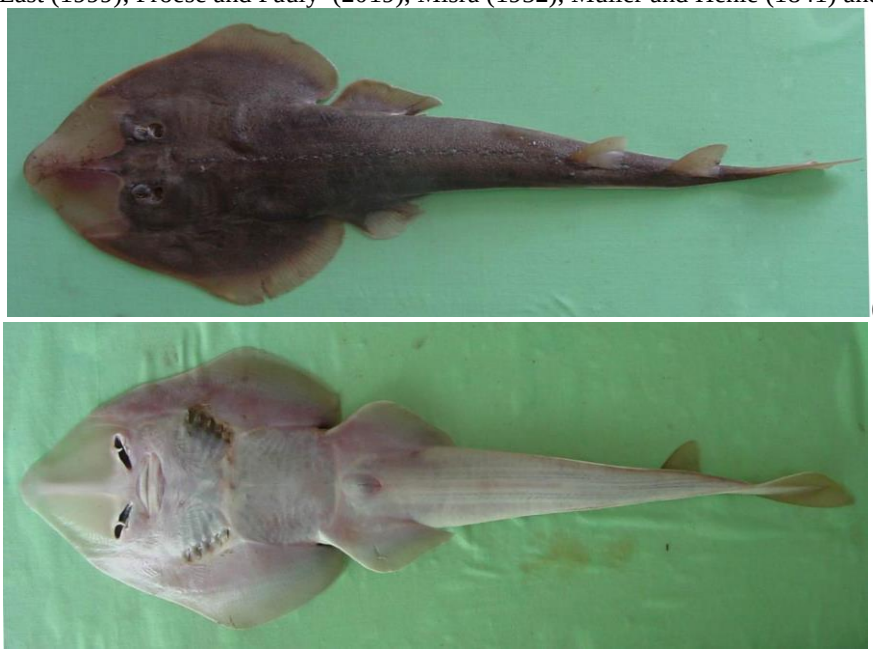
Fig. 11

Material Examined:

- One Female – Karachi Fish Harbor, commercial catch collected on October 23, 2013 (46 cm TL),
- One Female – Karachi Fish Harbor, commercial catch collected on October 31 2013 (52 cm TL),
- One Female– Karachi Fish Harbor, commercial catch collected on November 11, 2013 (50 cm TL),

Distribution

This species has a Indo-Pacific distribution Northern Indian Ocean: Pakistan to Thailand, with eastern limits unclear (Froese and Pauly, 2019; Last *et al.*, 2016). This species is commonly known widenose guitarfish and in Pakistan, it known as "seerol", "sail", "siroe" or "cun-daree" in Sindh, "zahro" or "palore" in Balochistan and in Karachi market it is called "rabba" or "kairi". It is recorded from Pakistan by Nasir and Afsar (2020) and Psomadakis *et al*., (2015) and It was also reported as *Rhinobatos obtusus* from Pakistan by Ahmad (1988), Compagno and Last (1999), Froese and Pauly (2019), Misra (1952), Muller and Henle (1841) and Murray (1880).



(a)

(b)

Fig. 11. *Glaucostegus obtusus* collected from Karachi Fish Harbour in September 16, 2009 (45 cm TL). (a) Dorsal view, (b) ventral view.

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is landed throughout the year with peak landings in December (Fig 12). According to Nasir and Afsar (2020), this species is found during September. During the present study its landings were noted to be 5,639 kg in December 2019 whereas its landings were only 21 kg in July 2019. *G. obtusus* is the second most dominating species of Order Rhinopristiformes landed at Karachi Fish Harbor. According to Nasir and Afsar (2020) this species contribute insignificantly in the total landings at Karachi Fish Harbour (1.05 %).

