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SPECIES COMPOSITION AND DISTRIBUTION OF ELECTRIC RAYS (CLASS: PISCES; SUBCLASS: ELASMOBRANCHII; ORDER: TORPEDINIFORMES) FROM PAKISTAN

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ABSTRACT

Electric rays (Order Torpedoniformes) represented by 13 species belonging to 4 genera and 3 families are reported from Pakistan. Genus *Narcine* is reported by 6 species, *Torpedo* by 5 species and *Benthobatis* and *Narke* by 1 species each. *Torpedo zugmayeri* was described from Gwadar Pakistan by Englehardt (1912) which was generally included in the synonym of *T. panthera*, *T. fuscomaculata* or *T. sinuspersici*, however, during the present study a number of specimens collected from Pakistan were examined and it was concluded that it is valid species. Based on the available specimens, two species *Torpedo adenensis* and *Narcine oculifera* are reported for the first time from Pakistan coast. Although no specimen of *Narcine atzi* from Pakistan was examined but considering its wide distribution in the Arabian Sea and Bay of Bengal, its presence in Pakistan cannot be overruled. There seems to be little knowledge available about abundance and distribution of various species of electric ray occurring in the area. Evaluation of International Union for Conservation of Nature *(*IUCN) Red listing is available for 11 out of 13 species occurring in Pakistan. Two species *Torpedo zugmayeri* and *Narcine brunnea* were not evaluated mainly because, these were included in synonymy of other species whereas one species *Benthobatis moresbyi* was rated as least concern (LC). *Torpedo adenensis* was rated as Endangered (EN). Remaining species are considered as data deficient (DD). Considering limited available information, it was stressed to study biology, ecological role in the benthic ecosystem and stock abundance of electric rays from Pakistan.

Key word: Elasmobranchii, Torpediniformes, Electric rays, *Torpedo zugmayeri T. adenensis, Narcine oculifera, Narke, Benthobatis.*

INTRODUCTION

Fishes belonging to Class Pisces: Subclass: Elasmobranchii: Order: Torpediniformes, includes electric rays, and commonly known as “Kakoria” and “Takora” in Karachi, “Bapha”, “Montar”, “Current pitan” and “Tankori” in Sindh and “Botan” in Balochistan. Electric rays are caught as bycatch of trawl and bottom set gillnet fisheries. Since these fishes are of no commercial value, therefore, used as raw material for fishmeal production. There is no aimed fishery for electric rays in Pakistan.

There is no dedicated study dealing with electric rays in Pakistan. These rays are included in checklist of fishes of Pakistan (Bianchi, 1985; Hoda, 1985, 1988; Hussain, 2003; Jalil and Khaliluddin, 1972, 1981; Misra, 1952 and Sorley, 1932). A few studies on elasmobranchs of Pakistan also listed species of electric rays as well (Ahmad and Niazi, 1975; Khan and Quadri, 1986; Misra, 1969; Niazi, 1994; Qureshi, 1953, 1977). Qureshi (1972) in his review of elasmobranchs have included electric rays of Pakistan in detail. Psomadakis, *et al*., (2015) who dealt with commercially important fishes and shellfishes reported a number of electric rays from Pakistan.

Fatima (2018) and Fatima *et al.* (2016) who have studied elasmobranch landings at Karachi Fish Harbour,= and reported landings and sizes composition of 3 species of electric rays. Gore *et al*. (2019) studies elasmobranch from Balochistan coast and reported 2 species (*Narke dipterygia* and *Torpedo sinuspersici*) from Balochistan.

Ecological role of batoid fishes including electric rays are not well understood. They play important role in benthic ecosystem as most of them are predators and feed upon a variety of invertebrates and small vertebrates (fishes), however, in most cases their contribution in benthic dynamic is not adequately known (Flowers, *et al.*, 2016, 2021; Pierce, 2005). Like all known rays, electric rays are carnivorous, and as a group they are high in the food web such as torpedo rays, have an arched lower jaw studded with small spiny teeth which can be thrust forward to suck up small fish .(Pierce, 2005).

Electric rays like many other batoids produce only a few pups which is an adaptation for a life history strategy with low natural rates. Sting rays are long-lived, slow-growing, and have delayed maturation making them highly vulnerable to human-induced pressures, such as fishing, habitat degradation and pollution (Pierce, 2005). Present

paper provide information about the species composition of electric ray fauna of Pakistan which may form basis for study on various aspects of biology and management..

