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SPECIES COMPOSITION, COMMERCIAL LANDINGS, DISTRIBUTION AND CONSERVATION OF STINGRAYS (CLASS PISCES: FAMILY DASYATIDAE) FROM PAKISTAN

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ABSTRACT

Stingrays belonging to Family Dasyatidae are commercially exploited in Pakistan (Northern Arabian Sea) since long and mainly landed as bycatch of trawling and bottom-set gillnet fishing, In some areas along Sindh and Balochistan coast target stingrays fisheries based on fixed gillnet used to main source of their landings. It is estimated that their commercial landings ranged between 42,000 m. tons in 1979 to 7,737 metric tons in 2019. Analysis of the landing data from Karachi Fish Harbour (the largest fish landing center in Pakistan) revealed that 27 species of stingrays belonging to 14 genera are regularly landed (January 2019-December 2019). Smooth coloured stingrays (*Himantura randalli/M. arabica/M.bineeshi*) contributed about 66.94 % in total annual landings of stingrays followed by cowtail and broadtail stingrays (*Pastinachus sephen* and *P. ater*) which contributed 24.42 %. Spotted/ocellated/reticulated stingrays (*Himantura leoparda, H. tutul, H. uarnak* and *H. undulata*) contributed and 5.71 % in total annual landings of stingrays. Scaly whipray (*Brevitrygon walga*) and aharpnose stingray (*Maculabatis gerrardi*) contributed about 1.95 % and 0.98 % in total annual stingray landings of stingrays, respectively. Three species leopard whipray (*Hiamntura undulata*), round whipray (*Maculabatis pastinacoides*) and Indian sharpnose stingray (*Telatrygon crozieri*) are reported for the first time from Pakistan coast. There is an important aimed fisheries for stingrays based in some coastal villages along Balochistan coast where fixed bottom set gillnet placed in shallow waters (15-20 m.), however, these fishes are also caught as by-catch of gillnetting and shrimp trawling. The paper discusses about commercial landings and conservation aspects of stingrays in Pakistan. It urges for enactment of national and provincial legislation for protection of stingrays as well as for placing some of the species which are either critically endangered, vulnerable or near threatened to be placed CITES appendices. It also urges for evaluation of a large number stingrays which have not been assessed for their IUCN Red List listings.

Key word: Stingray, seasonal variation, conservation, *Himantura undulata*, *Telatrygon crozieri*, *Maculabatis pastinacoides*

INTRODUCTION

Stingrays belong to Family Dasyatidae (Order: Myliobatiformes) are commonly known as "pittan" in Balochistan and Sindh. These are exploited commercially for use as raw material for fishmeal production whereas wings of a number of species are exported to Southeast Asian countries in frozen from. Although a major part of the landings of stingrays is made through fixed bottom set gillnet and in some coastal areas of Pakistan, however, these are also caught as bycatch of gillnet and trawl fisheries. There is no dedicated study dealing with stingrays in Pakistan except Fatima *et al.* (2016) who have studied sharks, guitarfishes and rays landings at Karachi Fish Harbour and reported commercial landings and sizes of four stingray species *Pateobatis bleekeri, Himantura randalli, H. uarnak* and *Pastinacus sephen*. Fatima (2018) reported size of three species (*Pateobatis bleekeri, Himantura randalli* and *Pastinacus sephen*) landed at Karachi Fish Harbour. Gore *et al.* (2019) studies elasmobranch from Balochistan coast and reported Himantura *leopard, H. uarnak, Pateobatus fai* and *Taeniurops meyeni* and considered them to be vulnerable (VU). Jabado *et al.* (2018) reported 20 species of stingrays occurring in Pakistan. Of which two species *Maculabatis bineeshi* and *M. arabica* were reported to be critically endangered (CR), two species, *Pateobatis bleekeri* and *Maculabatis gerrardi* to be endangered (EN) and four species *Himantura leopard, H. uarnak, Megatrygon microps, Urogymnus asperrimus* and *U. granulatus* to be vulnerable (VU).

Stingrays have been included in a number of checklists 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 stingrays (Ahmad and Niazi, 1975; Khan and Quadri, 1986; Misra, 1969; Niazi, 1994; Qureshi, 1953). Qureshi (1972) in his review of elasmobranchs has also included a number of species stingrays from Pakistan.

A majority of elasmobranch species are being overfished and some cases species have been fished to a stage that their number are dwindled considerably, therefore, a number of such species of sharks, mobulid rays and guitarfishes are included on CITES Appendices but no stingray is included in these appendices. However, a number of species of stingrays along with sharks and guitarfishes have been assessed for inclusion in the IUCN Red List (Dulvy *et al.*, 2014; Jabado *et al.*, 2018; Last *et al*., 2016a).

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; Henderson *et al.*, 2004; 2016; Jabado and Spaet, 2017; Jabado *et al.*, 2014, 2015, 2018; Karnard *et al.*, 2020). Jabado and Spaet (2017) have given a detailed description of shark fisheries including stingrays of the Arabian Sea including Pakistan. Studies on the fisheries of these species in Pakistan were also included in Jabado *et al.* (2017). Considering that there are lacunae in the information about stingrays of Pakistan, present paper is prepared and it deals with species composition, landings and fisheries of stingrays from Pakistan.

MATERIALS AND METHODS

Published scientific literature was examined for the records of various stingrays species occurrence from Pakistan coast (Fig.1). In addition, specimens of stingrays belonging to Family Dasyatidae collected between 2003 and 2020 from Karachi Fish Harbour which the largest fish is landing center for domestic fleet operating along coastal and offshore waters of Pakistan. No foreign vessel is allowed to land their catch at this fish harbour. Therefore, stingrays that have been studies are collected by Pakistani fishing vessels. 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 Family Dasyatidae 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 stingrays, observations were recorded at Karachi Fish Harbor on daily basis from 1 January, 2019 to 31 December 2019. It may be mentioned that the data of landings of fresh and chilled is collected from Karachi Fish harbor and those used as raw material for fishmeal is not included in the study. Such raw material for fishmeal is called “trash” and is putrefied and landed in mixed with other fishes, therefore, it is not possible to estimate the quantities of stingrays in “trash” fish. During this period estimated catch of members of Family Dasyatidae 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 AND DISCUSSION

Stingrays are important components of commercial fishing of Pakistan. These rays are mainly landed as by catch of trawling and gillnet fishing. In addition, there is aimed fisheries in which fixed gillnets and long line are used. Previously these gears were used throughout Pakistan coast but now this aimed fishery is based in some coastal villages and town of Jiwani and Gwadar area. Stingrays used mainly as raw material for production of fishmeal for poultry industry, however, now wings of a number of species are exported to Thailand and Malaysia in frozen form.

Fishing Methods of Stingrays

Stingrays are caught in commercial quantities as by catch of shrimp/fish trawling, bottom set gillnets and long lines being deployed in shallow coastal waters, bays, creeks as well as on the continental shelf areas along the coast of Pakistan. In addition, there is an aimed fishery based mainly in Jiwani and other parts of Gwadar District and Bundewari (Lasbela District). In this fishery stingrays are caught in specially designed fixed bottom set gillnets. These gillnets are 200 to 400 m. long and about 5 m wide. Mesh size is between 10 and 11.5 cm (stretched). A float is attached at every 15 m whereas a weight of about 1-2 kg is attached after every 8-10 m. It is mainly constructed from multifilament nylon (polyamide) net, however, recently some fishermen have started using monofilaments. The net is fixed to the bottom with the help of anchors at both end. However, in case the net is longer than 200 m then additional anchors may be attached. The net is laid down in the afternoon and harvest is made after every 24 hours. The net is retrieved and placed in other locations, if catch of stingrays is poor.

In Balochistan, the method of stingrays fishing is called "Arrassi" or "Lay". The main fishing ground is within Gwater Bay, near the mouth of Dashat River and adjacent waters in Jiwani area and Gunz, Pushukan, Sur, Karwat, Pasni, Ormara along Gwadar District and Sapat and Sonmiani Bay along Lasbela, Balochistan coast and off creek areas in Sindh coast. Fishermen are believed to have traditional knowledge about the migration route of stingrays and accordingly place the large-meshed, bottom-set fixed nets in these routes. The migratory routes may change with seasons and accordingly the placement of net is also shifted to these routes.

In Bundewari area, the fixed gillnets for targeting stingrays are placed along lower reaches Sonmiani Bay between Khalifa Point and Bundewari. Almost similar net is being used but it is fixed at the sea bottom with the help of anchors in a pattern that it is almost enclose a certain area usually about 1,500 m^2. One side of the enclosure are is kept open like a door. This arrangement is called "Darband" (meaning closed door). Stingrays and some other demersal fish move into the "Darband" and cannot get out. The net is checked every morning and entangled fishes mainly stingrays are harvested. There used to be more than 20 "Darband" fixed in Bundewari but now it is occasionally used and there are no more permanently fixed "Darbands" in the area.

In addition to fixed gillnets, bottom set longlines are used for catching stingrays along Sindh and Balochistan coast. The lines baited with sardinellas and anchovies are laid down in the evening and lines are retrieved in the morning.

Commercial Landings of Stingrays

Stingrays (Family Dasyatidae) are considered as important component of shark fisheries of Pakistan. Bottom-set gillnetting is the main fisheries through which stingrays 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. 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 stingrays. There are no trawlers registered in Balochistan. Although extent of contribution of different fisheries in the landings of stingrays has not been calculated but it is roughly estimated that about 75 to 80 % of the stingrays are contributed by bottom-set gillnetters and 10-15 % by bottom-set long lining whereas 5 to 15 % is contributed by trawlers.

Annual landings of Family Dasyatidae for the period from 1970 to 2019 is presented in Fig. 2 which indicates that the landings was 9,221 m. tons in 1970 which gradually increased to 49,017 m. tons in 1982. During this period, the stingrays were caught is large number mainly along Balochistan coast and sun-dried and used to be transported to Karachi for fishmeal production. The increase in the landings during 1973 and 1982 is attributed to introduction of motorization of the fishing fleet which helped in increasing turn-around time, fishing duration and increase in the stingrays' catches. Major decrease in stingrays was noticed since 1983 when the landings dropped to 10,116 m. tons which is due to start of transportation and marketing of fresh/chilled fish from Balochistan to main market in Karachi. This shift in marketing changed the fishing operation along Balochistan coast where most fishing boats shifted their fishing methods from stingray fishing to catching of other food fishes. Another decrease in catches of stingrays was noticed in 2003 which coincided with construction of Makran Coastal Highway which further changed fishing pattern and marketing in Sindh and Balochistan. A major part of fleet that was previously involved in stingray fishing shifted to catching of Indian mackerel which was transported to Karachi for freezing and export. Present landings of stingrays is 7,737 m. tons (2019 figures) and almost stable during last 15 years.

Taxonomic Descriptions

A total of 27 species of stingrays belong to 14 genera are reported from Pakistan coast. These are described alphabetic order. There are a few species whose specimens were not examined during the present study but these are reported in published scientific literatures. Detailed taxonomic characters is taken mainly from Last *et al.* (2016a).

***Bathytoshia lata* (Garman, 1880)**

(Fig.3)

Materials Examined

- 1 specimen collected from on 6 June 2015 from Karachi Fish Harbour (56 cm DW)
- 1 specimen collected from Karachi Fish Harbour on 20 September 2020 (76 cm DW)

Psomadakis *et al.,* (2015) reported this species from Pakistan as *Dasyatis ushiei* which is considered as a synonym of this species. It is a huge plain-coloured stingray with a broad rhombic disc, its width 1.2 to 1.3 times its length, trunk very thick, pectoral fin apex narrowly rounded to angular. Snout short, broadly triangular, tip

extended slightly, anterior margin weakly undulate. Eyes small, length of orbit and spiracle 2.1 to 2.5 in snout length; interorbital space broad, up to 4.5 times orbit length in adults. Mouth broad. Skin finely granular, with denser coverage of large thorns centrally. Tail broad and depressed at base, moderately elongated; length about twice DW; gently tapering to caudal sting, slender ventral tail fold and minute dorsal fold; tail beyond sting very thorny. Pelvic fins rather small, apices angular.

Colour: Uniform greyish-brown to blackish. Tail dark before sting above, usually with white base ventrally. It is commonly known as brown stingray and is known from Eastern Atlantic (southern France to Angola, including the Mediterranean Sea) as well as widespread in the Indo-Pacific region, (from southern Africa to Hawaii) (Froese and Pauly, 2020; Last et al., 2016a). This species is of rare occurrence in Pakistan, therefore, of very little commercial value and thus used only as raw material for production of fishmeal.

***Brevitrygon imbricata* (Bloch and Schneider, 1801)**

(Fig 4a, 5a)

Material Examined

- 1 Specimen collected on 24 January 2009 from Karachi Fish Harbour (18 cm DW)
- 1 Specimen collected on 9 October, 2013 from Karachi Fish Harbour (16 cm DW)
- 1 specimen collected on 22 December 2020 from Karachi Fish Harbour (13 cm DW)

Brevitrygon imbricata is commonly known as Bengal whipray and it was reported from Pakistan coast by a number of workers. This *is* a small whipray with a suboval (slightly longer than wide); length 1.1 times in DW; pectoral fin apex broadly rounded. Snout rather long, broad, apical lobe pointed, anterior margin deeply concave. Eyes small, protruding slightly, length of orbit and spiracles 2.9-3.6 in snout length; interorbital space rather broad, 2 times orbit length. Mouth weakly arched, 2 minute oral papillae; lower jaw arched with deep central concavity. Nasal curtain skirt-shaped, broad, posterior margin finely fringed. Mid shoulder denticles barely larger than denticles adjacent; denticle band expanded over abdomen in adults, constricted beside spiracles; skin smooth outside denticle band. Up to 6 enlarge thorns on tail, crowns low and narrow. Tail moderately elongate, length 1.5 to 1.7 times DW; stout and oval in cross-section at base; filamentous beyond caudal sting in young and males, more flattened posteriorly in large females; usually 2 caudal stings.

Colour: Dorsal surface brownish to greenish brown, margin of disc slightly paler. Tail forward of caudal sting brownish above and white below; lateral ridges white, demarcated and separated by dark upper and lower surfaces of tail behind sting. Ventral surface of disc white, disc and pelvic margins yellowish brown.

B. imbricata is reported from Pakistan by Ahmad (1988), Ahmad *et al* (1973); Ahmad and Niazi (1975), Anonymous (1955, 2001), Bianchi (1985), Froese and Pauly (2020), Hoda (1985, 1988), Hussain (2003), Hussain and Arshad (1969), Jalil and Khalil (1972, 1981), Khan and Quadri (1986), Misra (1952), Psomadakis *et al.*, (2015), Qureshi (1952,1953, 1957, 1972) and Siddiqi (1956) from Pakistan coast. In these studies this species was reported to belong to genera *Dasysatis, Dasyatis (Anpholistius, Himantura* or *Ampholistius.*

***Brevitrygon walga* (Müller and Henle, 1841)**

(Fig. 4b, 5b)

Material Examined

- 1 Specimen collected on 24 June, 2010 from Karachi Fish Harbour (23 cm DW)
- 1 Specimen collected on 19 June, 2013 from Karachi Fish Harbour (16 cm DW)
- 1 Specimen collected on 7 August, 2016 from Karachi Fish Harbour (19 cm DW)
- 1 Specimen collected on 22 December 2020 from Karachi Fish Harbour (22 cm DW)
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Commonly known as scaly whipray it is called “kutti” in Sindh and “uthar” or “shikki” in Balochistan. it has been reported to belong to genera *Trygon Dasyatis* and *Himantura* in previous studies from Pakistan. This species is reported *from* Sindh by **Anonymous** (2001), Niazi (2001) and Sorley (1932). It is also reported from Pakistan coast without specifying any specific location by Ahmad and Niazi (1975), Bianchi (1985), Froese and Pauly (2020), Hoda (1985, 1988), Hussain (2003), Jalil and Khalil (1981), Khan (1924), Khan and Quadri (1986) and Misra (1969).

Brevitrygon walga is a small whipray with a suboval disc (slightly longer than wide); length usually 1-1.1 times in DW; pectoral fins broadly rounded. Snout long, broadly concave, with distinct apical lobe, anterior margins strongly concave. Eyes small, protruding slightly, length of orbit and spiracle 2.6 to 3.0 in snout length; interorbital space rather broad, 1.5-2.0 times orbit length; interspiracular distance 17.1-18.0 % DW. Mouth arched, 2 central oral papillae (close together); lower jaw arched with central concavity. Nasal curtain almost rectangular, posterior margin finely fringed. Mid-shoulder denticles small and heart sharped; denticle band narrow in both juveniles and adults extending just forward of orbits and constricted at nape; skin smooth outside denticle band. Thorns in median row on tail spear-shaped with convex crown, varying in size. Tail rather short, length 1.3 to 1.5 times in DW; depressed slightly, base stout and oval in cross-section, ridge-like ventral fold on tail and no dorsal fold; very slender beyond caudal sting in both sexes; fold rudimentary or absent; 1-3 caudal stings.

Colour: Dorsal surface uniform dark brownish, margin of disc pale; tail forward of caudal sting dark brown above and white below, uniformly brownish beyond sting. Ventral surface white, disc margins dusky.