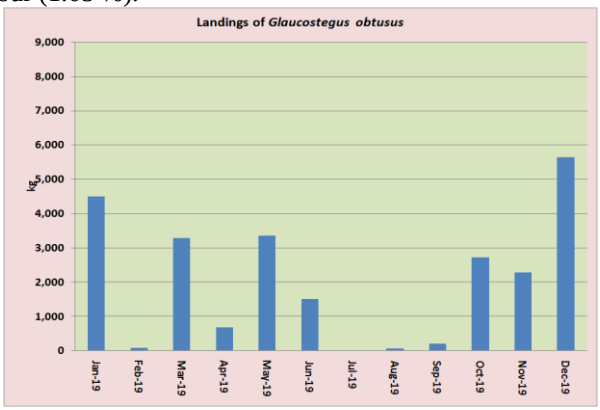


Fig. 12. Landings of *Glaucostegus obtusus* at Karachi Fish Harbour

Biological Information

The species may attain a size of 93 cm TL (Compagno and Last, 1999; Froese and Pauly, 2019), however, during the present study a few specimens exceeding 100 cm have been observed. The specimens examined during the present study were between 31 and 75 cm. Nasir and Afsar (2020) reported a maximum length of 61 cm. This species has characteristic shovel-shaped disc with short snout which is broadly triangular. It has broad oblique nostrils with an oval anterior opening. Its disc is flattened centrally.

Stomach contents of one specimen was examined and it consisted of crushed pieces of unidentified gastropods. This species is known to be ovoviviparous (Dulvy and Reynolds,1997). Females with developing fetuses were observed in May. During the present study a female was dissected and it was observed to have 18 pups with a size range of 11.5 to 19.0 cm TL (Fig. 13). There were 9 male pups (11.5, 16.0, 16.0, 17.0, 17.0, 17.0, 17.5, 17.5, 18.0 cm TL) and 9 females (17.0, 17.5, 17.5, 18.0, 18.0, 19.0, 19.0, 19.0, 19.0 cm TL).

Fig.13. Pups of *Glaucostegus obtusus* dissected from a female (100 cm TL) on May 16, 2014

Glaucostegus halavi (Forsskål, 1775)
(Fig. 14)

Material Examined:

- One Female – Karachi Fish Harbor, commercial catch collected on November 11, 2009 (60 cm TL),
- One Female – Karachi Fish Harbor, commercial catch collected on September 20 2014 (80 cm TL),

Distribution

It is known from Northern Indian Ocean, Red Sea, Persian and Gulf of Oman to the coast of Pakistan (Froese and Pauly, 2019; Last *et al*., 2016). This species is commonly known Halavi guitarfish. It is locally known as "seerol", "sail", "siroe" or "cun-daree" in Sindh, "zahro" or "palore" in Balochistan and in Karachi market it is called "rabba" or "kairi". It is recorded from Pakistan by Fatima *et al.* (2016), Nasir and Afsar (2020) and Psomadakis *et al*., (2015). It was also reported as *Rhinobatos halavi* from Pakistan by Bianchi (1985), Hoda (1985, 1988) and Hussain (2003).

Fig. 14. *Glaucostegus halavi* collected from Karachi Fish Harbour in September 20, 2014 (180 cm TL). Dorsal view.

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is one of the rarest species which is landed only in the month of February 2019 (245 kg). According to Nasir and Afsar (2020), this species is found during August, September and December and contributing about 13.02 % in the total landings of guitarfish at Karachi Fish Harbour. Fatima *et al*., (2016) reported this to be the most dominating species of guitarfish contributing about 47 % of the landings of this group of fishes. According to them it is abundant during October 2015 and April-May, 2016.

Biological Information

The species may attain a size of 177 cm TL (Last et al., 2016), however, during the present study a specimen was measured to have a length of 180 cm TL. Nasir and Afsar (2020) reported a maximum length of 100.7 cm. This species has characteristic wedge-shaped disc and wide triangular snout with a broadly rounded cartilage at its tip. It has relatively broad, oblique and narrow nostrils, with a narrow anterior opening. Snout tip is more broadly rounded and never extended forward to form a lobe (Last *et al.*, 2016).