MATERIALS AND METHODS

Published scientific literature was examined for the records of various electric rays species occurrence from Pakistan coast (Fig.1). In addition, specimens of were collected between 2003 and 2021 from Karachi Fish Harbour which is the largest fish landing center for domestic fleet operating along coastal and offshore waters of Pakistan. Samples collected from the harbour, were photographed and salient features and measurement are recorded, before, their preservation in 5 % neutralized formalin.

RESULTS AND DISCUSSIONS

Electric rays have no commercial value in Pakistan but are caught mainly as bycatch of bottom set gillnetting and trawling as well as some time caught in other fishing gears such as cast net, beach seine and line gears.

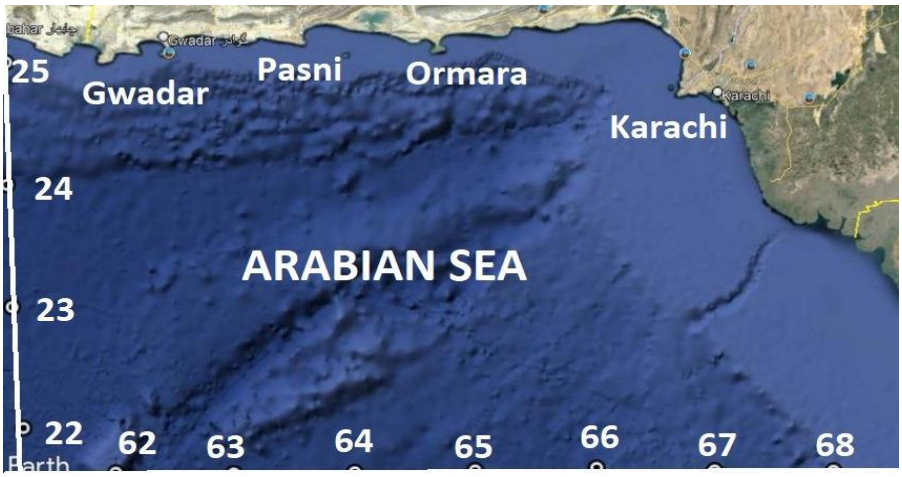

Fig. 1. Pakistan coast.

Electric rays belong to Order Torpediniformes which are known to have discs that are truncate or emarginate anteriorly; jaws extremely slender, no labial cartilages and rostrum absent or reduced. Members of order Torpediniformes have two special kidney-shaped organs that generate and store electricity like a battery; some of which generate enough power to produce a shock of about 220 volts, while some smaller electric ray can only muster a shock of about 37 volts. Three families Torpedinidae (torpedoes), Family Narcinidae (numbfishes) and Narkidae (sleeper rays) are included in .included in this order.

Family Torpedinidae (torpedoes),

Electric rays with head equipped with electric organs, developed from branchial muscles; eyes small; disc truncate anteriorly; jaws extremely slender; no labial cartilage; rostrum reduced; tail well developed; 2 dorsal and caudal fins well developed Large specimens can give a severe jolt, normally used to stun small fishes on which they feed. The young hatch inside the uterus and are born fully developed. Six species known from Pakistan *Torpedo adenensis*, *T. fuscomaculata*, *T. marmorata*, *T. panthera*, *T. sinuspersici* and *T. zugmayeri* of which records of occurrence of *T. marmorata* are based on misidentification.

Torpedo adenensis Carvalho, Stehmann & Manilo 2002
(Fig. 2)

Material Examined

- 1 Specimen (male) collected on 28 November 2013 from Karachi Fish Harbour (51 cm TL)