According to Last *et al.* (2016a) *B. imbricata* is only found in Bay of Bengal further south to Andaman Sea whereas Golzarianpour *et al.* (2020) and Naylor *et al.* (2012) reported that *B. walga* is the only representative of the genus *Brevitrygon* in the Persian Gulf and the Gulf of Oman. According to them among four species of the genus *Brevitrygon*, both *B. walga* and *B. imbricata* are restricted to the Indian Ocean while *B. walga* is common in the north western part of the region and the *B. imbricata* inhabits eastern waters of India. According to Last *et al.* (2016a) more than 1 form of this species exists in the Indian Ocean and there is a need to determine level of interspecific variability by examining more material. They further added there is a confusion about identification of dwarf whiprays of genus Brevitrygon.

During the present study a number of both species were collected from Pakistan coast and detailed examination of these material were made which revealed that both *B. imbricata* and *B. walga* are commonly found in Pakistan. Considering that there are confusion in the identification of two species, a comparison was made (Table 1) which clearly demonstrates that two species have distinctive characters on the basis of which these can be separated.

Table I. Differentiation between *Brevitrygon walga* and *B. imbricata.*

S. No.	*Brevitrygon walga*	*Brevitrygon imbricata*
1	Suboval disc; length 1.1 times in DW (Fig. 4a-5a).	Suboval disc but length usually 1-1.1 times in DW (Fig. 4b-5b).
2	Interspiracular distance 17.1-18 % DW (Fig.4).	Interspiracular distance 18-19 % in DW (Fig. 4b).
3	Narrow denticle band from interorbital to base of spine on tail (Fig. 6a).	A broad median denticle band from interorbital to base of spine on tail (Fig. 6b).
4	Mid shoulder denticles narrow and heart shaped (Fig. 6c).	According to Last *et al*. (2016a), the mid shoulder denticles barely larger than denticles adjacent whereas Psomadakis *et al.*, (2020) pointed out that in this species it has usually pearl like tubular thorn (Fig. 6d).
5	Nasal curtain rectangular (Fig. 7a)	Nasal curtain skirt shaped (Fig. 7b).
6	Tail rather short, length 1.3 to 1.5 times in DW; depressed slightly, base stout and oval in cross-section (Fig. 8a).	Tail moderately elongate, length 1.5 to 1.7 times DW; stout and oval in cross-section at base (Fig. 8b)
7	Tail narrow, with a row of spear-shaped thorns (Fig. 8a).	Tail broader, thorns fewer and smaller (Fig. 8b)
8	Dorsal profile shows dense denticles and 8-9 thorns in median row on tail spear-shaped with convex crown, varying in size (Fig. 9a).	Dorsal profile shows small denticles and 6 enlarge thorns on tail, crowns low and narrow (Fig. 9b).

Considering these features, it is certain that both scaly whipray (*Brevitrygon walga*) and Bengal whipray (*B. imbricata*) do occur in Pakistan and commonly caught during commercial fishing in coastal waters and continental shelf area.

Commercial landings of scaly whipray (*Brevitrygon walga*) and Bengal whipray (*B. imbricata*)

B. walga and *B. imbricata* are commercially important species as wings of larger specimens are exported to Thailand and Malaysia. These species are harvested throughout the year but are dominantly found during summer

and early winter months (between May and October). Fig. 10 shows their annual landings in Karachi Fish Harbour which indicates that these species have a peak of landings in summer month. Because of the smaller size of these species, these are of little interest for the exporters. However, these species and their offal are also used as raw material for fish meal.

***Hemitrygon bennettii* (Müller & Henle, 1841)**

(Fig. 11)

Material Examined

- 1 specimen collected on 18 December 2020 from Karachi Fish Harbour (29 cm DW)

Bennett's stingray is commonly known as "pittan" in Sindh and "shikki" in Balochistan. This species is reported from Pakistan as *Pastinachus bennetti* by Ahmad and Niazi (1975), Hoda (1985, 1988), Jalil and Khalil (1981) and, Khan and Quadri (1986) whereas Misra (1969) and Qureshi (1952) reported it as *Dasyatis (Pastinachus) bennetti*. This species is known to be distributed in northwest Pacific (between Java Indonesia to Central China and Taiwan (Froese and Pauly (2020). Assadi and Dehghani (1997), Mukhta *et al*., (2019) and Vossoughi and Vosoughi (1999) reported this species from Iran and Oman, therefore, there is a likelihood of occurring of this species in Pakistan

This is a medium sized stingrays which has pale brownish body with an elongate, weakly rhombic disc, length 0.9-1.0 times width; trunk rather thick; pectoral fin apex broadly rounded. Snout angular and produced slightly, tip pointed, preorbital length 22-24 % DW; anterior margins straight, distinctly shorter than posterior margin. Eyes small, length of orbit and spiracle 2.3-2.4 times in snout length; inter-orbital space rather broad, twice or orbit length. Nasal curtain skirt shaped, elongate, margin strongly fringed, nostrils narrowly oval, oblique. Adults usually with Y-shaped band of small denticles extending from eyes to hind disc; young smooth or with small patch of denticles on mid-disc. Small thorns in long median row on disc and short row on each shoulder; row of large spear like tubercles on tail before caudal sting; thorns usually absent in young. Tail length 2.3-2.6 times DW; base rather broad, thickened, tapering strongly at sting then becoming whip like, pre-sting length 1.2-1.3 times DW; 1 or 2 caudal stings; ventral fold long, low (base length 60-67 % DW). Pelvic fin extends well beyond disc.

Colour: Dark brown to greyish green above, marginally paler on pelvic fins and around disc margin; yellow at front of eye and edge of spiracle. Undersurface of disc white with broad yellowish margin; tail yellowish or white and strongly contrasted with black ventral fold; tail mostly black beyond caudal sting.

***Himantura leoparda* Manjaji-Matsumoto & Last, 2008**

(Fig. 12)

Material Examined

- 1 Specimen collected on 18 December 2008 from Karachi Fish Harbour (185 cm DW)
- 1 Specimen collected on 24 April, 2014 from Karachi Fish Harbour (90 cm DW)
- 1 Specimen collected on 26 February 2015 from Karachi Fish Harbour (100 cm DW)
- 1 specimen collected from 19 December 2020 from Karachi Fish harbor (86 cm DW)

It is commonly known as honeycomb stingray whereas in Sindh it is called "chitto" or "chitta", "tiger" and "garamari" or "garabari" in Balochistan. Leopard whipray was reported from Pakistan by Last *et al.* (2016a) and Psomadakis *et al.*, (2015). It is a large whipray with a weakly rhombic disc and broadly pointed snout, nasal curtain, skirt-shaped. Central disc usually with two broad heart-shaped thorns proceeded by a row of up to 13 smaller denticles of similar shape and a row of small denticles posteriorly no other enlarged thorns extending along mid-line of disc and tail. Tail whip-like and without skin fold, and course ocellate or reticulate colour pattern on upper surface (dark spots and blotches in young). Unique colouration of the disc is the most important and striking characteristic of this species which has whitish to yellowish brown dorsal surface that is mottled with dense pattern of dark medium-sized rings. The colour pattern is different in newborn and subadults. Newborn rays have large black spots (bigger on mid-disc than near its edge) whereas in subadults the spot are coalescing and opening to form reticulums, rings and spots and ring-like markings extending over tail before sting, tail banded beyond sting. Ventral surface almost entirely white.

This species is widely distributed in the Indo-West Pacific area extending from South Africa o northern Australia including Arabian Sea, Bay of Bengal to New Guinea, North to the Ryukyu Islands (Last *et al*, 2016a; Froese and Pauly, 2020). However, according to Eschmeyer (2020) it is distributed only to India and Sri Lanka east to Java (Indonesia) and Borneo.

This species is almost similar to *Himantura undulata* but has smaller dark rings and reticulations on the dorsal surface of the adults and its mid shoulder denticles area heart-shaped (pearl shaped in *H. undulata*). *Himantura uarnak*, on the other hand has pale yellowish, white or greyish dorsal surface which is densely covered with very small brownish black spots and flecks.

Four species of stingrays belonging to genus *Hiamntura* which has either spotted, ocellated or reticulated pattern on their dorsal surface are reported during present study. This include *Himantura leoparda*, *H. tutul*, *H. uarnak* and *H. undulata*. Although four species have distinct patterns but there is a series of intermediate forms making it difficult to ascertain identification. Similar extensive colour pattern variation seen across these species complex by Borsa (2017), Borsa *et al*.(2013), Fernando *et al*., (2019) and Manjaji-Matsumoto and Last (2016). The need for further investigations are required to understand this species complex and to decipher some intermediate species.

***Himantura tutul* Borsa, Durand, Shen, Alyza, Solihin and Berrebi, 2013**
(Fig.13)

Material Examined

- 1 Specimen collected on 23 December, 2010 from Pasni Fish Harbour (79 cm DW)
- 1 specimen collected 12 November 2019 from Karachi Fish Harbour on (90 cm DW)
- 1 specimen collected 17 June 2020 from Karachi Fish Harbour on (108 cm DW)
- 1 specimen collected 20 December 2020 from Karachi Fish Harbour on (111 cm DW)

This species commonly known as fine-spotted whipray is a new record from Pakistan. This species was described by Borsa *et al*. (2013) on the specimen collected from Mkoani Fish Landing Center, Pemba Island, Tanzania. According to them the shape of the snout, proportion of disc width, disc length, tail length and finely spotted leopard- like patterns and lack of enlarged scapular denticles on the dorsal surface make them distinguishable from other species of *Himantura* that have spotted/reticulated/ocellated pattern on their dorsal surface. According to Borsa *et al.* (2013) the 'atypical fine leopard form of *H. leoparda sensu* Manjaji-Matsumoto and Last (2008) was characteristic of *H. tutul* while it was mostly absent in *H. leoparda.*

According to Eschmeyer (2020) and Last *et al.* (2016a) the current status of *H. tutul* is synonym of *H. uarnak*. *H. tutul* was described as cryptic species under *H. leoparda* complex (Borsa *et al*., 2013) and previous studies have shown genetic distinction of *H. tutul* from other species in this complex (Arlyza, *et al.*, 2013; Borsa, 2017; Borsa *et al*., 2013). Kumar et *al.* (2020) further validated that *H. tutul* is genetically distinct from other *Himantura species*. They observed that there are biogeographical variations between specimens from western Indian Ocean studied by Arlyza *et al.* (2013) than those studied from Indo-Malay Archipelago by Borsa *et al.* (2013), which Kumar *et al*. (2020) attributed to the presence of Sunda Shelf Marine Biogeographic Barrier (Briggs and Bowen, 2012).

Although there seems to be some doubts among identification of the small spotted/ocelatted/reticulated *Himantura* (*H. uarnak* and *H. tutul*) but DNA barcoding based on COI gene done by Kumar *et al.* (2020) ascertained their *H. tutul* is a valid species which is distributed along western Indian Ocean (Tanzania), Laccadive Sea and Indo-Malay Archipelago including Sunda Strait area, southern coast of Java Island, the Bali Sea, eastern South China Sea and Sulu Sea (Sabah). This also reported from Sri Lanka (Fernando *et al*., 2019) and now from northern Arabian Sea (Pakistan).

***Himantura uarnak* (Gmelin, 1789)**
(Fig. 14)

Material Examined

- 1 Specimen collected on 21 March 2014 from Karachi Fish Harbour (40 cm DW)
- 1 specimen collected on 11 June 2016 from Karachi Fish Harbour (87 cm DW)
- 1 specimen collected on 11 September 2020 rom Karachi Fish Harbour (105 cm DW)
- 1 specimen collected on 17 December 2020 from Karachi Fish Harbour on (108 cm DW)

It is commonly known as honeycomb or coach whipray whereas in Sindh it is called "chitto" or "chitta", "tiger" and "garamari" or "garabari" in Balochistan. It is reported from Sindh coast by Ahmad *et al* (1973), Anonymous (1955), Misra (1952), Murray (1880), Niazi (2001) and Sorley (1932) whereas it is reported from Balochistan by

Ahmad *et al*, (1973), Anonymous (1953, 1955), Misra (1952) and Qureshi (1952, 1957). In addition, Ahmad (1988), Ahmad and Niazi (1975), Anonymous (2001), Bianchi (1985), Froese and Pauly (2020), Hoda (1985, 1988), Hussain (2003), Jalil and Khalil (1972, 1981), Last and Stevens (2009), Hussain and Arshad (1969), Khan and Quadri (1986), Last and Stevens (2009), Last *et al*. (2016a), Misra (1969), Qureshi (1952, 1953, 1957, 1972), and Psomadakis *et al.*, (2015) and Siddiqi (1956) reported this species without mentioning any specific location. In previous studies from Pakistan this species was included in genera *Raja*, *Trygon*, *Dasyatis* or *Dasyatis* (*Himantura*).

According to Borsa *et al.* (2020), it is large whipray with disc rhomboidal, length 94.6% DW; snout with distinct apical lobe; anterior margins of disc convex, lateral apices narrowly rounded; posterior margin convex, free rear tip rounded. Nasal curtain skirt-shaped, tail whip-like and without skin fold. Pelvic fins moderately elongate. Central disc with 1-3 mall heart shaped thorns but no enlarged thorns extending along mid-line of disc and tail. Tail whip-like, tapering gently toward sting. It has pale yellowish, white or greyish dorsal surface which is densely covered with very small brownish black spots and flecks (finest along the disc margins) in adults (finely spotted or densely reticulate in young), tail densely dark spotted above before sting, weakly banded posteriorly. Ventral surface almost entire white.

Since there was no type specimen for P. Forsskål's *H. uarnak*, therefore, there was a serious impediment to the taxonomy of the reticulate whipray of genus *Himantura* complex, therefore, Borsa *et al*. (2020) have collected specimens of whipray from the Jeddah region, the assumed type locality of *H. uarnak*, characterized genetically at the cytochrome-oxidase subunit 1 (CO1) locus and designated neotypes of *H. uarnak*. This species is known to be distributed in the Indo-Pacific area including Persian Gulf, Red Sea (and eastern Mediterranean via Suez Canal) to southern Africa and French Polynesia, north to Taiwan, south to Australia. Also in the Arafura Sea (Froese and Pauly, 2020). It may, however, be added that there exists a confusion about the identification of this species as there are a group of small densely spotted, ocellated and reticulated whiprays which are not adequately identified.

***Himantura undulata* (Bleeker, 1852)**

(Fig. 15)

Material Examined

- 1 specimen collected on 18 November 2020 from Karachi Fish Harbour (87 cm DW)
- 1 specimen collected on 21 December 2020 from Karachi Fish Harbour (35 cm DW)

It is a large stingray commonly known as leopard whipray which has a suboval and robust disc; width subequal to length; pectoral fins apex broadly rounded. Snout triangular, small pointed lobe at tip; anterior margin straight to convex before tip. Eyes small protruding; length of orbital and spiracle 2.7-3 in snout length; interorbital space 2.7 - 3.1 in orbit length. Mouth arched, usually 4 oral papillae; labial furrows and folds weak; lower jaw with prominent central concavity. Nasal curtain skirt-like, broad and short, posterior margin finely fringed. Central disc with large peal-shaped thorn (yellowish), followed by two smaller similar thorns in adult; no other enlarge thorns extending along midline of disc and tail. Denticle band well developed in adults, extending onto tail. Tail narrow-based, suboval in cross-section, tapering evenly towards caudal sting; becoming whip-like, tapering more gradually beyond sting, elongate, length 3 times in DW; usually with one caudal sting.

Colour: Dorsal surface of large adults with dense pattern of large dark, thick-lined rings and reticulations; young with large dusky spots and blotches that coalesce to form reticulations during growth, disc colouration extended over tail before sting, tail weakly banded beyond sting. Ventral surface almost entirely white.

This species is distributed in the Indo-West Pacific extending from Bay of Bengal to New Guinea, north to the Ryukyu Islands, south to northern Australia. It was thought to be not occurring in the western Indian Ocean but present paper reports it for the first time from northern Arabian Sea (Pakistan coast).

According to Roy *et al*. (2014) this species attain 140 cm (disc width); size at birth is 20 cm DW. across and has a diamond-shaped disc with a striking dorsal colour pattern consisting of large, dark brown rings and reticulations declined by thin yellow lines. Specimens from Pakistan has similar pattern reported by Roy *et al*., (2014) from Bangladesh.

Commercial landings of spotted/ocellated/reticulated stingrays (*Himantura leoparda*, *H. tutul*, *H. uarnak*, and *H. undulata*).

Himantura leoparda, *H. uarnak*. *H. tutul* and H. undulata which are four spotted/ocellated/reticulated stingrays found in Pakistan are of commercial, importance as their wings are exported in frozen form to to Thailand and Malaysia. Although as compared to other species of stingrays, the wings of these species fetch comparatively lower rates but still, these are exported in substantial quantities. These species are harvested throughout the year but is dominantly found during summer and early winter months (between May and October). Fig. 16 shows their annual landings in Karachi Fish Harbour which indicates that these species are found throughout the year with peak in summer month. In addition, these species as well as their offal are also used as raw material for fishmeal.

***Maculabatis arabica* Manjaji-Matsumoto & Last, 2016**

(Fig. 17)

Material Examined

- 1 Specimen collected on 13 June 2017 from Karachi Fish Harbour (27 cm DW)
- 1 Specimen collected on 2 July 2019 from Karachi Fish Harbour (30 cm DW)
- 1 Specimen collected on 12 August 2020 from Karachi Fish Harbour (21 cm DW)
- 1 Specimen collected on 11 December 2020 from Karachi Fish Harbour (32 cm DW)

Arabic whipray was reported from Pakistan by Manjaji-Matsumoto and Last (2016) and Last *et al.* (2016a). Its holotype (LACM 38133-74) was collected from 3–4 km west of Turshian Creek, Sindh, Pakistan, Arabian Sea and housed in Los Angeles County Museum, Los Angeles, California, USA. This species now known from Pakistan, Gujrat, West Coast of India and Sri Lanka (Eschmeyer, 2020). According to IUCN Red List this species is considered to be Critically Endangered (CR) (A2d+3d).