No stomach content was analyzed but considering its mouth part it may be feeding on benthic animals including mollusks. This species is known to be ovoviviparous (Dulvy and Reynolds, 1997). In the Red Sea it produces 10 pups in a liter with size at birth to be 29 cm TL mainly from May to October (Gohar and Mazhar, 1964; Last *et al.*, 2016).

Family Rhinobatidae (Guitarfish)

Rhinobatos annandalei Norman, 1926

Fig. 16

Material Examined

- One Female- Karachi Fish Harbor, commercial catch collected on October 1, 2009 (86 cm TL)
- One Female – Karachi Fish Harbor, commercial catch collected on September 28, 2013 (63 cm TL)
- One Female -Offshore waters of Pakistan (23°50.500'N; 67°01.400'E) (depth 94 m) on September 28, 2015 (90 cm TL).

Distribution

This species is known from Northern Indian Ocean between Oman along Iran, Pakistan and Indian coast along Bay of Bengal (Froese and Pauly, 2019; Last *et al.*, 2016). This species is commonly known Annandale's guitarfish and in Pakistan, it is known as "seerol", "sail", "khair" in Sindh, "zahro" in Balochistan and in Karachi market it is called "rabba" or "kairi". It was recorded from Pakistan by Ahmad and Niazi (1975), Bianchi (1985), Fatima *et al.* (2016), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Last *et al.* (2019), Nasir and Afsar (2020) and Psomadakis *et al*., (2015). In a recent study Last *et al.* (2019) analyzed morphometric data collected from specimens of *R. annandalei* from Myanmar and Pakistan and observed strong congruence with Norman's types specimen collected from Hooghly River (India) in the Bay of Bengal in morphometrics and squamation.

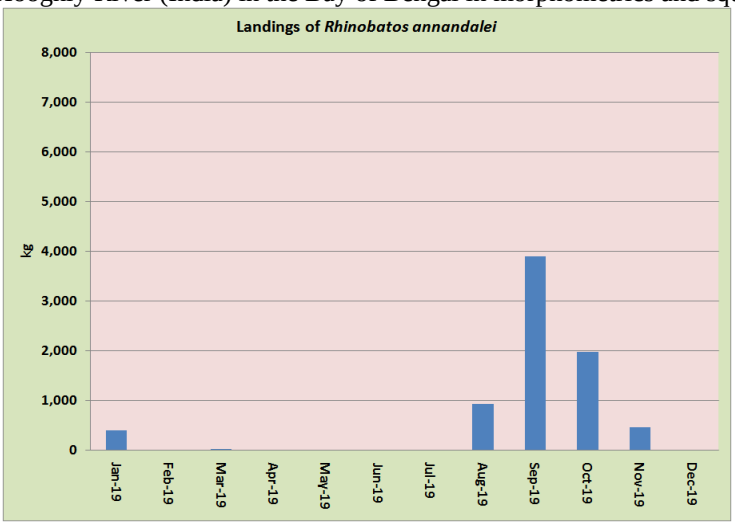


Fig. 15. Landings of *Rhinobatos annandalei* at Karachi Fish Harbour.

(a)

(b)

Fig. 16. *Rhinobatos annandalei* collected from offshore waters of Pakistan on September 28, 2015 (90 cm TL). (a) Dorsal view, (b) ventral view.

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is mainly landed during August and November with peak landings in September (Fig. 15). Its landings were noted to be 3,900 kg in September 2019. According to Nasir and Afsar (2020), this species is found during May and September. Fatima *et al.*, (2016) observed its landing in October 2015 and May 2016.

Biological Information

The species may attain a size of 80 cm TL (Last *et al.*, 2016), however, during the present study a specimen was measured to have a total length of 90 cm. Nasir and Afsar (2020) reported a maximum length of 88.3 cm. This species has characteristic wedge-shaped disc with long and pointed triangular snout. There are prominent thorns around eyes and along mid-line of body. Upper surface with small widely spaced white spots (Last *et al.*, 2016). Stomach contents of many specimens were examined and found to have partially digested benthic invertebrates including a few pieces of crabs and bivalves. This species is known to be ovoviviparous (Dulvy and Reynolds, 1997). During the present study 1 female was dissected on September 3, 2014 which was observed to have 7 pups having a size range of 15.0 to 20.0 cm TL (Fig. 17). There were 4 male pups (15.0, 16.0, 18.0, 18.5 cm TL) and 3 females (16.5, 18.5, 20.0 cm TL) making the liter of 7. According to Last *et al.* (2016) there are also 7 pups in a liter s having a size of about 20 cm TL.

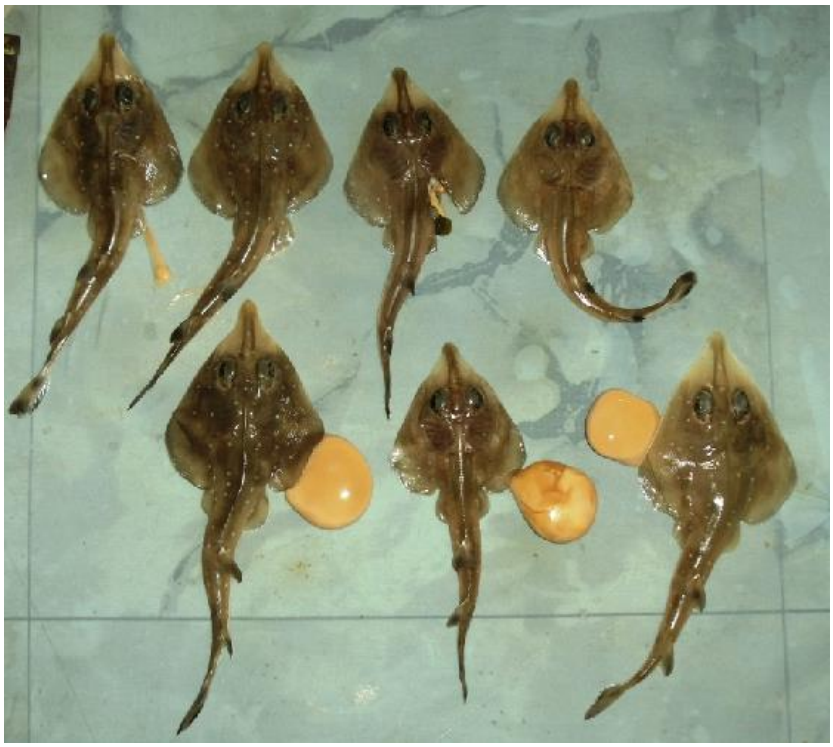


Fig.17. Pups of *Rhinobatos annandalei* dissected on September 3, 2014

Rhinobatos punctifer Compagno & Randall, 1987
Fig. 18

- One male- Karachi Fish Harbor, commercial catch collected on October 10, 2013 (76 cm TL)
- One male -Offshore waters of Pakistan (25°09.700'N; 65°47.300'E) (depth 25 m) on October 14, 2016 (92 cm TL)

Distribution

This species is known from Northern Indian Ocean between Red Sea, Gulf of Aqaba, Oman, Persian Gulf, Iran, Pakistan and possibly extending further towards east (Froese and Pauly, 2019; Last *et al.*, 2016). This species is commonly known spotted guitarfish and in Pakistan it is known as "seerol", "sail", "khair" in Sindh, "zahro" in Balochistan and in Karachi market it is called "rabba" or "kairi". It is recorded from Pakistan by Ahmad and Niazi (1975), Bianchi (1985), Fatima *et al*. (2016), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Last *et al.*, (2019), Nasir and Afsar (2020) and Psomadakis *et al*., (2015).