It was previously identified as *Himantura gerrardi* and is diagnosed by a combination of external characters including relatively short disc, narrow interspaces between paired structures on the head, squamation (relatively slow denticle development and a characteristic denticle band shape), plain dorsal disc coloration (rather than spotted), and tail light brown and banded beyond the caudal sting in juveniles but almost plain in adults.

Medium sized plain coloured whipray with a rhombic disc large head (43-47 % in DW) and internasal width (8.4-9.6 % in DW); nasal curtain skirt shaped; mid shoulder denticles heart or seed shaped, broad denticle band in adults; posterior tail rather thick and whip-like, without skin folds, and tail partly banded in young. Disc rather broad through trunk, mid shoulder region raised slightly wider than long, length 88-94 % DW, pectoral apex narrowly rounded. Snout broad and rather short, triangular apical lobe distinct, anterior margins slightly concave. Eyes small, protruding slightly, length of orbit and spiracle 1.9-2.3 % in snout length, interorbital space 2.3 times orbit length. Mouth small, 2-4 oral papillae (medial pair enlarged); labial furrows and folds prominent, lower jaw arched slightly. Nasal curtain posterior margin finely margined. Mid-shouldered denticles 1-3 small, preceded by rows of up to 10 smaller enlarged denticles, denticle wide and adults sub-rectangular broader than interspiracular distance for most of its length , rest of disc smooth, no enlarge thorny denticles on mid-line of tail before sting. Tail long and slender, length 2.2.-2.6 times DW, narrow based, slightly depressed in cross section; tapering gently and evenly towards caudal sting then weakly beyond sting; usually 1 caudal sting, tail beyond caudal sting sparsely covered with denticles. Pelvic fins broad.

Colour: Dorsal surface uniformly pale brown to greyish brown, paler along the margin and denticle band. Tail with alternative pale band and broader dark bands on upper half of the tail behind sting in young (uniformly pale ventrally); uniformly pale brownish in adults. Ventral surface white, disc margin often dusky.

***Maculabatis bineeshi* Manjaji-Matsumoto & Last, 2016**

(Fig. 18)

Material Examined

- 1 Specimen collected on 11 September 2018 from Karachi Fish Harbour (35 cm DW)
- 1 Specimen collected on 13 August 2018 from Karachi Fish Harbour (40 cm DW)
- 1 Specimen collected on 3 October 2019 from Karachi Fish Harbour (21 cm DW)
- 1 Specimen collected on 13 December 2020 from Karachi Fish Harbour (39 cm DW)
-

Short-tail whipray was reported from Pakistan by Manjaji-Matsumoto and Last (2016) and Last *et al.* (2016a). Its holotype (LACM 38131-43) was collected from 6–8 km south of Hajambro Creek, Sindh, Pakistan, Arabian Sea. This species is characterized in having suboval to weakly rhombic disc (in young, squamation with rapid denticle

development and broad denticle band with margins truncate near pectoral-fin insertions, plain dorsal disc coloration with no white spots, and a dark blackish tail with weakly mottled banding on its dorsal surface beyond the caudal sting. It is known to be distributed in Arabian Sea (Pakistan and India) and Bay of Bengal (Eschmeyer, 2020).

It is a small plain-coloured whipray with a rhombic disc, large head (44-49 % DW) and internasal length 8.8-9.4DW, nasal curtain skirt shaped, largest mid mid-shoulder denticle heart-shaped, broad denticle band in adults, and tail whip-like without skin- fold and partly banded in young. Disc rather broad through trunk; slightly wider than long; length 93-99%DW; pectoral fin apex narrowly rounded. Snout broad and moderately elongate; distinct triangular apical lobe; anterior margin s almost straight. Eyes small, protruding slightly, length of orbit and spiracle 1.9-2.7in snout length; interorbital space 1.7-2.6times orbit length. Mouth small, 4 oral papillae (medial pair enlarged, lateral pair small), labial furrows and folds prominent; lower jaw arched slightly. Nasal curtain posterior margin finely fringed. Mid shoulder denticles 1-3 (1 large and pearl like) not preceded by distinct row of smaller denticles; denticle band wide in adults (much wider than interspiracular space) denticles very densely packed on mid-disc; rest of disc smooth; no enlarge thorny denticles on midline of tail. Tail slender, elongate, length 2.3-2.6times DW; narrow based, slightly depressed in cross section; tapering gently and evenly toward caudal sting, then weakly beyond sting; usually one caudal sting, tail beyond caudal sting sparsely covered with denticles. Pelvic fins rather broad,

Colour: Dorsal surface uniformly pale brown, pre-sting tail with white spots along the dorso-lateral surface. Tail dark with weak dorsal banding behind sting. Ventral surface white, with broad yellowish margins on disc and pelvic fins.

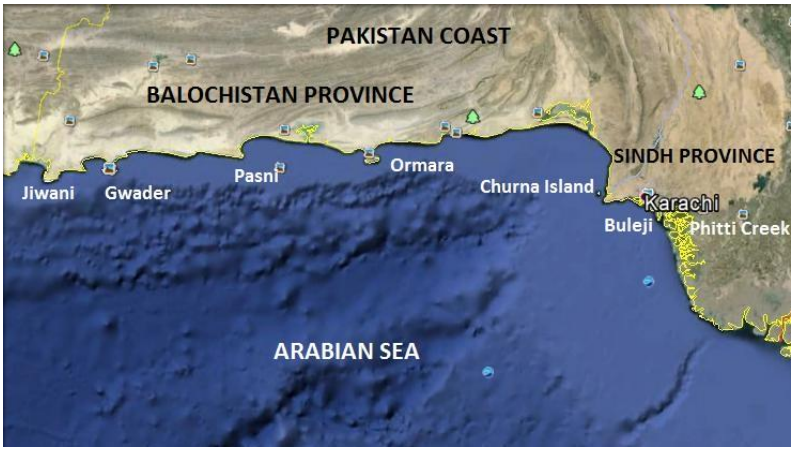


Fig. 1. Pakistan coast.

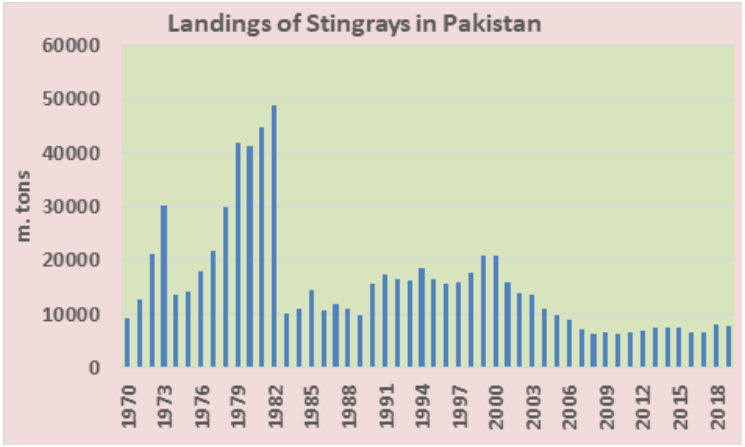


Fig. 2. Landings of Stingrays in Pakistan (1970-2019)

Fig. 3. *Bathytoshia lata* collected from Karachi Fish Harbour (76 cm DW). (a) Dorsal view; (b) Ventral view.

Fig. 4. *Brevitrygon walga* (a) and *B. imbricata* (b) collected on 22 December 2020 (dorsal view)

Fig. 5. *Brevitrygon walga* (a) and *B. imbricata* (b) (ventral view)

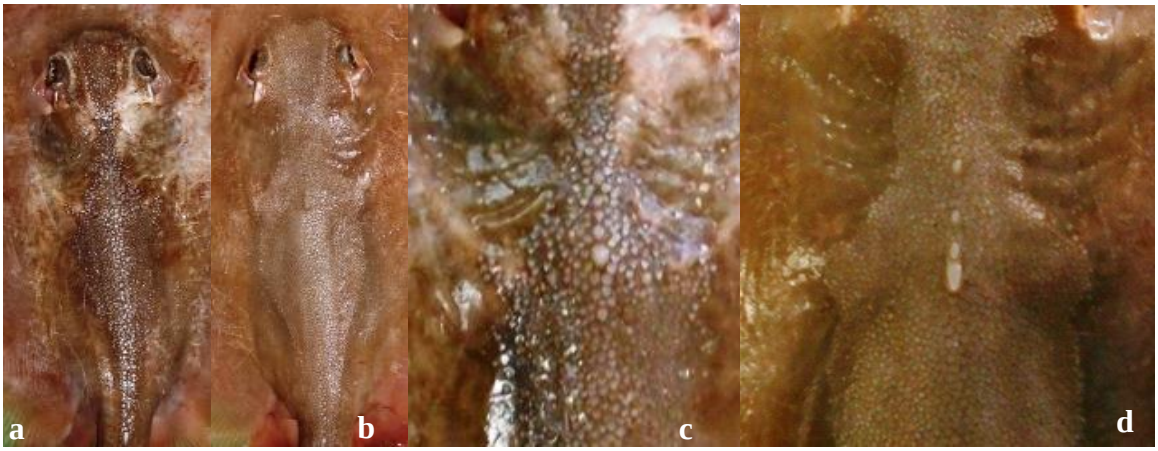


Fig. 6. *Brevitrygon walga* (a) denticle band; *B. imbricata* (b) denticle band; Mid-shoulder denticle (c) in *B. walga*. (d) in *B. imbricata.*

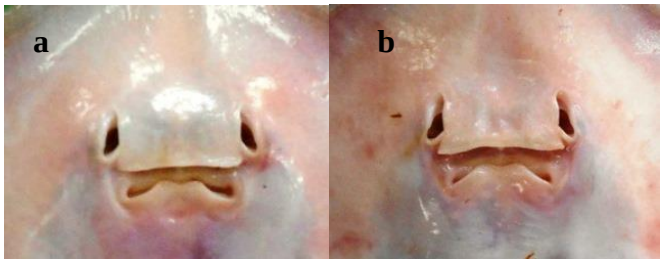


Fig. 7. *Brevitrygon walga* and *B. imbricata* (Nasal curtain rectangular in *B. walga;* skirt-shaped in *B. imbricata*)

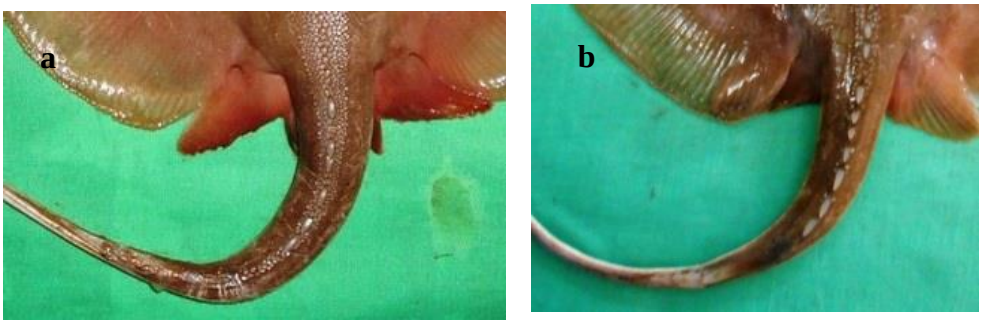


Fig. 8. Tail in (a) *Brevitrygon walga* and (b) *B. imbricate.*

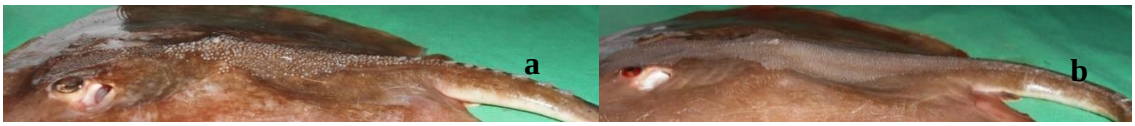


Fig. 9. Dorsal profile in (a) *Brevitrygon walga* and *(*b) *B. imbricate.*

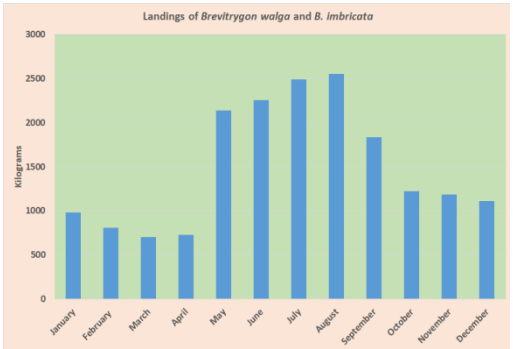


Fig. 10. Landings of *Brevitrygon walga* and *B. imbricata* at Karachi Fish Harbour

Fig. 11. *Hemitrygon bennettii* collected from Karachi Fish harbor on 18 December 2020 (29 cm DW); (a) dorsal view; (b) Mid-shoulder spine.

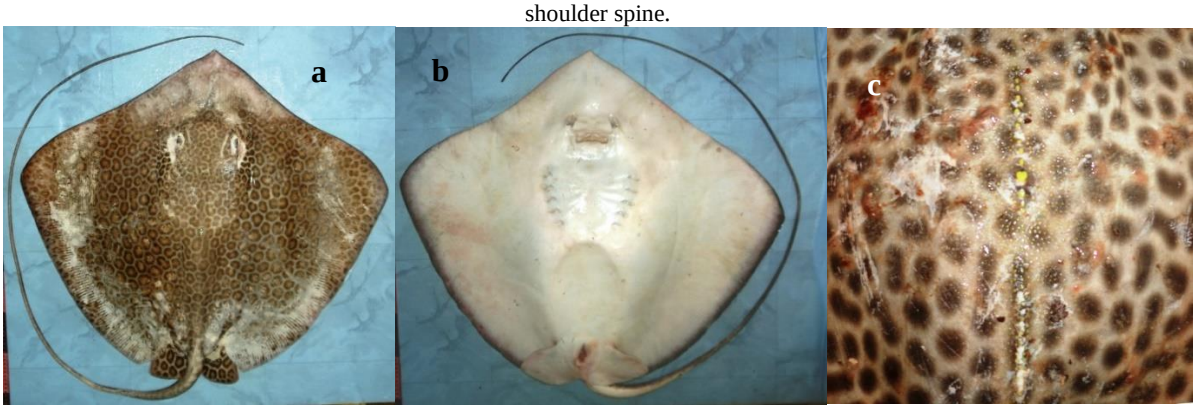


Fig. 12. *Himantura leoparda* collected from Karachi Fish harbor on 19 December 2020 (86 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

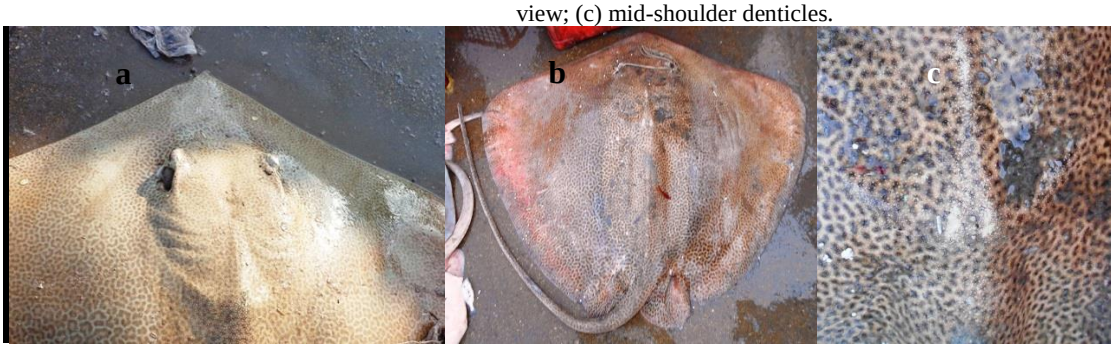


Fig. 13. *Hematuria tutul* collected from Karachi Fish harbor on 20 December 2020 (111 cm DW). (a) Snout (b) dorsal view; (c) mid-shoulder denticles.