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is landed only during December 2019 when a total of 1,555 kg was landed. In May 2019, 10 kg of this fish was also reported from Karachi Fish Harbour. According to Nasir and Afsar (2020), this species is found in February only. Fatima *et al.*, (2016) observed its landing in April 2016 and considered it to be the rarest of guitarfish landed at Karachi Fish Harbour

Biological Information

According to Last *et al.*, (2019) *R. punctifer* is a highly variable in coloration and body shape, both across and within its range, and the various forms were initially suspected of being different species. Individuals reported from Oman by Henderson *et al.*, (2016) varied from being sparsely white spotted (some spots paired while others are random), or vividly marked with prominent dark-edged ocelli that are often variably connected by fine reticulations and lines. Last *et al.*, (2019) further pointed out that material collected from the Karachi was a plain coloured morph and also an individual had an ocellated/reticulated pattern. They have also conducted molecular analysis of 166 specimens of *R. punctifer*, including representatives of these four morphs from Pakistan and Oman which demonstrated two weakly divergent subgroups. They suggests that one of these subgroups might consist of plain and

white-spotted morphs and the other subgroup the ocellated morph. accordingly, retention of a single intraspecifically variable species may be provisionally supported but there is a need for a more comprehensive regionally investigation of these forms.

Morphometric data of 3 adult males (all white-spotted morph) and 3 large females (2 white-spotted morph, one ocellate morph) from Oman indicated that *R. punctifer* is strongly sexually dimorphic for some characters (Last *et al.*, 2019). According to them adult males of *R. punctifer* typically have a narrower disc, longer snout and preoral length, narrower interorbital space and mouth, more narrowly separated gill openings, and smaller pelvic fins than females observed both in case plain coloured morph and ocellated/reticulated individuals from Pakistan and Oman. Photographs of oceallated/reticulated specimens collected 0n February 24, 2014 and January 29, 2003 collected from Karachi are given in Fig. 18 and Fig, 19 respectively.

The species may attain a size of 88 cm TL (Last *et al.*, 2016), however, during the present study a specimen was measured to have a total length of 92 cm. Nasir and Afsar (2020) reported a maximum length of 97 cm. This species has characteristic angular wedge-shaped disc which is moderately elongate and broadly triangular snout. Its dorsal surface is yellowish brown to grayish with small widely spaced white spots and large ocellate markings. (Last *et al.*, 2016).

(a)

(b)

Fig. 18. *Rhinobatos punctifer* collected from offshore waters of Pakistan on October 10, 2013 (76 cm TL). (a) Dorsal view, (b) ventral view.

Fig. 19. *Rhinobatos punctifer* ocellated/reticulated morph collected from Karachi Fish Harbour on February 24, 2014 (70 cm TL). Dorsal view.

No stomach content was analyzed but considering its mouth part it may be feeding on benthic animals including mollusks. This species is known to be ovoviviparous (Dulvy and Reynolds,1997). According to Last *et al.* (2016) the pups have a size of about 25 cm TL.