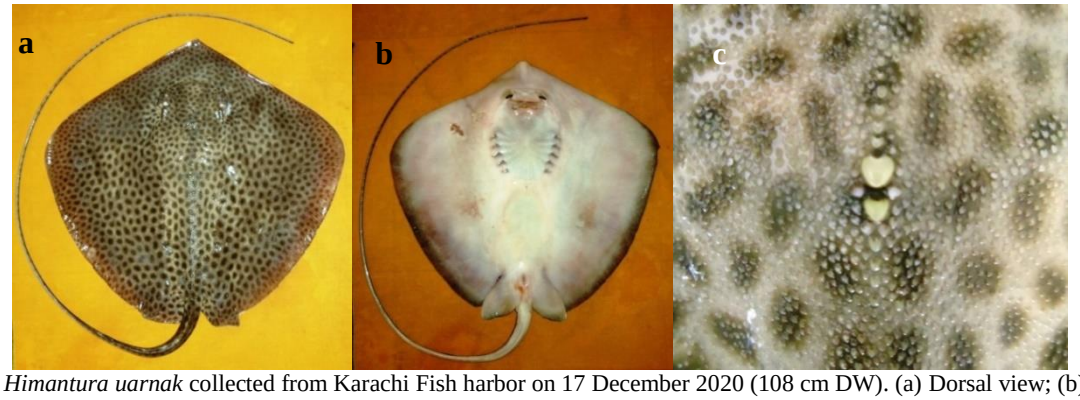


Fig. 14, *Himantura uarnak* collected from Karachi Fish harbor on 17 December 2020 (108 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

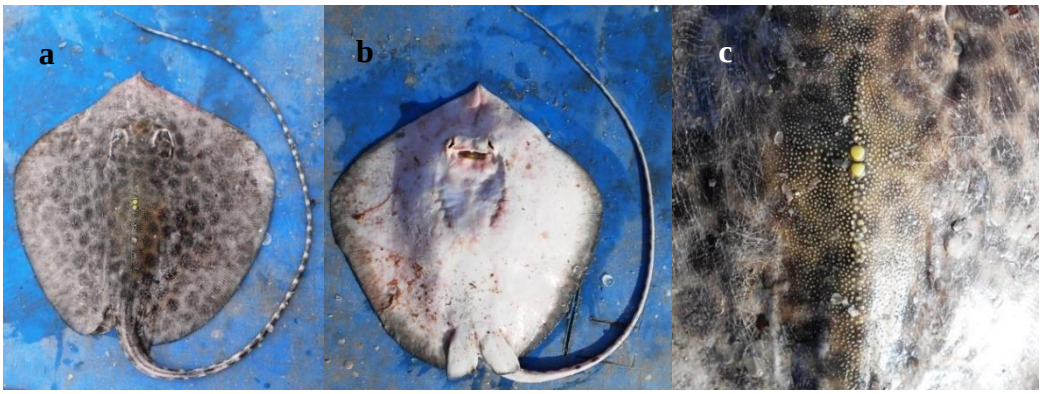


Fig.15. Himantura *undulata* collected from Karachi Fish harbor on 21 December 2020 (35 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

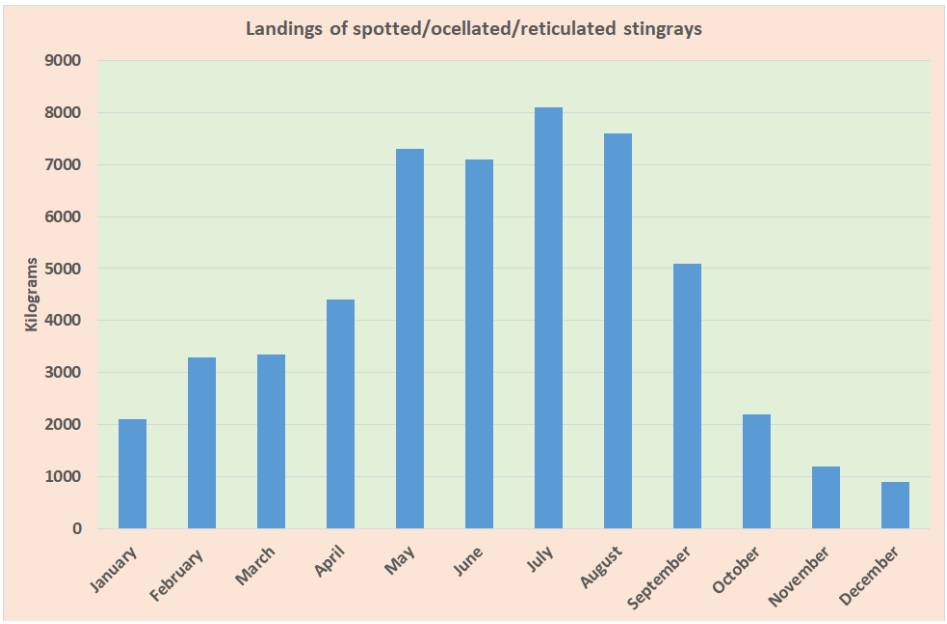


Fig. 16. Landings of spotted/ocelatted/reticulated stingrays (*Himantura leoparda*, *H. uarnak*, *H. tutul* and *H. undulata*).

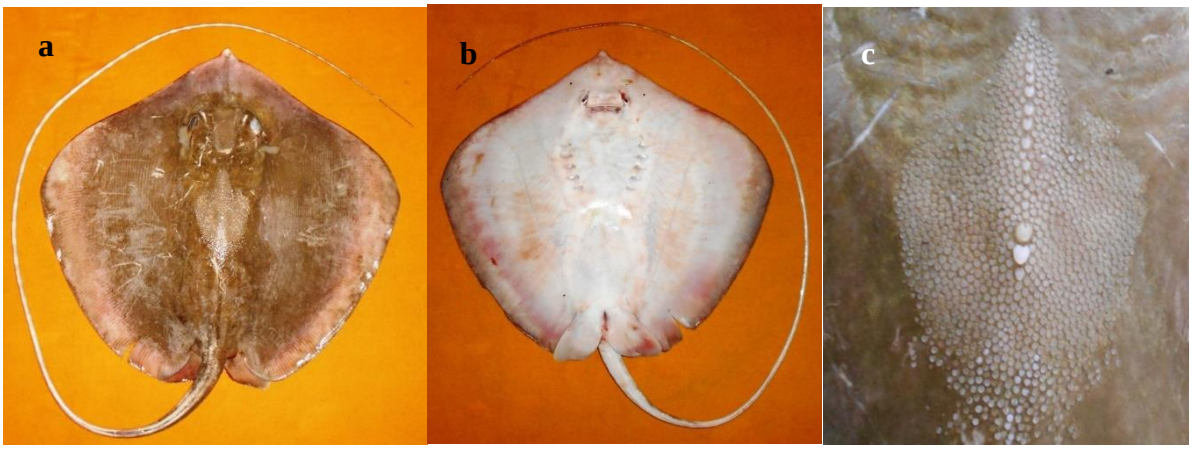


Fig. 17. *Maculabatis arabica* collected from Karachi Fish harbor on 11 December 2020 (32 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

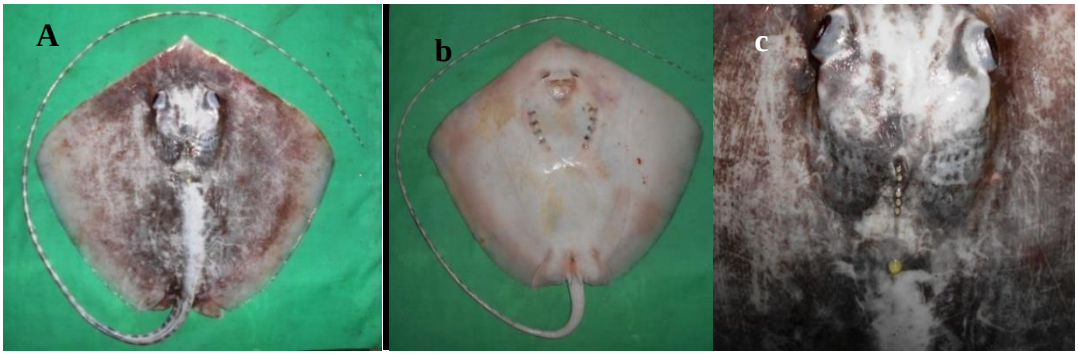


Fig. 18. *Maculabatis bineeshi* collected from Karachi Fish harbor on 13December 2020 (39 cm DW). (a) dorsal view; (b) ventral view; (c) mid-shoulder denticles.

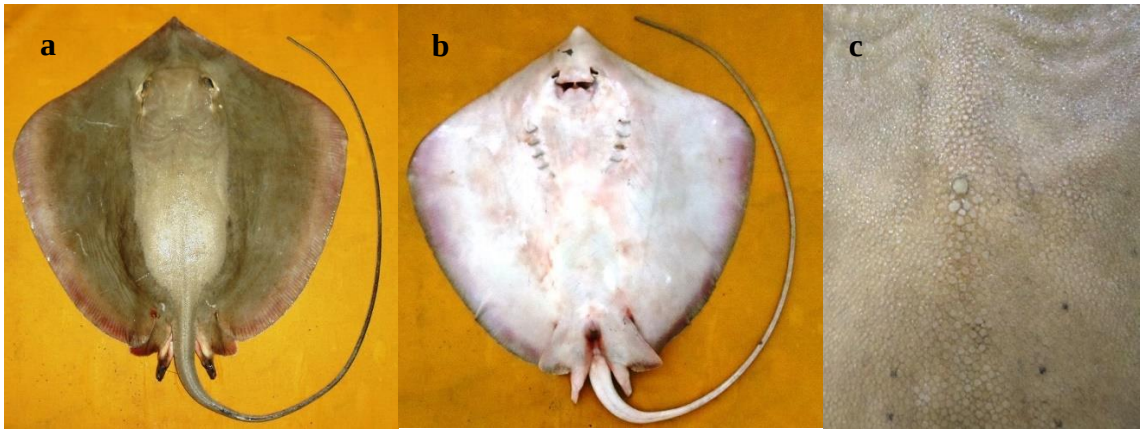


Fig. 19. *Himantura randalli* collected from Karachi Fish harbor on 16 December 2020 (34 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

***Himantura randalli* Last, Manjaji-Matsumoto and Moore, 2012**
(Fig. 19)

Material Examined

- 1 Specimen collected on 22 March 2014 from Karachi Fish Harbour (28 cm DW)
- 1 specimen collected on 12 May 2016 from Karachi Fish Harbour (25 cm DW)
- 1 specimen collected on 7 August 2018 from Karachi Fish Harbour (18 cm DW)
- 1 specimen collected on 19 September 2018 from Karachi Fish Harbour (33 cm DW)
- 1 specimen collected on 16 December 2020 from Karachi Fish Harbour (31 cm DW)
- 1 specimen collected on 20 December 2020 from Karachi Fish Harbour (30 cm DW)

Arabian banded whipray was reported by from Pakistan by Psomadakis *et al.*, (2015). Last *et al.* (2016a) also reported it from Pakistan as (*Maculabatis randalli).* It is medium-sized whipray which has weakly rhomboidal disc; moderately elongate with weak apical lobe preorbital snout, nasal curtain skirt-shaped; rounded pectoral-fin apices; small, protrusible orbits; relatively broad mouth, its width 0.9-1.2 in internasal width; broad pelvic-fin base, 13-17% DW; in juveniles, the tail behind sting is subcircular with deep longitudinal ventral groove and prominent mid-lateral ridge, in adults, it is weakly depressed; 1-2 small, broadly heart-shaped to seed shaped suprascapular denticles (largest mid shoulder denticle heart-shaped), primary denticle band and thorns absent; secondary denticle band irregularly sub-oval, relatively narrow, with well-defined lateral margins, narrowly tapering near tail base; fully developed band and covering entire dorsal surface of tail.

Colour: Dorsal surface mainly uniformly greenish grey coloured, disc margin sometimes paler dorsally; ventral disc uniformly whitish, in adults, darker dorsal surface of tail sharply demarcated from paler ventral surface; juveniles

with dark tail with conspicuous white saddles, its distal portion usually almost uniformly dark. Ventral surface white. Fatima (2018) reported its size (DW) to be between 57 and 63 cm.

This species is reported from western Indian Ocean including Kuwait, UAE, Bahrain, Qatar and Iran (Last et al., 2016a; Froese and Pauly, 2020). According to Golzarianpour *et al.* (2020) this species is endemic and doubted about its presence along Pakistan coast. However, the present study consider this to be one of the common species of stingray found along the Pakistan coastline.

Commercial landings of smooth coloured stingrays (*Himantura randalli/M. arabica/M.bineeshi*).

Himantura randalli, M. arabica and M. bineeshi which are three smooth and plain coloured stingrays found in Pakistan are of commercial, importance as their wings are exported in frozen form to to Thailand and Malaysia. Although as compared to other species of stingrays, the wings of these species fetch comparatively much higher prices and these are exported in substantial quantities (Fig. 37a-b). These species are harvested throughout the year but is dominantly found during summer and early winter months (between May and October). Fig. 20 shows their annual landings in Karachi Fish Harbour which indicates that these species are found throughout the year with peak in summer month. In addition, these species as well as their offal are also used as raw material for fishmeal.

***Maculabatis gerrardi* (Gray, 1851)**

(Fig. 21)

Material Examined

- 1 Specimen collected on 14 January, 2008 from Karachi Fish Harbour (34 cm DW)
- 1 Specimen collected on 29 December, 2008 from Karachi Fish Harbour (38 cm DW)
- 1 Specimen collected on 24 June, 2010 from Karachi Fish Harbour (32 cm DW)
- 1 specimen collected on 11 September 2020 from Karachi Fish Harbour (27 cm DW)

This species is commonly known as sharpnose stingray and called “pittan” in Sindh and “shikki” in Balochistan. This species is reported from Karachi (Niazi, 2001) whereas Ahmad and Niazi (1975), Bianchi (1985), Jalil and Khalil (1981), Hoda (1985 , 1988), Hussain (2003), Khan and Quadri (1986), Misra (1969), Psomadakis *et al.*, (2015) and Qureshi (1972) reported this species from Pakistan without mentioning any specific location. This species was previously included in genera *Dasyatis or Dasyatis (Himantura).*

It is large whipray with a rhombic disc, flat, slightly wider than long, large head (41-45 % DW), snout broad, with an enlarged triangular apical lobe, anterior margin weakly concave, internasal width 6.4-7.7 % DW). Eyes small protruding slightly. Nasal curtain sub-rectangular, posterior margin finely fringed. Mid-shoulder denticles large oval, much larger than smaller denticles adjacent, obvious denticle band in adults. Pectoral fins rounded to somewhat angular. Tail long, whip-like and slender, length 2.4-2.9 times DW, slightly depressed in cross section, tapering gently and evenly towards caudal sting, then weakly beyond sting; usually 1 caudal sting, tail beyond caudal sting sparsely covered with dneticles, without skin folds.

It is large whipray with a rhombic disc, flat, slightly wider than long, large head (41-45 % DW), snout broad, with an enlarged triangular apical lobe, anterior margin weakly concave, internasal width 6.4-7.7 % DW). Eyes small protruding slightly. Nasal curtain sub-rectangular, posterior margin finely fringed. Mid-shoulder denticles large oval, much larger than smaller dentcles adjacent, obvious denticle band in adults. Pectoral fins rounded to somewhat angular. Tail long, whip-like and slender, length 2.4-2.9 times DW, slightly depressed in cross section, tapering gently and evenly towards caudal sting, then weakly beyond sting; usually 1 caudal sting, tail beyond caudal sting sparsely covered with dneticles, without skin folds.

Colour: Dorsal surface dark olive green to paler greenish grey, usually with numerous white spots (may be dark edged), or spots confined to posterior disc, often paler on outer margin of disc; tail with lateral row of white spots forward of caudal sting and banded behind sting in young (faintly banded in adults). Ventral surface white. This species is distributed in the Indo-West Pacific area between Oman to Indonesia and extending north to Taiwan (Eschmeyer, 2020; Froese and Pauly, 2020).

Commercial landings of sharpnose stingray (*Maculabatis gerrardi*)

Sharpnose stingray (*Maculabatis gerrardi*) is among the common stingrays found in Pakistan and are considered to be of commercial importance as its wings are exported in frozen form to to Thailand and Malaysia. Although as compared to other species of stingrays, the wings of this species fetch comparatively lower rates but still, its wings are exported to Thailand and Malaysia. This species is harvested throughout the year but is dominantly found during summer and early winter months (between May and October). Fig. 22 shows its annual landings in Karachi Fish Harbour which indicates that is found throughout the year with peak in summer month. In addition, this species as well as its offal is also used as raw material for fishmeal.

***Maculabatis cf. pastinacoides* (Bleeker 1852)**

(Fig.23)

Material Examined

1 Specimen collected on 14 January, 2008 from Karachi Fish Harbour (34 cm DW)

Commonly known as round whipray, it is medium sized, plain coloured stingray with disc as wide as long, rather broad through trunk, raised slightly on shoulders; pectoral fin apex broadly rounded, Snout rather short, broadly triangular apical lobe short; anterior margin weakly convex. Eyes large, length of orbit and spiracle 2.2-.2.5 in pre-orbital length; interorbital distance 1.7-4.1 times orbit length. Mouth small. 204 oral papillae (medial pair large, lateral 2 small); labial furrows and folds prominent; lower jaw arched slightly. Nasal curtain skirt-shaped; posterior margin finely fringed. Denticle band very broad, well defined, edge sharply demarcated, rounded anteriorly and wider than twice interorbital space over entire disc. Thorns confined to mid-disc, pearl like, anterior most thorn enlarged. Tail narrow-based subcircular in cross-section, tapering gently and evenly towards caudal sting. Pelvic fin triangular.

Colour: Dorsal surface uniform brownish greyish to greenish; tail blackish beyond sting, not banded. Ventral surface entirely white, with narrow dusky margins. Specimens collected from Pakistan have spots (a bit smaller than eye size) on pelvic fin.

This species is known from Indo-Malay Archipelago including Borneo, Java, Sumatra and Myanmar (Eschmeyer, 2020). Its occurrence in Pakistan is great interest because it is not known from other parts of the Indio-Pacific areas. It is reported from Myanmar (Bay of Bengal) by Psomadakis *et al*. (2020), however, not known from Arabian Sea. This species can be distinguished from *Maculabatis bineeshi* in having much less densely packed denticles in the mid disc band. This is a species reported for the first time from Pakistan coast as a single male (34 DW) was collected from Karachi Fish harbor on 11 December 2020. This species is of rare occurrence in Pakistan, therefore, of very little commercial value and thus used as raw material for fish meal.

***Megatrygon microps* (Annandale, 1908)**

(Fig. 24)

Material Examined

- 1 Specimen collected on 10 May 2015 from Karachi Fish Harbour (122 cm DW)
- 1 Specimen collected on 29 November 2016 from offshore Sindh waters (24^{o}24.946'N; 61^{o}38.883É); 77 m (142 cm DW)

It is commonly known as small eye stingray and called "pittan" in Sindh and "shikki" or "uthar"in Balochistan. It is reported from Pakistan by Osmany *et al*. (2015) as *Dasyatis microps*, Hoda (1985, 1988) as *Himantura) microps* and by Qureshi (1952, 1953) as *Dasyatis* (*Himantura) microps.*

Small eye stingray is one of the largest species of stingray found in Pakistan. It is huge, plain- coloured stingray with a thick, very angular rhombic disc, width 1.4-1.5 times its length; apex abruptly angular to narrowly rounded. Snout short, bluntly rounded, tip not extended, anterior margins almost straight. Eyes small, length of orbit and spiracle 3 in snout length in adults; interorbital space variable. Mouth usually with 5 oral papillae, labial furrow shallow, lower jaw almost straight. Skin densely covered with minute, satellite denticles; largest on snout tip and near eyes; tail base and sides covered with slightly larger thorn-like denticles, thorns beyond sting densest, mostly small, Tail short very broad-based and depressed to sting; its length sub-equal to disc width; usually 1 sting, tail becoming filamentous at base of caudal sting, sting positioned well back on tail, ventral fold very low, dorsal fold reduced, keel like. Pelvic fin large, extending well beyond disc, apices angular.

Colour: Brownish or pinkish above with diagonal rows of white spots on each pectoral fin base; tail greyish dorsally, blackish beyond caudal string. Ventral side white; margins of disc and under surface of tail before sting often dusky.

This species is known to be distributed in Indo-Pacific area extending between Mozambique and eastern Australia. This is benthopelagic species that is found on continental shelves. The specimens reported during the present study were collected from outer continental shelf. According to Last *et al*. (2016a), this species may not be a true stingray (Family Daysatidae) which is evident from molecular studies and seemingly more close to round rays (Family Urotryogonidae) and neo-tropical (Potamotrygonidae) which requires further study. This species is of rare occurrence in Pakistan, therefore, of very little commercial value and thus used as raw material for fish meal.

***Neotrygon caeruleopunctata* Last, White & Serét, 2016**

Material Examined

None examined

According to Last *et al.* (2016b) this species, which is commonly known as bluespotted maskray, is known from southern Indonesia but may have extended distribution to east African coast. This large species of the *kuhlii*-complex can distinguished from its congeners by the following set of characters:

Disc is much broader than long, width 1.2-1.3 times length; pectoral apices are abruptly angular; snout fleshy, broadly rounded to obtuse, its length 1.8-2.4 times interorbital width; maximum width is relatively well forward on disc, length from snout tip to pectoral-fin insertion 1.9-2 times and disc width 2.6-2.9 times horizontal distance from snout tip to maximum disc width; dermal denticles are entirely absent from body.

Colour: Blue spots are medium-sized, largest spot on disc 0.5-0.8 times eye width; with 0-3 blue spots on medial belt, mask-like marking dark, not covered with dark peppery spots; ventral surface of disc and pelvic fins are with sharply defined dark greyish brown submarginal bands; dark ventral tail before caudal sting; ventral tail fold is almost entirely dark in young . Although no specimen of this species is available, however, its occurrence in Pakistan cannot be overruled.

***Neotrygon indica* Pavan-Kumar, Kumar, Pitale, Shen and Borsa, 2018**

(Fig. 25)

Material Examined

1 Specimen collected on 21 November 2008 from Karachi Fish Harbour (24 cm DW)
1 specimen collected on 4 August 2013 from Karachi Fish Harbour (34 cm DW)
1 specimen collected on 11 September 2015 from Gwadar Fish Harbour (28 cm DW)
1 specimen collected on 1 November 2020 from Karachi Fish Harbour (37 cm DW)
1 specimen collected on 22 December 2020 from Karachi Fish Harbour (10.7 cm DW)

Indian bluespotted stingray which this species may be commonly called "kutti", "gadumb" or "chitti pittan" in Sindh and "phulano"in Balochistan. This species is previously referred to as *Neotrygon kuhlii*, *Dasyatis (Anpholistius) kuhlii*, as *Ampholistius kuhlii* or *Trygon kuhlii.* This species is recorded from Sindh by **Anonymous** (1955), Misra (1952), Sorely (1932) and from Balochistan by Anonymous (1953, 1955), Misra, (1952) and Qureshi (1952). It is also reported from Pakistan without mentioning any specific location by Ahmad (1988), Ahmad and Niazi (1975), Bianchi (1985), Hoda (1985, 1988), Hussain (2003), Hussain and Arshad (1969), Jalil and Khalil (1981), Khan and Quadri (1986), Misra (1969), Psomadakis *et al.*, (2015), Qureshi (1953, 1957, 1972) and Siddiqi (1956).

Indian blue-spotted muskray were previously assigned to *N. kuhlii* is consisted of multiple cryptic species that are now considered to be a complex of 11 different species including *N. australiae*, *N. bobwardi*, *N. caeruleopunctata*, *N. indica*, *N. malaccensis*, *N. moluccensis*, *N. orientale*, *N. vali*, *N. varidens*, *N. westpapuensis* and undescribed Ryukyu maskray (Borsa *et al*., 2016, 2018; Pavan-Kumar *et al.,* 2018). Most of these species are known from Southeast Asia extending from Malaysia, south China Sea to Japan and to east coast of Australia (Borsa *et al*., 2018) whereas one species, *N. indica*, is known from Bay of Bengal, West coast of India (Laccadives Islands) and Tanzania. The specimens from Bay of Bengal were characterized on dorsal side by a moderately large number

of small ocellated blue spots, a low number of medium-sized ocellated blue spots, the absence of large ocellated blue spots, a high number of dark speckles, a few dark spots, and a conspicuous occipital mark (Pavan-Kumar *et al.*, 2018). According to Pavan-Kumar *et al.* (2018), *N. indica* forms a distinct haplogroup in the tree built from concatenated nucleotide sequences at the CO1 and cytochrome b loci making it distinguishable from all other species of "*N. kuhlii*" group. This species is also reported from Sri Lanka (Fernando *et al.*, 2019). In Pakistan, this species is not landed in substantial quantities but its wings are exported alongwith other smooth coloured stingrays. Its offal and putrefied specimens are used as raw material for fishmeal.

Specimens described by Pavan-Kumar *et al.* (2018) were characterized by a moderately large number of small ocellated blue spots (n = 15–57), a generally low number of medium-sized ocellated blue spots (n = 0–34), a total absence of large ocellated blue spots, a high number of dark speckles (n = 23–176), generally a few dark spots (n = 0–11), and a conspicuous occipital mark. The specimens collected from Pakistan also have almost same pattern of spot making it different from other species of *Neotrygon* and it certainly belong to *N. indica*, although there is some minor difference in pattern of spot on dorsal side. Further investigation from other parts of the Arabian Sea and Western Indian Ocean is required to ascertain distribution of *N. indica*.

***Pastinachus ater* (Macleay, 1883)**

(Fig. 26)

Material Examined

- 1 Specimen collected on 12 March 2013 from Karachi Fish Harbour (143 cm DW)
- 1 Specimen collected on 28 June 2015 from Karachi Fish Harbour (89 cm DW)
- 1 Specimen collected on 19 July 2018 from Karachi Fish Harbour (114 cm DW)
- 1 Specimen collected on 23 December 2020 from Karachi Fish Harbour (93 cm DW)

It is commonly known as broad cowtail stingray and called "gadum pittan", "shaukoo" in Sindh and "pittan-dumb", "uthar", "gore-dumb" or "shikki" in Balochistan. According to Last *et al.* (2016a), it is a medium sized stingray with a very broad rhombic disc, starry based denticles forming wide band on central disc, long thornless tail with well-developed ventral tail fold and terminal filament. Anterior margins of disc almost straight, apices angular. Snout short obtuse, with minute lobe at tip. Pelvic fins large, tip narrowly rounded. It has 4 small thorns on shoulder, often barely larger than surrounding denticles. Tail about twice DW or less.

In most the specimens collected from Pakistan there are at least 3 or 4 shoulder thorn whereas in *P. sephen* there are only 2. In addition tail is less than DW is in *P.sephen* and equal in *P. ater*. In specimens collected from Pakistan tails in almost all cases are less than DW (for example in one specimen DW was 25 cm whereas tail was 30cm; in another DW was measured to be 38 cm and was 40 cm). This is considered to be one of the most feared stingray amongst fishermen because of its large caudal spine and aggressive nature when entangled in fishing nets.

It seems difficult to ascertain whether previous records from Pakistan belong *P. ater* or *P. sephen*. However, in the absence of any museum material or other evidence, these are placed in *P. sephen.*

***Pastinachus sephen* (Forsskål, 1775)**

(Fig. 27)

Material Examined

- 1 Specimen (juvenile) collected on 2 May 2013 from Karachi Fish Harbour (25 cm DW)
- 1 Specimen collected on 6 May 2013 from Karachi Fish Harbour (38 cm DW)
- 1 Specimen collected on 21 December 2015 from Sindh coast ($23^{o}30.200$'N; $66^{o}41.100$E), 121m (86 cm DW)
- 1 Specimen collected on 12 April 2020 from Karachi Fish Harbour (78 cm DW)
- 1 Specimen collected on 24 December 2020 from Karachi Fish Harbour (78 cm DW)

It is commonly known as cowtail stingray and called "gadum pittan", "shaukoo" in Sindh and "pittan-dumb", "uthar", "gore-dumb" or "shikki" in Balochistan. This species is known from Red Sea, northern Indian Ocean: Gulf of Aden, Gulf of Oman and Persian Gulf east to India and Pakistan (Eschmeyer, 2020; Last et al., 2016a).

Specimens of this species collected from Pakistan shows that there are only 2 shoulder thorn in *P. sephen* (at least 3 or 4 in *P. ater*) there are. In addition tail is more than DW in *P.sephen* and equal in *P. ater*. In the specimens of this species collected from Pakistan, the tail is more than DW (for example in one specimen DW was 63 cm whereas tail was 100 cm).

This species is reported from Sindh as Anonymous (1955), Misra (1952), Punwani, (1934), Qureshi (1952) and Sorley (1932). From Balochistan, it is reported by Anonymous (1953, 1955), Misra (1952), Qureshi (1957) and Zugmayer (1913). It is also reported from Pakistan without mentioning any specific location by Ahmad (1988), Ahmad and Niazi (1975), Bianchi (1985), Datta-Munshi and Srivastava (1988), Hoda (1985, 1988), Hussain (2003), Hussain and Arshad (1969), Jalil and Khalil (1972, 1981), Khan and Quadri (1986), ~~and~~ Psomadakis *et al.*, (2015) and Qureshi (1953, 1972). This species was previously included in gen~~e~~ra ~~by~~ *Trygon*, *Daysatis* (*Dasyatis*), *Dasyatis* (*Pastinachus*) and *Hypolophus.* ~~This~~ It is considered to be one of the most feared stingray amongst fishermen because of its large caudal spine and aggressive nature when entangled in fishing nets. Fatima (2018) reported its size (DW) to be between 28 and 55 cm from Karachi Fish Harbour.

Commercial landings of brown stingrays (*Pastinachus sephen* and *P. ater*).

Pastinachus sephen and *P. ater* are among the common stingrays found in Pakistan and are considered to be of commercial, importance as their wings are exported in frozen form to Thailand and Malaysia (Fig. 38 a-b). The wings of these species fetch comparatively lower rates but still, these are exported in substantial quantities. These species are harvested throughout the year but is dominantly found during summer and early winter months (between May and October). Fig. 28 shows their annual landings in Karachi Fish Harbour which indicates that these species are found throughout the year with peak in summer month. In addition, these species as well as their offal are also used as raw material for fishmeal.

***Pateobatis bleekeri* (Blyth, 1860)**

(Fig. 29)

Material Examined

- 1 Specimen collected on 21 December 2020 from Karachi Fish Harbour (40 cm DW)

It is commonly known as Bleeker's whipray and called "pittan" in Sindh and Balochistan. It is reported from Sindh by Ahmad *et al* (1973), Anonymous (2001, 1955), Misra (1952), Niazi (2001) and Sorley (1932). It is reported from Balochistan, by Ahmad *et al.* (1973), Anonymous (1953, 1955), Misra (1952) and Qureshi (1952, 1957). It is also reported from Pakistan without mentioning any specific location by Ahmad (1988), Ahmad and Niazi (1975), Bianchi (1985), Froese and Pauly (2020), Hoda (1985, 1988), Hussain (2003), Hussain and Arshad (1969), Jalil and Khalil (1972, 1981), Khan and Quadri (1986), Misra (1969), Psomadakis *et al.*, (2015), Qureshi (1953, 1972), Siddiqi (1956) and Talwar and Jhingran (1991). This species was previously included in genera by *Trygon* and *Daayatis (Himantura) bleekeri*.

It is a large plain coloured whipray having a subcircular disc, length 1-1.1 times the width, no thickened through trunk; pectoral fin apex broadly rounded. Snout long and pointed, length of orbit and spiracle 3.2-4 in snout length, apical lobe broadly triangular, anterior margin s weakly to moderately concave. Eyes small, interorbital distance 2.5-2.9 times orbit length. Mouth arched, 2 oral papillae; labial furrow and folds prominent. Nasal curtain skirt-shaped, posterior margin fringed. Very broad denticle band which is flask shaped in adults, its edge rounded anteriorly then tapering to tail, rest of disc smooth. Usually one pearl like thorn on mid disc which is greatly enlarged and prominent in young; a few additional slightly enlarged thorns and denticles before and after pearl thorn. Tail whip-like, narrow-based, subcircular in cross-section, slender tapering evenly towards caudal sting, tapering weakly beyond sting becoming whip-like, without skin folds and tail not banded. Pelvic fin tips narrowly rounded.

Colour: Dorsal disc uniformly brownish; tail brownish, darker dorsally than ventrally. Ventral surface white with dark margin in young becoming almost entirely dark, with occasional whitish patches in adults.

This species is distributed in northern Indian Ocean (Pakistan to Myanmar). Although this species is not of rare occurrence in Pakistan but there is no definite seasonal pattern noted. Fatima (2018) reported its size (DW) to be between 26 and 56 cm. This species is not landed in substantial quantities, therefore, it is of very little commercial value. Sometimes its wings are exported in frozen form but is mainly used as raw material for fish meal.

***Pateobatis fai* (Jordan & Seale, 1906)**
(Fig. 30)

Material Examined

- 1 Specimen collected on 14 March 1986 from Karachi Fish Harbour (19.5 cm DW)

Pink whipray is known to have a widespread distribution in the Indo-West Pacific area extending from South Africa to the central Pacific Islands, north to Japan (Okinawa). Reported from off Andaman and Nicobar Islands (Bay of Bengal) by Bineesh *et al*. (2020). This species is frequently confused with *Pateobatis jenkinsii.* According to IUCN Red List this species is vulnerable (VU) (A2bd). It is not previously reported from Pakistan, however, Last et al., (2016a) did show its distribution extending into Arabian Sea along coast of Pakistan.

P. fai is a large sized ray, and is characterized by a broad rhombic disc, width 1.1-1.2 times length; pectoral fin apex narrowly rounded. Snout rather short, extremely broad, with enlarged triangular apical lobe, anterior margins weakly convex. Eyes small protruding slightly, length of orbit and spiracle 1.9-2.3 times in snout length; interorbital space 1.8-2.2 times orbit length. Mouth small, 4 oral papillae (medial pair enlarge, lateral 2 minute); labial furrows and folds prominent; lower jaw arched slightly. Nasal curtain skirt-shaped, subrectangular, posterior margin finely fringed. Mid-shoulder denticles sparse, in loosely defined band. Tail narrow, subcircular in cross-section, tapering gently and evenly towards caudal sting, then weakly beyond sting, becoming whip-like; length 2.2-2.6 times DW; usually 1 caudal sting , tail beyond caudal sting sparsely covered with denticles.

Colour: Dorsal surface pale pinkish brown to greyish with dark dendritic markings on disc margin; small white patch anterior to orbits and spiracles; tail black behind sting. Ventral surface white with broad dark margin behind mouth level.

From *Pateobatis jenkinsii*, this species can be distinguished as it lacks the distinctive row of enlarged thorns along the mid-disc and tail is narrow, subcircular in cross-section, tapering gently and evenly towards caudal sting, then weakly beyond sting becoming whip-like, usually 1 caudal sting, tail beyond caudal sting sparsely covered with denticles.