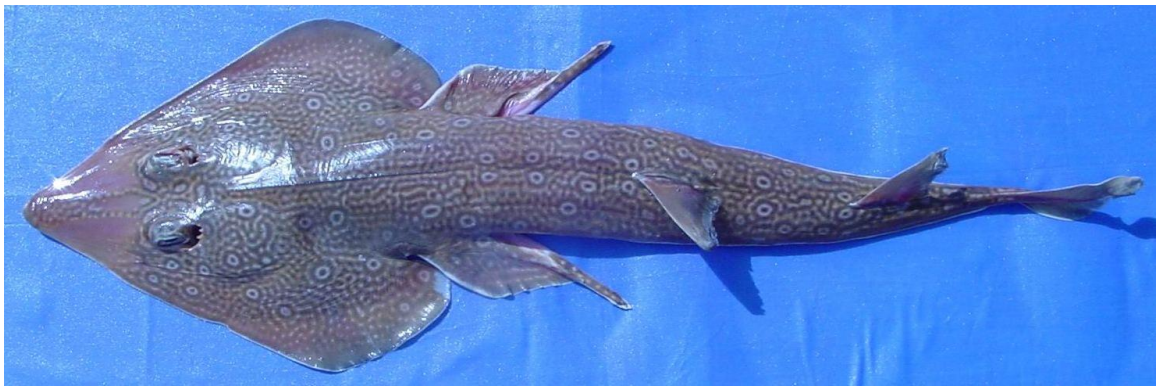
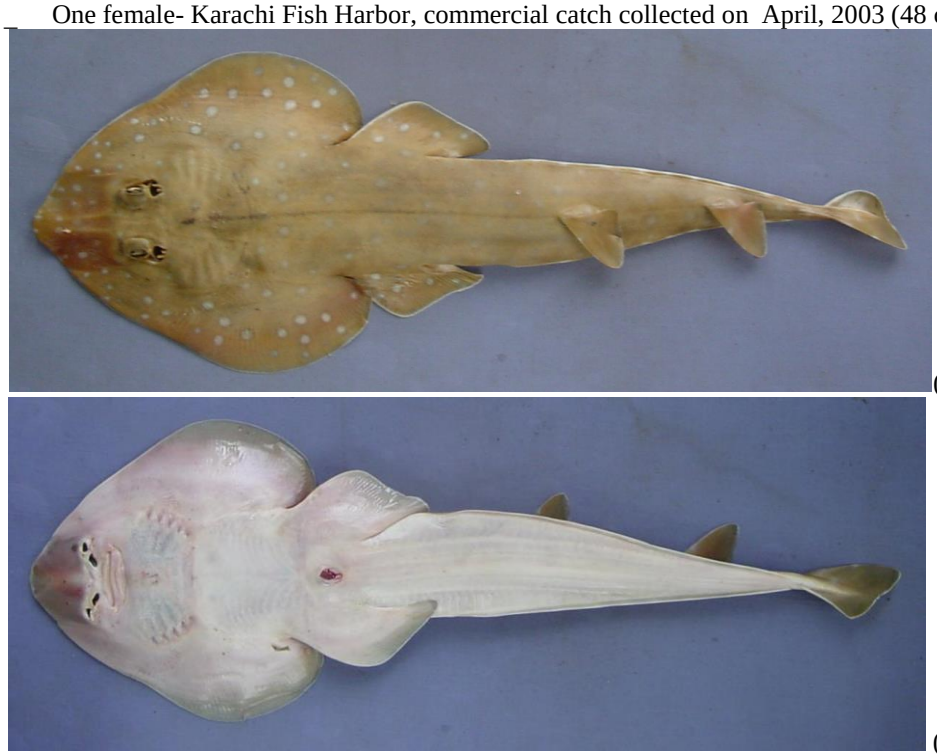


Fig. 20. *Rhinobatos punctifer* ocellated/reticulated morph collected from Karachi Fish Harbour on January 29, 2003 (89 cm TL). Dorsal view.

Acroteriobatus salalah (Randall & Compagno, 1995)
Fig. 21

Material Examined

- One Female- Karachi Fish Harbor, commercial catch collected on February 12, 2009 (63 cm TL)
- One male – Karachi Fish Harbor, commercial catch (possibly caught off Gwadar) collected on February 24, 2014 (70 cm TL)
- One female- Karachi Fish Harbor, commercial catch collected on April, 2003 (48 cm TL)



(a) (b)

Fig. 21. *Acroteriobatus salalah* collected from offshore waters of Pakistan on February 12, 2009 (63 cm TL)

Distribution

This species is known from Northern Indian Ocean between Oman and Pakistan (Froese and Pauly, 2019; Last *et al.*, 2016). This species is commonly known Salalah guitarfish and in Pakistan, it is known as “seerol”, “sail”,

"khair" in Sindh, "zahro" and "Palore" in Balochistan and in Karachi market it is called "rabba" or "kairi". It is recorded from Pakistan only by Psomadakis *et al*., (2015).

Commercial Landings

Analysis of the data collected from Karachi Fish Harbour reveals that this species is landed rarely during December, January to April. It is not landed in commercial quantities and seen in landing centers rarely.

Biological Information

The species may attain a size of 78 cm TL (Last *et al.*, 2016), however, during the present study a specimen was measured to have a total length of 70 cm. This species has heart-shaped disc and very broad triangular snout. Anterior nasal flaps barely separated in the internasal space. Its dorsal surface yellowish brown with dense pattern of faint bluish spots which are dark edged. (Last *et al.*, 2016).

Stomach content of 2 specimens were examined which contained digested benthic material which contained pieces of small crabs. This species is known to be ovoviviparous (Dulvy and Reynolds, 1997). According to Last *et al.* (2016) there can be 1 to 6 pups with a size of about 18 cm TL.

Reported Species whose Presence in Pakistan is Doubtful

Rhinobatos lionotus Norman, 1926 (smooth back guitarfish) was reported from Pakistan by Hoda (1985, 1988). This species is known from West Bengal to Myanmar, upper Bay of Bengal (India) and Sri Lanka to possibly Arabian Sea (Froese and Pauly, 2019; Last *et al.*, 2016). Till some new evidences of their presence in Pakistan is available, it may be considered as doubtful record.

Acroteriobatus blochii (Müller & Henle, 1841) (bluntnose guitarfish) was reported from Karachi, Pakistan by Anonymous (2001) as *Rhinobatos blochii*. This species is, however, known from Southeast Atlantic including South Africa (Cape Province) to Namibia and uncertainly from Angola, Senegal and Mauritania Africa (Froese and Pauly, 2019; Last *et al.*, 2016). The presence of this species, therefore, is based on wrong identification.

Glaucostegus cemiculus (Geoffroy Saint-Hilaire, 1817) (blackchin guitarfish) reported by Nasir and Afsar (2020) during January and November attaining a size of 102.3 cm. Presence of this species is doubtful because this species is known from Eastern Atlantic (northern Portugal to Angola) and the Mediterranean Sea Africa (Froese and Pauly, 2019; Last *et al.*, 2016). From the photograph given by Nasir and Afsar (2020) it is evident that the specimen is actually *R. annandalei* which has wide disc and wide separate rostral ridge whereas G. *cemiculas* has long snout with narrowly separate rostral ridge.

Glaucostegus thouin (Anonymous [Lacepède] 1798). (clubnose guitarfish) was recorded from Pakistan by Ahmad (1988), Ahmad and Niazi (1975), Bianchi (1985), Hussain (2003), Jalil and Khaliluddin (1981) and Sorley (1932). It was also reported from Pakistan by Anonymous (1953, 1955), Khan and Quadri (1986), Misra (1969), Qureshi (1952, 1953), Siddiqui (1956) and Sorley (1932) as *Rhinobatos thouinana* whereas Hoda (1985, 1988) listed it as *Rhinobatos thouinana*. This species is known from Indo-West Pacific: Red Sea, India, including Sri Lanka to Indonesia, north to Japan (Froese and Pauly, 2019; Last et al., 2016). Till some new evidences of their presence in Pakistan is available, it may be considered as doubtful record.

Glaucostegus typus (Anonymous [Bennett], 1830) (giant shovelnose ray) is recorded from Pakistan by Ahmad (1988), Ahmad and Niazi (1975), Hoda (1985, 1988), Jalil and Khaliluddin (1981), Khan and Quadri (1986) and Misra (1952) as *Rhinobatos armatus*. This species is known from Indo-West Pacific: Thailand to New Guinea and the Solomon Islands, south to Australia (Froese and Pauly, 2019; Last *et al.*, 2016). There are records of this from the south coast of India, Sri Lanka, Bangladesh, and Myanmar but need confirmation (Froese and Pauly, 2019). Till some new evidences of their presence in Pakistan is available, it may considered as doubtful record. Nasir and Afsar (2020) also mentioned occurrence of *G. typus* (as *Rhinobatos typus*) in August although contributing insignificant in total landings (056 %). Till some new evidences of their presence in Pakistan is available, it may considered as doubtful record.