***Pateobatis jenkinsii* (Annandale, 1909)**
(Fig. 31)

Material Examined

- 1 Specimen collected on 30 June 2016 from Karachi Fish Harbour (58 cm DW)
- 1 Specimen collected on 11 November 2019 from Karachi Fish Harbour (87 cm DW)
- 1 Specimen collected on 17 December 2020 from Karachi Fish Harbour (49 cm DW)

Jenkins whipray is reported from Pakistan by Qureshi (1953) as *Dasyatid (Himantura) jenkinsii.* Last *et al*. (2016a) showed its distribution extending into Arabian Sea along coast of Pakistan. This is large whipray with a broad rhombic disc with robust trunk, width 1.1 times length; pectoral fin apex narrowly rounded. Snout moderately broad, obtuse, rather short; apical lobe small and triangular, anterior margin straight. Eyes small, protruding slightly, length of optic and spiracle 2-2.2 in snout length; inter-orbital space 1.3-2.4 times in orbit length. Mouth small to moderately wide, 2-4 oral papillae; labial furrow and fold s prominent; lower jaw arched slightly. Nasal curtain skirt-shaped, expanded posteriorly, posterior margin finely fringed. Mid-shoulder denticles dense, in well-defined narrow band; band usually constricted over gill arches. Thorn prominent, wedge-shaped, much taller than surrounding denticles. Tail narrow based, subcircular in cross-section; tapering gently and evenly towards caudal sting, then weakly beyond sting, becoming whip-like; not elongate, length 1.1-1.4 times DW; usually 1 caudal sting but large, adult with up to 3 caudal stings.

Colour: Dorsal surface yellowish-brown; tail blackish beyond sting; ventral surface white.

It is known from Indo-Pacific area from South Africa to New Guinea; north to the Philippines. This species resembles with Pink whipray but differs in having a row of well-developed thorn extending along the mid-disc and tail,

***Pteroplatytrygon violacea* (Bonaparte, 1832)**

(Fig, 32)

Material Examined

- 1 Specimen collected on 9 April 2013 from offshore waters of Balochistan (24°11.697'N; 64°14.475'E), 2363 m (46 cm DW)
- 1 Specimen collected on 25 April 2013 from Karachi Fish Harbour (50 cm DW)
- 1 Specimen collected on 27 February 2014 from Karachi Fish Harbour (60 cm DW)
- 1 Specimen collected on 28 February 2014 from Karachi Fish Harbour (30 cm DW)
- 1 Specimen collected on 22 October, 2016 from offshore waters of Sindh (23°20.652'N; 66°26.548'E), 534 m (54 cm DW)
- 1 Specimen collected on 21 January 2019 from offshore waters of Balochistan (24°32.547'N; 62°5.2505E), 1737 m (49 cm DW)
- 1 Specimen collected on 17 December 2020 from Karachi Fish Harbour (45 cm DW)

This species is previously reported from Pakistan by Anonymous (2013) and Psomadakis *et al.* (2015). It is medium sized stingray with a flattened, cone-shaped, broad disc, anterior margin entirely rounded trunk very thick; pectoral fin apex and rear tip angular. Snout very short and obtuse, very small apical lobe at tip. Eyes very small interorbital space very broad. Mouth small with numerous short bifurcated oral papillae; labial furrows and folds prominent; lower jaw weakly convex. Nasal curtain skirt-shaped, short, very broad, fringed weak, nostrils short circular. Thorns small, in single row from nape to sting. Tail broad-based, slightly depressed anteriorly, tapering strongly, becoming whip-like beyond caudal sting; 1-2 caudal stings; ventral cutaneous fold low, elongate extending onto posterior half of tail beyond sting; dorsal fold rudimentary or absent. Pelvic fin rounded, usually barely extended beyond disc.

Colour: Upper surface, tail folds and whip-like portion of tail uniformly black, violet, purple, or dark blue-green. Ventral surface of disc and tail dark-brownish or black. Cloaca, thorns and stings mostly pale.

This is cosmopolitan in tropical and subtropical oceans. Pelagic stingray is found in offshore waters of Pakistan and occasionally caught in the tuna gillnet operations. They are not landed in substantial quantities, therefore, they are of very little commercial value and mainly as raw material for fish meal.

***Taeniura lymma* (Forsskål, 1775)**

Material Examined

Not examined

Ribbon tail stingray is a colorful stingray with large bright blue spots on an oval, elongated disc and with blue side-stripes along the tail; snout rounded and angular, disc with broadly rounded outer corners, and tail stout, tapering and less than twice body length when intact, with a broad lower caudal fin-fold reaching the tail tip; disc with no large thorns but with small, flat denticles along mid-back (in adults); usually 1 medium-sized sting on tail further behind base than in most stingrays. Its colour is grey-brown to yellow, olive-green or reddish brown dorsally, white ventrally.

It is widely distributed in Indo-West Pacific are including Persian Gulf, Red Sea and East Africa to the Solomon Islands, north to southern Japan, south to northern Australia. It is reported from Pakistan by Ahmad and Niazi (1975), Bianchi (1985), Hoda (1985, 1988), Froese and Pauly (2020), Hussain (2003), Jalil and Khalil (1972, 1982), Khan and Quadri (1986), Last and Stevens (1994), Psomadakis *et al.* (2015) and Qureshi (1953, 1972). There have been reports of SCUBA diver encountering this species at Churna Island, however, authors have not seen them in the landing center or their presence was confirmed from dive-sites.

***Taeniurops meyeni* (Müller & Henle, 1841)**

{Fig. 33)

Material Examined

- 1 Specimen collected on 17 November 2008 from Karachi Fish Harbour (104 cm DW)
- 1 Specimen collected on 19 October 2010 from Karachi Fish Harbour (80 cm DW)
- 1 Specimen collected on 1 June, 2012 from Karachi Fish Harbour (86 cm DW)
- 1 Specimen collected on 26 January 2014 from Karachi Fish Harbour (50 cm DW)
- 1 Specimen collected on 31 January 2014 from Karachi Fish Harbour (180 cm DW)
- 1 Specimen collected on 17 March 2014 from Karachi Fish Harbour (97 cm DW)
- 1 Specimen collected on 9 April 2014 from Karachi Fish Harbour (52 cm DW)

It is commonly known as round ribbontail ray and called 'limpi garamari" in Balochistan. It is widely distributed in the Indo-West Pacific area extending from Persian Gulf, Red Sea and East Africa to southern Japan, Micronesia, tropical Australia and Lord Howe Island. Eastern Pacific It is reported from Pasni, Balochistan by Qureshi (1972). It is also reported from Pakistan by **Bianchi** (1985), Hussain (2003) and Psomadakis *et al.*, (2015) without mentioning any specific location. It is reported as *Taeniura melanospila* Bleeker 1853 from Pakistan coast which is a junior synonym based on the description of a juvenile specimen.

A very large stingray with a sub-circular disc (slightly wider than long), trunk massive. Snout short, very obtuse, tip not pointed. Eyes small, length of orbit and spiracle about half snout length, interorbital space broad, more than twice orbit length. Mouth broad, 7 short oral papillae, labial furrow and folds weak, lower jaw convex. Nasal curtain skirt-shaped, short, very broad, fringe short; nostril large, oval. Thornlets short, clustered in narrow bonds along mid-body and in 2 small patches on each shoulder. Disc surface of adults granular, covered with short star-shaped denticles. Tail slightly exceed DW, very broad based, depressed anteriorly, tapering strongly to sting, compressed beyond sting, usually 1 sting; ventral fold very well developed, several times deeper than tail; dorsal fold absent. Pelvic fin barely extend beyond disc.

Colour: Dorsal surface usually mottled with black and white, sometime uniformly brownish or black; skinfold and tail beyond sting uniformly black. Ventral surface of disc pale; disc margin and undersurface of tail grayish brown to black.

This species is widely distributed in the Indo-West Pacific area extending from Persian Gulf, Red Sea and East Africa to southern Japan, Micronesia, tropical Australia and Lord Howe Island. It is also known from Eastern Pacific (Cocos and the Galapagos) and may the Central America mainland. This species not landed in substantial quantities, therefore, they are of very little commercial value and mainly used as raw material for fish meal.

Telatrygon crozieri (Blyth, 1860)

(Fig. 34)

Material Examined

1 Specimen collected in 11 December, 1976 from Karachi Fish Harbour (15 cm DW)

It is commonly known as Indian sharpnose stingray and called "kutti pittan"in Sindh and "uthar" "chombo" or "Shikki" in Balochistan. This species is known to be distributed in Northern Indian Ocean: India east to Myanmar (Last *et al*., 2016a; Psomadakis *et al.*, 2020). *Telatrygon zugei* (Muller and Henle, 1841) which was reported by a number of workers from Pakistan is considered to be distributed in the North West Pacific including from Vietnam to Japan and possibly in the Philippines and Thailand.

This species is a medium-sized and pale coloured species with a weakly rhombic disc with long pointed snout and deeply concave anterior margins. Tail narrow based, depressed slightly, tapering then becoming filamentous beyond caudal sting; length 1.7-2.2 times in disc width (1.4-1.5 times in disc width in *T. zugei*). Eyes small; not protruding; length of orbit and spiracle 3.3-3.7 times in snout length (3.1-3.6 times in snout length in *T. zugei*); interorbital 2.4-3.5 times orbit length (1.9 to 2.4 times orbit length in *T. zugei*). Pelvic fin very small (small in *T. zugei*), narrowly triangular. *T. crozieri* mainly differs from *T. zugei* in having a large snout and tail and smaller eyes and pelvic fins.

This species is reported from Sindh by Anonymous (1955, 2001), Niazi (2001) and Sorley (1932 as *Trygon zugei*) and from Balochistan coast by Anonymous (1955) and Qureshi (1952, 1957). It is reported from Pakistan coast without specifying any location by Ahmad (1988), Ahmad and Niazi (1975), Bianchi (1985), Froese and Pauly (2020), Hoda (1988), Hussain (2003), Hussain and Arshad (1969), Jalil and Khalil (1972, 1981), Khan and Quadri (1986), Misra (1969), Qureshi (1953, 1972) and Siddiqi (1956). It was mainly reported from Pakistan as *Dasyatid (Anpholistius) zugei or Ampholistius zugei*

It is known to be distributed in India east to Myanmar and now to Pakistan. This used to be occasionally observed in Karachi Fish Harbour and other landing centers along Pakistan coast during 1970s and 1980s but have not been seen in last 30 years indicating that it is extremely rare or may be locally extinct.

***Urogymnus asperrimus* (Bloch & Schneider, 1801)**

Material Examined

No Specimen examined

It is commonly known as porcupine whipray and called "kuntic pittan" in Sindh and Balochistan. It is reported from Sindh by Anonymous (1955) and from Balochistan as Anonymous (1955) and Qureshi (1952, 1957). It is also reported from Pakistan without mentioning any specific location by Ahmad and Niazi (1975), Anonymous (1955), Bianchi (1985), Hoda (1985, 1988), Hussain (2003), Jalil and Khalil (1972, 1981), Khan and Quadri (1986), Misra (1969) and Psomadakis *et al.*, (2015), Qureshi (1953, 1972). Most of these records referred this species as *Urogymnus africana*.

It is small to medium-sized plain-coloured stingray with sub-circular disc and long pointed snout and deeply concave anterior margins, no oral papillae with extremely rough and prickly dorsal surface. Tail slender, almost equal to disc length and cylindrical in cross section and tapering to the end of the tail, makes this species very distinct from all other stingrays (Bineesh *et al.*, 2020; Last *et al*., 2016a).

This heavily armored stingray which lacks a venomous barb, is known from Indo-Pacific area extending from Red Sea and coast of East Africa to the Marshall Islands and Fiji, south to northern Australia. It is also known from eastern Atlantic including Senegal, Guinea, and Côte d'Ivoire. According to IUCN Red List, this species is Vulnerable (VU). This used to be occasionally observed in Karachi Fish Harbour and other landing centers along Pakistan coast during 1970s and 1980s but have not been seen in last 40 years indicating that it is extremely rare or may be locally extinct.

***Urogymnus granulatus* (Macleay, 1883)**

Material Examined

No Specimen examined

It is commonly known as mangrove whipray and reported from Pakistan coast by Jabado *et al*. (2018). It is a coastal whipray species that occurs throughout the northwest Indian Ocean from the Red Sea to India and the Maldives, including the Gulf and Sea of Oman. The species inhabits mangroves, estuaries, coral reefs, sand flats, and broken rocky-sandy substrate. It is assessed as Vulnerable A2cd according to IUCN Red List.

This species is a large whipray with an oval disc, distinctively longer than wide, very thick through trunk; pectoral fin apex broadly rounded. Snout short, with a weak apical lobe, anterior margin convex to straight. Eyes small, protruding, length of orbit and spiracle 1.5-2 in sound length, inter-orbital space 1.3 to 2.8 times orbit length. Mouth small, 2-7 papillae, labial furrow and folds prominent, lower jaw arched slightly. Nasal curtain small, with posterior margin finely fringed. Mid shoulder denticles small, no enlarged thorns or thornlets on body; well-developed denticle band with sparse denticles; no denticles on undersurface or side of tail. Tail broad based, subcircular in cross-section, tapering gently and evenly towards caudal sting, then weakly beyond sting, becoming whip-like with 1-2 caudal stings.

Colour: Dorsal surface grayish or yellowish brown, covered with small white flecks and often with dark mucus; tail white behind sting. Ventral surface white in young, with dense black blotches in adults; broad dusky or black margin around most of the disc and outer edge of pelvic fin.

COMMERCIAL UTILIZATION OF STINGRAYS

Stingrays are commercially important group of fishes, because it is not only used as raw material for fishmeal plants but their wings are also exported in frozen form to Thailand and Malaysia. Stingrays are landed at almost all major landing centers (Fig. 35) and transported to fish meal plants located mainly in Ibrahim Hayderi, Karachi where they are sundried being operated by middlemen or the plant operators. In addition, offal of stingrays from seafood processing plants are also pass through same channels. Dried or semidried stingrays are steamed or boiled in fishmeal plants, again sundried and pulverized to form fishmeal which is mainly used in poultry industry of the country. In addition, offal of stingrays from seafood freezing plants are also used as raw material for production of fishmeal, through same procedure.

Stingrays are also important raw material which is being processed in seafood freezing plants. At least 35 seafood processing plants located in Karachi, Gwadar, Pasni, Ormara and Jiwani which are involved in stingray processing. Chilled (treated with ice) or fresh (not treated with ice) stingrays are landed at major fish harbor and jetties where it is procured by Seafood processing plants through a series of middlemen. Stingrays are butchered in processing plants and wings are carefully removed, washed, graded and packed in polyethylene bags before freezing them in blast tunnels. Frozen wings are packaged and labelled before keeping in freezers till exported to Thailand and Malaysia, It is estimated that annually about 400-500 m. tons of wings are exported from Pakistan to these countries. In 2020, the quantities of export reduced to about 250 m. tons due to reduced demand in importing countries because of COVID-19.

Observations recorded at Karachi Fish harbor during the present study reveals that stingrays are landed throughout the year with maximum landings during May and August with peak during June when landings of about 193,000 kg was reported (Fig. 36). Minimum landings of stingrays at Karachi Fish Harbour was recorded during the month of December when only 38,000 kg of stingrays were landed. A major part of these stingrays are utilized in the processing of the wing. It may be mentioned that the data of landings of fresh and chilled is collected from Karachi Fish Harbour and those used as raw material for fishmeal is not included in the study. The wings are categorized in three types: white or smooth; brown and spotted.

White or Smooth coloured stingrays: Locally known as "papri" in Sindhi and "Garri" in Balochi, this group is considered the most important being processed for wings. Three species of stingrays (*Himantura randalli*, *M. arabica* and *M. bineeshi*) are main contributor to this category of stingrays (Fig. 37a-b). The wings of this group fetches higher prices in the export market and is the most dominating group in the wing trade. Wings of some other species such as scaly whipray (*Brevitrygon walga*), Bengal whipray (*B. imbricata*), sharpnose stingray (*M. gerrardi*), Indian blue spotted stingray (*Neotrygon indica*) and Bleeker's whipray (*Pateobatis bleekeri***)** are also mixed with white of smooth coloured stingrays, although they fetch comparatively lower prices.

Brown coloured stingrays: Wings of two species *Pastinachus sephen* and *P. ater* locally known as gadum or ghoordheem re-included in brown coloured stingrays. These wings are comparatively bulkier but fetch comparatively lower prices as compared to white or smooth coloured stingrays.

Spotted/ocellated/reticulated stingrays: The wings of three species of stingrays that have reticulations or spots on the dorsal surface (Fig. 37c) including *Himantura leoparda*, *H. uarnak* and *H. tutul* are also exported to Malaysia and Thailand. These stingrays fetch lowest prices as compared to other categories of stingrays. Because of the large size of the species usually wings are trimmed to make them square or rectangular shaped having a weight of about 1 to 1.5 kg (Fig. 38c).

Although export was started about 10 years back but since landings of stingrays were stable since then. However, because of throat-cutting competition, the prices of stingrays are increasing in local market. In addition to frozen product, skins of some stingrays were also exported in dried form, however, this is not a regular trade. This trade is now not viable because of high prices of raw material because of export of frozen wing trade.

CONSERVATION OF STINGRAYS

According to Dulvy and Reynolds (1997) and Ribeiro *et al.* (2006) stingrays, like other elasmobranch, exhibit ovoviparity (aplacental viviparity), with embryos feeding initially on yolk, then receiving additional nourishment from the mother by indirect absorption of uterine fluid enriched with mucus, fat or protein through specialized

structures. Mating is followed immediately by ovulation and fertilization with no evidence for female sperm storage. Gestation may include embryonic diapause, a temporary period of suspended or arrested embryonic development (Wyffels, 2009; Waltrick, et *al.,* 2012).