Pseudobatos horkelii (Müller and Henle, 1841) (Brazilian guitarfish) reported by Nasir and Afsar (2020) during August, September and December attaining a size of 100.5 cm. Presence of this species is doubtful because this species is known from Western South Atlantic from Rio de Janeiro to Argentina (Froese and Pauly, 2019; Last *et*

al., 2016). From the photograph given by Nasir and Afsar (2020) it is evident that the specimen *Pseudobatos horkelii* is actually G. halavi because snout is wide and the position of first dorsal fin is far back whereas in *P. horkelii* disc is longer and origin of first dorsal fin is posterior to the tips of pelvic fins.

DISCUSSION

Batoids including members of Order Rhinopristiformes are characterized by a life-history of slow growth, late maturity, and low fecundity, making them extremely vulnerable to population decline from overexploitation (Dulvy *et al.*, 2014; Jabado, 2018; Stevens *et al.*, 2000). There are no two opinions that guitarfish and wedgefish like other shark species are susceptible to capture in fishing gears being used globally (Jabado, 2018). These fishes are generally retained for both their fins and meat; whereas the meat is consumed locally, at least in Pakistan and fins are high priced (Compagno and Last, 2008; Jabado, 2018, 2019).

Their landings in Pakistan started to increase since 2011 (Fig. 2), therefore, it was suggested by WWF-Pakistan to two maritime provincial governments of Pakistan to put a ban on the fishing, landing and marketing on guitarfish and wedgefish. Government of Balochistan promulgated rule in 2016 in this regard and there is a blanket ban on the catching, marketing and sale whereas Government of Sindh placed a similar ban but it restrict catching on only small size specimens (less than 30 cm). These provincial legislations were possibly first such ban on fishing of the members of Order Rhinopristiformes in any country. Later on in August, 2019, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) agrees to trade controls for critically endangered six species of giant guitarfish and ten species of wedgefish (Jabado, 2019). Almost all of these species are also considered as critically endangered according to IUCN Red List (Jabado, 2019; Tyabji *et al*., 2020).

Although caught as bycatch of the bottom-set gillnetting and trawling, guitarfish and wedgefish form important part of fisheries of Pakistan. Most dominant species were observed to be *Glaucostegus granulates* and *Glaucostegus obtusus* jointly contributing 85 % of the total landings of this group of fishes. Although Fatima *et al.* (2016) and Nasir and Afsar (2020) have shown other species to be the most dominating in their studies. It may be noted that identification of members of Order Rhinopristiformes is considerably difficult, therefore, it is challenging to obtain information related to various species. There are a number of taxonomic issues for many species of shark-like batoids which requires detailed molecular and comprehensive morphological studies (Jabado, 2018). Nasir and Afsar (2020) reported 10 species of Order Rhinopristiformes including *Pseudobatos horkelii* and *Glaucostegus cemiculus* which are known from Atlantic Ocean and their presence in Pakistan is definitely based on misidentification.

Nasir and Afsar (2020) has given a photograph of *G. granulatus* which is actually *G. halavi* because the former has longer disk than latter and has lot of thorn on ventral side. In addition the photograph of *R. punctifer* indicates that it is actually a specimen *R. annandalei* as it has more narrow and long disc. In addition, photograph of *R. halavi* indicates that it is *R. annandalei* as rostral ridge are joined in the latter. Additionally *R. djiddensis* given in Nasir and Afsar (2020) is actually *R. laevis* because dorsal fin is located slightly back on the origin of pelvic fin. In the light of these lapses, such studies may be used with care. Although comparison of the landings data from this study is compared with those presented by Nasir and Afsar (2020), however, it may be kept in mind that there are identification issues in the latter.

Management of fisheries of guitarfish and wedgefish is extremely difficult because these species are caught as bycatch of bottom-set gillnetting and trawling. It is estimated that more than 5,700 fishing vessels are engaged in these two fisheries which are main source for raw material for seafood processing industry in Pakistan. In addition, a number of species including guitarfish and wedgefish are caught by these fisheries which are locally consumed. In addition, fins of these species are also sold at high rates. Although there is a ban on export of fins but, there are still issues regarding the identification of sharks and batoids making it difficult to control the export of fins.

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