Fecundity in stingrays ranges from 1 for *Megatrygon microps* (Nair and Soundararajan, 1976; Pierce *et al.* 2008) to 13 for Pteroplatytrygon *violacea* (Wilson and Beckett 1970). Size of dasyatid stingrays ranges from 30 cm (as in *Telatrygon zugei*) to more than 2 m in *Bathytoshia centroura* (Last et *al*. (2016a). Because of the low fecundity and slow growth as well as excessive fishing pressure some of the species of stingrays, if not all, are facing serious threat of depletion of their stocks.

Elasmobranchs typically exhibit life-history characteristics that include relatively slow growth, late ages of maturity, low birth rates, long gestation periods and decreased natural mortality rates over their relatively long life spans (Stevens *et al*. 2000). These life-history strategies render the group especially vulnerable to fisheries exploitation. Most of the species of stingrays have relatively long-lived, slow growing species (Smith *et al*., 2007), however, some species have life history traits that make them more productive and resistant to fisheries such as Panamic stingray, (*Urotrygon aspidura*) and round stingray (*Urotrygon rogersi*) which are small-sized species with a short life and fast growth (Mejía-Falla *et al*., 2014; Torres-Palacios *et al.*, 2019). However, most stingrays have low fecundity, therefore, adequate conservation measures are immediately required, else their resources may decline.

Major reduction in landings of stingrays has been notice in past 5 decades in Pakistan (Fig. 2) which may be attributed to change in fishing pattern and because of overfishing through increased fishing effort. The fleet engaged in demersal fishing is increasing resulting in excessive pressure on the stingrays stocks. Although mainly caught by the target fixed bottom-set gillnetting and long lining but substantial contribution is made as by catch of demersal fisheries resulting in the increase of fishing pressure on stocks of stingrays. The demand for stingrays is increasing in Pakistan because these are used as an important raw material for export of frozen wings but despite increase in efforts, the landings of stingrays is stable during past 15 years.

Table 2. Conservation status of stingrays occurring in Pakistan.

No.	Species	IUCN Red List Status	Date assessed
1	*Maculabatis arabica*	Critically Endangered (CR)	08 February 2017
2	*Maculabatis pastinacoides*	Vulnerable (VU)	12 September 2004
3	*Himantura leoparda*	Vulnerable (VU)	20 February 2015
4	*Himantura uarnak*	Vulnerable (VU)	20 February 2015
5	*Himantura undulata*	Vulnerable (VU)	12 December 2011
6	*Pateobatis fai*	Vulnerable (VU)	22 February 2015
7	*Pateobatis jenkinsii*	Vulnerable (VU)	12 May 2015
8	*Urogymnus asperrimus*	Vulnerable (VU)	20 February 2015
9	*Urogymnus granulatus*	Vulnerable (VU)	20 May 2015
10	*Maculabatis gerrardi*	Vulnerable (VU)	08 September 2004
11	*Taeniurops meyeni*	Vulnerable (VU)	14 May 2015
12	*Taeniura lymma*	Near Threatened (NT)	01 October 2005
13	*Brevitrygon walga*	Near Threatened (NT)	09 February 2017
14	*Pastinachus sephen*	Near Threatened (NT)	07 February 2017
15	*Brevitrygon imbricata*	Data deficient (DD)	08 September 2004
16	*Megatrygon microps*	Data deficient (DD)	15 May 2015
17	*Bathytoshia lata*	Least Concern (LC)	10 July 2007
18	*Pastinachus ater*	Least Concern (LC)	19 February 2015
19	*Pteroplatytrygon violacea*	Least Concern (LC)	16 February 2007
20	*Hemitrygon bennettii*	Not Evaluated	
21	*Himantura tutul*	Not Evaluated	
22	*Himantura randalli*	Not Evaluated	
23	*Maculabatis bineeshi*	Not Evaluated	
24	*Neotrygon caeruleopunctata*	Not Evaluated	
25	*Neotrygon indica*	Not Evaluated	
26	*Pateobatis bleekeri*	Not Evaluated	
27	*Telatrygon crozieri*	Not Evaluated	

Jabado *et al.* (2018) reported 20 species of stingrays occurring in Pakistan (Table 2). Of which two species *Maculabatis bineeshi* and *M. arabica* were reported to be critically endangered (CR), two species, Pateobatis ***bleekeri*** and *Maculabatis gerrardi* to be endangered (EN) and four species, *Himantura leopard, H. uarnak, Megatrygon microps, Urogymnus asperrimus* and *U. granulatus* to be vulnerable (VU).

According to IUCN Red List, there is one species Pakistan whipray (*Maculabatis arabica*) which is rated as Critically Endangered (CR) (Dulvy, *et al.* 2017; Jabado *et al*., 2018). This species was described by Manjaji-Matsumoto and Last, (2016) based on holotype collected from 3-4 km west of Turshian Creek, Sindh, Pakistan, Arabian Sea, This species now known from Pakistan, West Coast of India and Sri Lanka (Eschmeyer, 2020). Present study reveals that this species is of rare occurrence in Pakistan, however, it is frequently caught in commercial quantities. It wide distribution between Pakistan, West coast of India and Sri Lanka and present data suggest reevaluation of the status of this species, as species may not be Critically Endangered (CR). However, till any reevaluation is done, its status may be kept at Critically Endangered (CR).

According to Jabado *et al.* (2018), the status of short-tail whipray **(***Maculabatis bineeshi*) is Critically Endangered. According to Froese and Pauly (2020) the Red List status of this species is not evaluated. This species was also described by Manjaji-Matsumoto and Last, (2016), based on holotype collected from 6-8 km south of Hajambro Creek, Sind, Pakistan, Arabian Sea. This species now known from Pakistan, India and Bay of Bengal (Froese and Pauly, 2020). Present study reveals that this species is of occasional occurrence in Pakistan and frequently caught in commercial quantities. It wide distribution between Pakistan India including Bay of Bengal and present data suggest that it status may be evaluated. However, till any such evaluation is done, its status may be kept at Critically Endangered (CR) as mentioned by Jabado *et al.* (2018).

IUCN Red List considers round whipray (*Maculabatis pastinacoides*), honeycomb stingray (*Himantura leopard*), honeycomb or coach whipray (*Himantura uarnak*), pink whipray (*Pateobatis fai*), Jenkin's whipray (*Pateobatis jenkinsii*), Porcupine whipray (*Urogymnus asperrimus),* mangrove whipray (*Urogymnus granulatus*), sharpnose stingray (*Maculabatis gerrardi*) and round ribbon tail ray (*Taeniurops meyeni)* as Vulnerable (VU) (Froese and Pauly, 2020). Of these *M. pastinacoides* is known through only one specimen from Pakistan whereas during present study no specimen of *U. asperrimus* were examined and their presence is Pakistan is known trough published literature. In contrast *H. leoparda, H. uarnak, M. gerrardi* and *T. meyeni* are commonly seen in the landing centers. These are being used as raw material for export or fishmeal. Most these species grows to larger size and thus comparatively more prone to fishing and thus may be rightly placed in the Vulnerable (VU) category under IUCN Red List. Small spot whipray *H. tutul* was described by Borsa *et al*. (2013) and now considered to be a valid species (Kumar *et al*., 2020). This species can attain large size reaching up to 100 cm DW, found almost in same habitat and has similar biological features as that of honeycomb stingray (*H. leoparda*), honeycomb or coach whipray (*H. uarnak*) or leopard whipray (*H. undulata*), therefore, it may also be a vulnerable species. Therefore, there is a need to assess this species for Red Listing.

According to IUCN Red List, three species namely ribbon tail stingray (*Taeniura lymma*), scaly whipray (*Brevitrygon walga*) and cow tail stingray (*Pastinachus sephen*) are considered as Near Threatened (NT) (Froese and Pauly, 2020). Present study reveals that *T. lymma* is extremely rare and even a specimen was not available for examination during present study. This evaluation of this species may, therefore, correct to be Near Threatened, at least in Pakistan. However, cow tail stingray (*Pastinachus sephen*) and scaly whipray (*Brevitrygon walga*) are found in commercial quantities and commonly seen in the landing centers. There is need for reevaluation of the status of and *Pastinachus sephen* at least in the Northern Arabian Sea. Bengal whipray (*Brevitrygon imbricata*) is reported to be of common occurrence in Pakistan whereas small eye stingray (*Megatrygon microps*) are caught occasionally along Pakistan coast. These two species are considered as Data Deficient (DD) according to IUCN Red List (Froese and Pauly, 2020) whereas three species brown stingray (*Bathytoshia lata*), broad cow tail stingray (*Pastinachus ater*) and pelagic stingray (*Pteroplatytrygon violacea*) are considered to be Least Concern (LC). There are 8 species of stingrays occurring in Pakistan are not evaluated for IUCN Red List (Table 2).

Although a number of elasmobranch species are included in the list of species whose international trade is regulated by international instruments including various appendices CITES (Convention on International Trade in Endangered Species) or included in appendices of CMS (Convention on Conservation of Migratory Species). However, none of the stingrays (Family Dasyatidae) are included either in CITES or CMS appendices, as such there is no control on international trade of stingrays and parts thereof (wings, fins, skin or meat). In Pakistan, legislations

have been enacted under maritime provincial government laws banning the catching, landings and export of shark and guitarfish species included in various appendices of CITES, however, these legislations does not include any stingray species (Moazzam and Osmany, 2020).

Although landings of stingrays are stable during last 15 years but demand for raw material for frozen wings is increasing resulting in escalation in fishing pressure on its stocks. In addition to overall reduction in the landings of the stingrays, noticeable reduction in catches of some of the species such as Indian sharpnose stingray (*Telatrygon crozieri*) and porcupine whipray (*Urogymnus asperrimus*) which used to of occasional occurrence but have not been seen in landing centers for past two decades. There may be other species whose numbers are decreasing substantially but because of lack of a proper data collection system and monitoring of the catch in Pakistan, their status are not well understood. There are 12 species which are considered as Critically Endangered (CR), Vulnerable (VU) or Near Threatened (NT) which required special attention and there is need to consider placing them of CITES Appendix. Other species from the region and globally which have same status may also be considered to be placed under CITES appendices. There is also need for having national and provincial legislations for the protection and conservation of stingrays in Pakistan so that these may not disappear from the area or may become extinct.

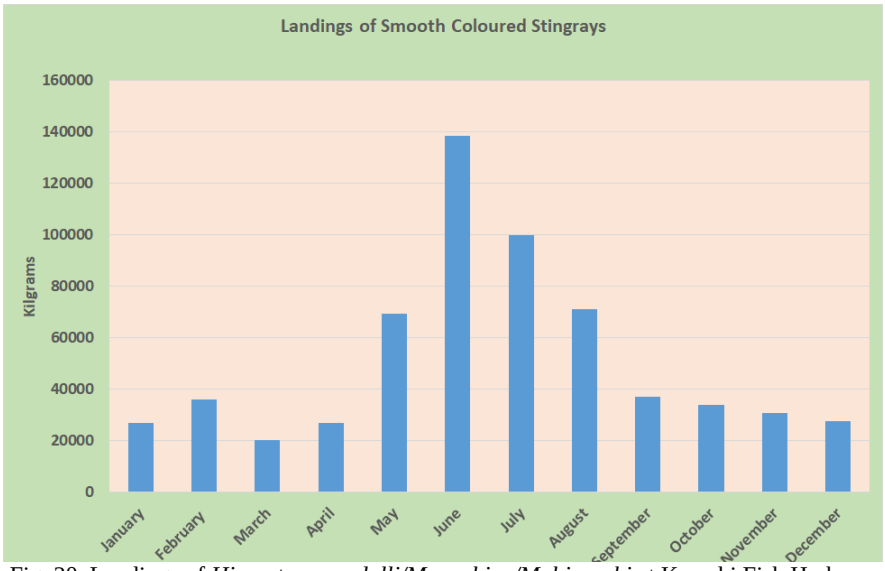


Fig. 20. Landings of *Himantura randalli/M. arabica/M. bineeshi* at Karachi Fish Harbour.

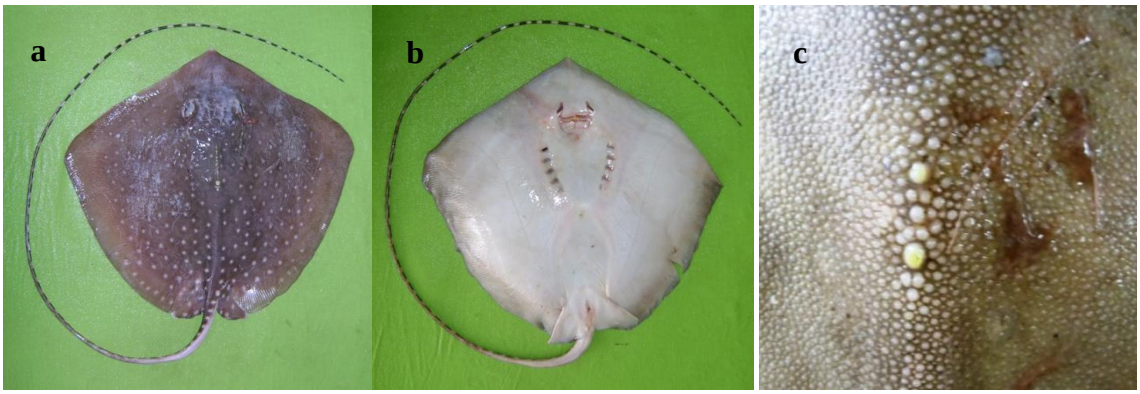


Fig. 21. *Maculabatis gerrardi* collected from Karachi Fish harbour on 11 September 2020 (27 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

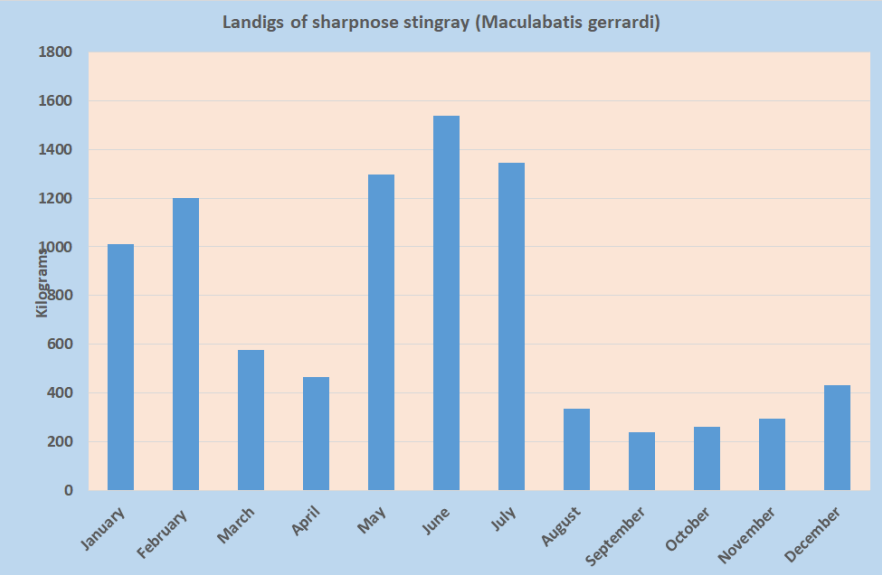


Fig. 22. Landings of sharpnose stingray (*Maculabatis gerrardi*)

Fig. 23. *Maculabatis cf. Pastinacoides* collected from Karachi Fish harbour 11 December 2020 (34 cm DW).). (a) Dorsal view; (b) ventral view.

Fig. 24. *Megatrygon microps* (a) collected on 29 November 2016 from offshore Sindh waters-Front view (142); (b) collected from Karachi Fish harbour on 10 may 2015 (122cm)

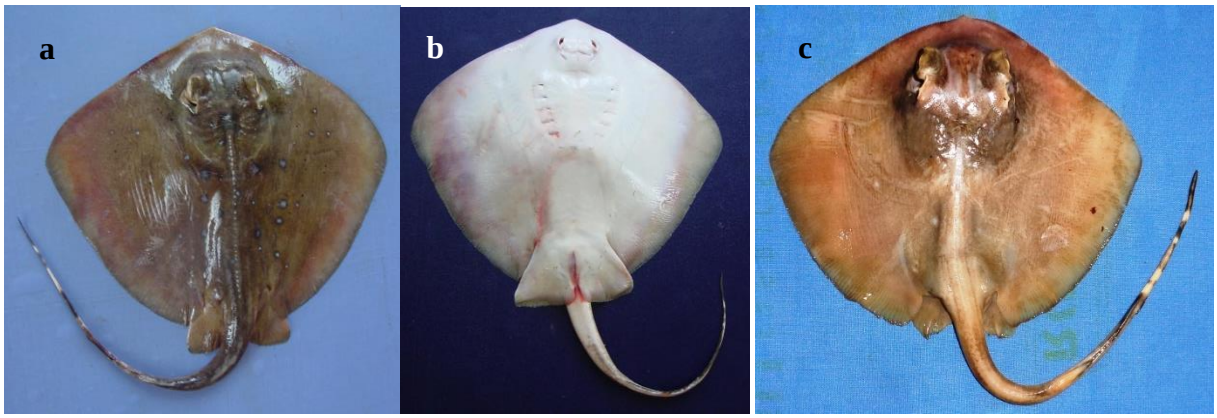


Fig. 25. *Neotrygon indica* collected from Karachi Fish harbour on 11 September 2015 (28 cm DW); (a) dorsal view; (b) ventral view; (c) juvenile (10.7 cm DW) collected on 22 December 2020 from Karachi Fish Harbour.

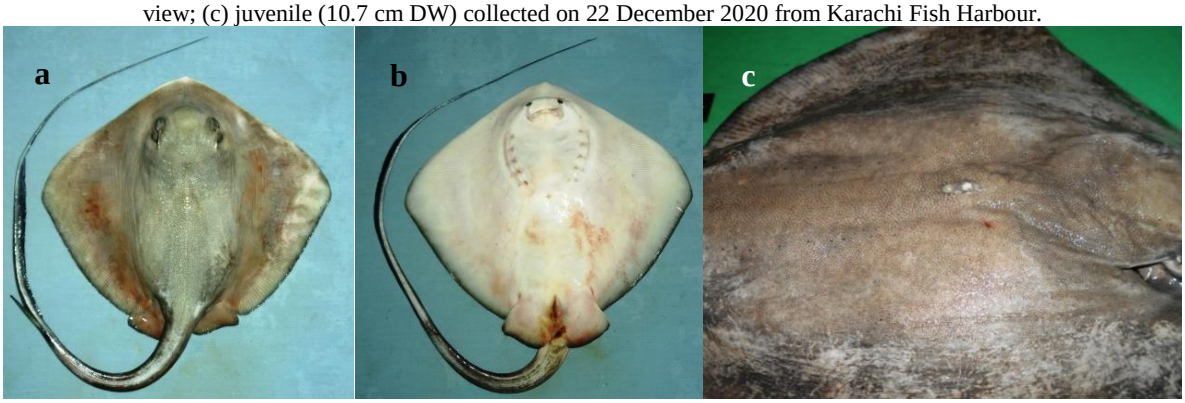


Fig. 26. *Pastinachus ater* collected from Karachi Fish harbour on 11 September 2020 (27 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

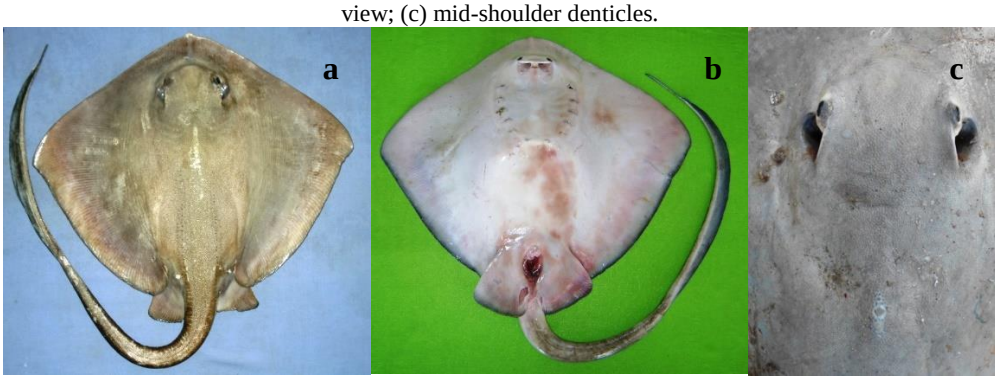


Fig. 27. *Pastinachus sephen* collected from Karachi Fish harbour on 24 December 2020 (78 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

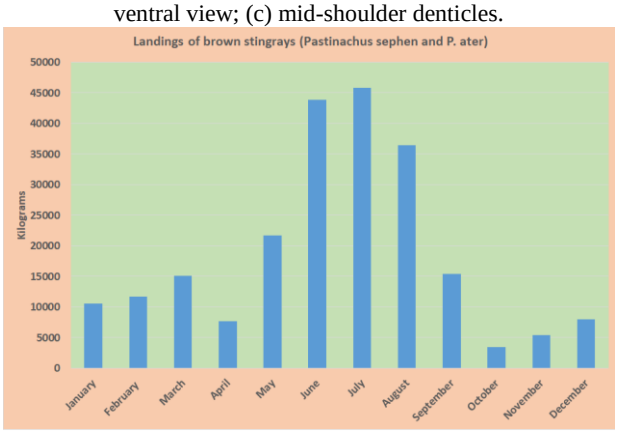


Fig. 28. Landings of *Pastinachus sephen* and *P. ater* in Karachi Fish Harbour.

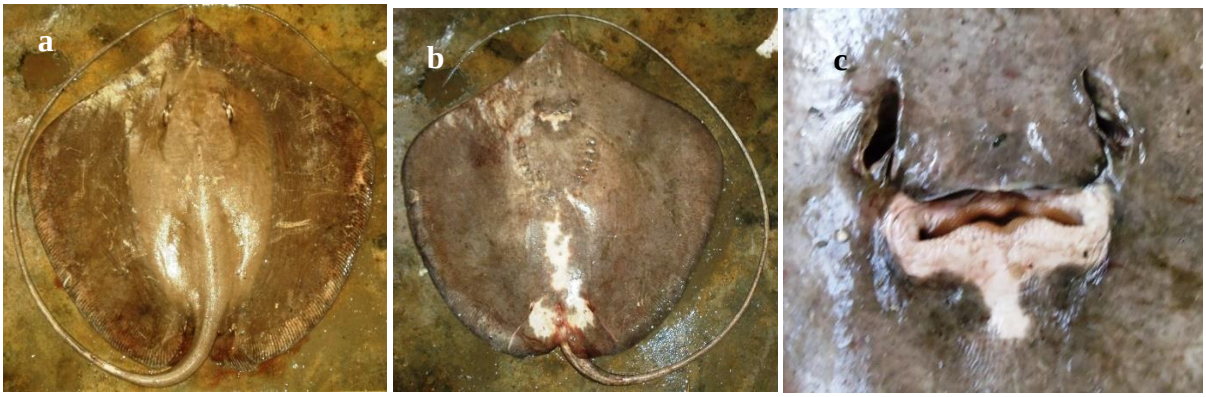


Fig. 29. *Pateobatis bleekeri* collected from Karachi Fish harbour on 21 December 2020 (40 cm DW). (a) Dorsal view; (b) ventral view; (c) Nasal curtain and mouth.

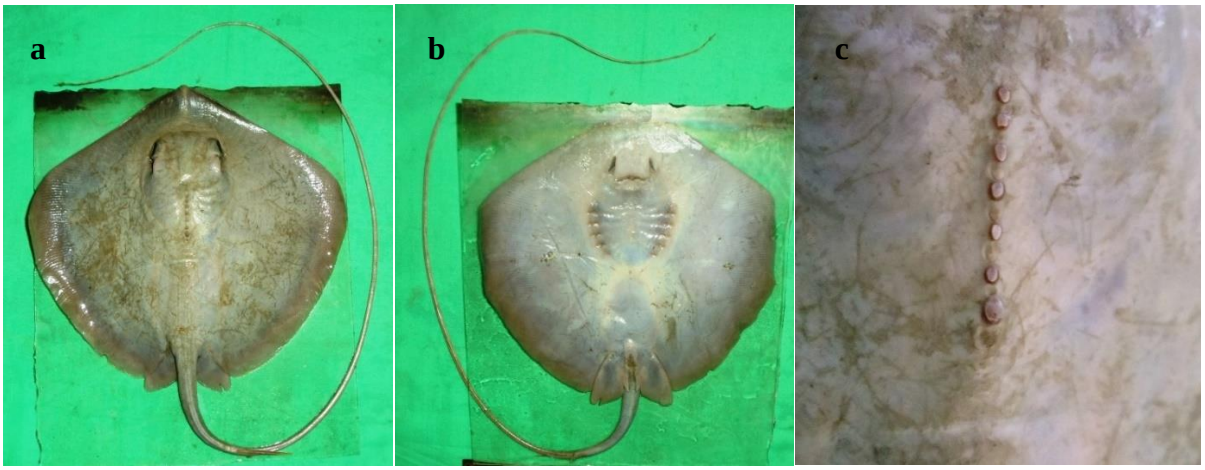


Fig. 30. *Pateobatis fai* collected from Karachi Fish harbour on 14 March 1986 (19.5 cm DW). (a) Dorsal view; (b) ventral view; (c) mid-shoulder denticles.

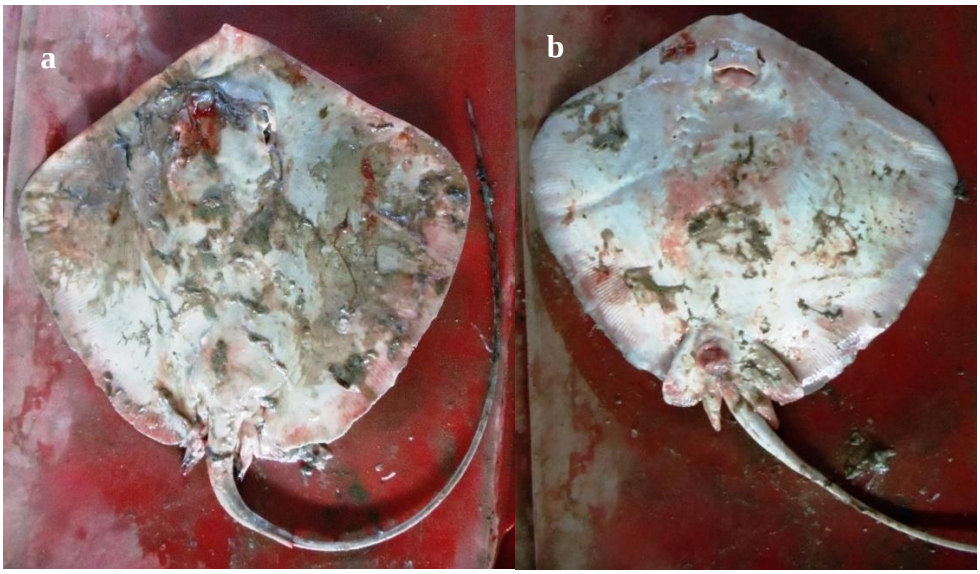


Fig. 31. *Pateobatis jenkinsii* collected from Karachi Fish Harbour on 17 December 2020 (49 cm DW); (a) dorsal view; (b) ventral view.

Fig. 32. *Pteroplatytrygon violacea* collected from Karachi Fish harbour on 25 April 2013 (50 cm DW). (a) Dorsal view; (b) ventral view.

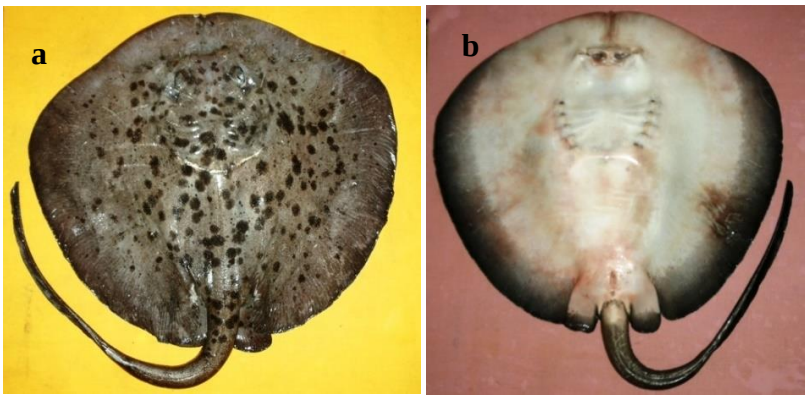


Fig. 33. *Taeniura meyeni* collected from Karachi Fish harbour on 9 April 2014 (52 cm DW); (a) dorsal view; (b) ventral view.

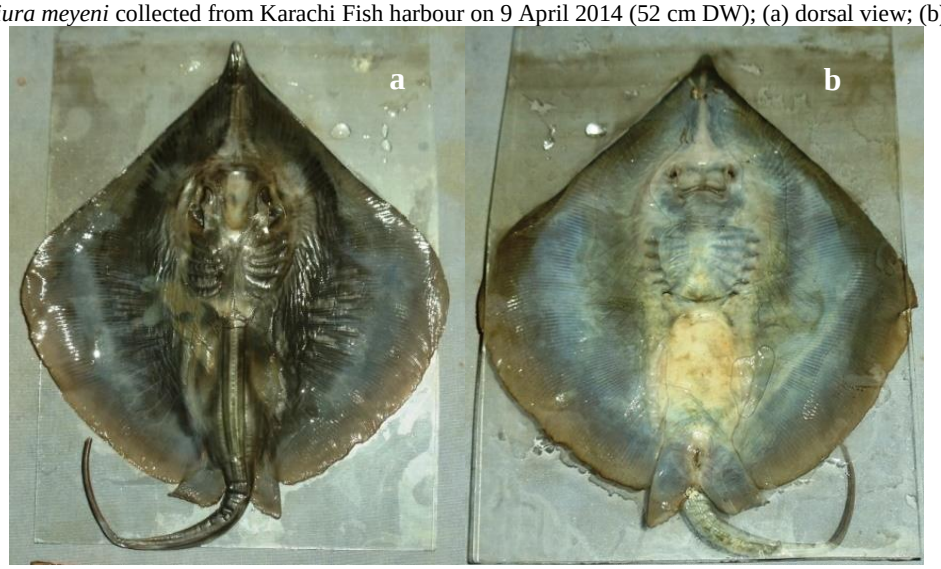
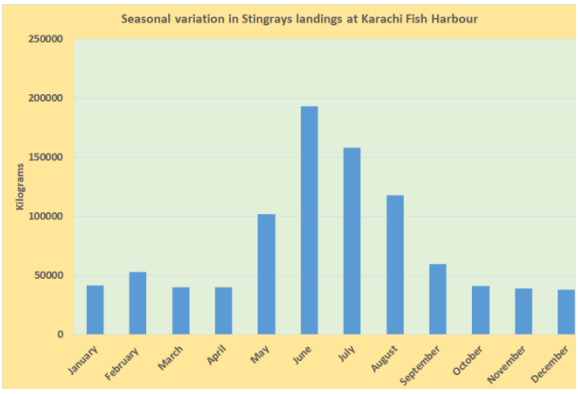


Fig. 34. *Telatrygon crozieri* collected from Karachi Fish harbour on 11 December 1976 (15 cm DW); (a) dorsal view (b) ventral view.

Fig. 35. Commercial landings of stingrays at Karachi Fish Harbour (the catch is dominated by species belonging to smooth coloured stingrays)



Fig, 36. Seasonal variations in the stingray's landings at Karachi Fish Harbour (2019)

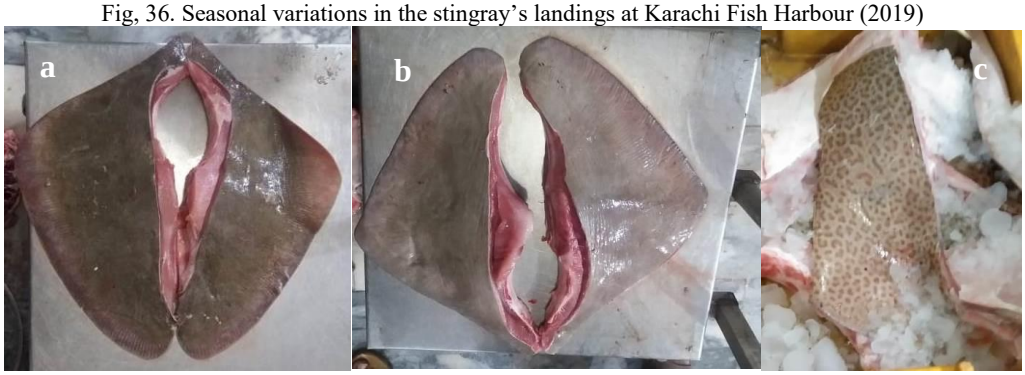


Fig. 37. Wings of rays being graded before freezing. a) White or smooth coloured stingrays (dorsal surface); b) smooth coloured stingrays (ventral surface); c) spotted /ocellated/reticulated stingrays (dorsal surface).

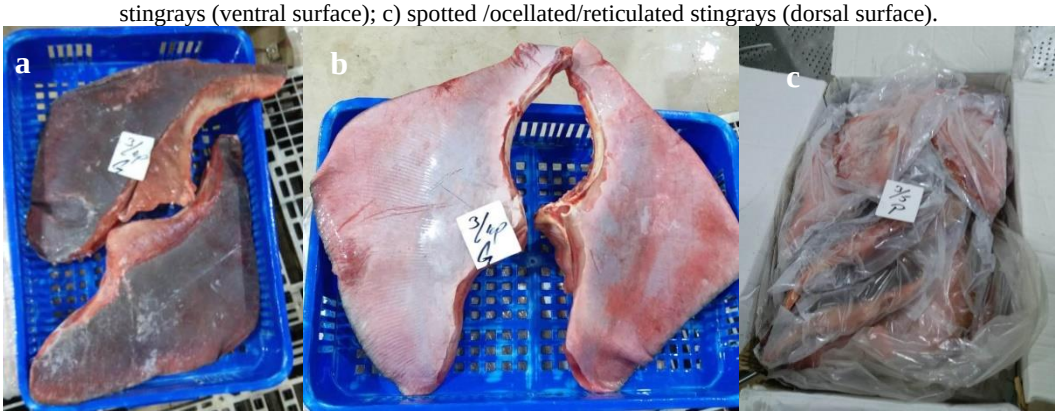


Fig. 38. Wings of rays being graded before freezing. a) brown coloured stingrays (dorsal surface); b) grey coloured stingrays (ventral surface); c) wings packed in polyethylene bags before freezing.

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