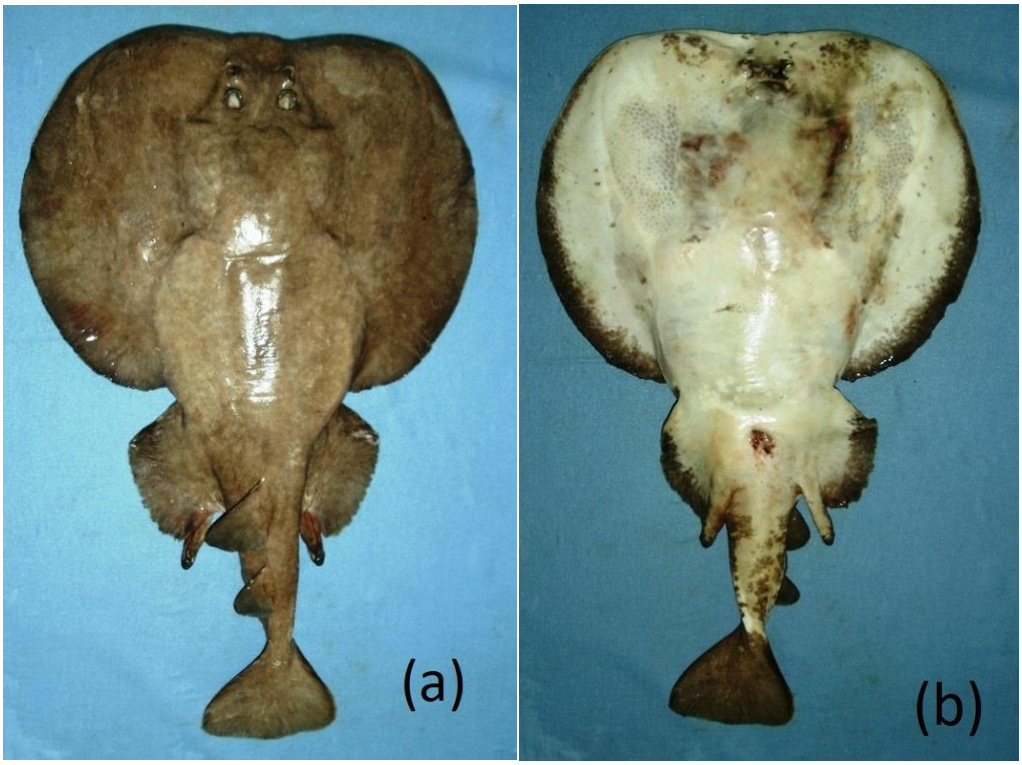

Fig. 2 *Torpedo adenensis.* (a) dorsal view; (b) ventral view.

This species is commonly known as Aden torpedo and generally a small or medium sized electric ray. It has a broad, slightly wider than long disc; widest at its anterior third, anterior margin almost straight with a median protuberance. Eyes slightly smaller than spiracles. Spiracles large and rounded, with slightly elevated rims; 3-4 knob-like, somewhat inconspicuous papillae on outer and posterior margins. Nostrils large, round, with well-defined nasal flaps. Mouth weakly arched. Electric organs more clearly visible in ventral than dorsal view. Pelvic fins rounded at apices; second dorsal fin more slanted than much smaller than first. First dorsal situated almost entirely over posterior pelvic fins; second dorsal at mid-tail length as measured from ends of pelvic fins. Claspers have fleshy integumental flap in clasper glans region. Tail somewhat short and stout with a low skin fold. Upper lobe of caudal fin slightly more clopping than lower lobe; posterior margin of fins straight to rounded.

Colour: Reddish brown or orange brown above, without any distinctive marking; posterior margin of dorsal and caudal fins creamy. Ventrally white with orange or greyish pectoral fin margins; darker blotches sometimes present on tail.

This species can be distinguished from all *Torpedo* species occurring in the area in its unique dorsal coloration, uniform reddish-, rusty-, or orange-brown and no any distinctive spots, blotches, or reticulations. Its spiracles has few, knoblike, and somewhat inconspicuous spiracular papillae; spiracles and eyes relatively close together; base of first dorsal fin extending just posterior to level of pelvic fin axil; distance between second dorsal and caudal fin greater than distance between first and second dorsal fins;. This species was reported from Pakistan by Moazzam and Osmany (in press). This species was previously known from Western Indian Ocean, Gulf of Aden (Eschmeyer, 2021; Froese and Pauly, 2021). This is the only species of electric rays that has been evaluated for IUCN Red List and considered as Endangered (EN) (B1ab(v)).

Torpedo fuscomaculata Peters 1855
(Fig.3)

Material Examined

- 1 Specimen (male) collected on 16 January 2015 from Karachi Fish Harbour (41 cm TL)
- 1 Specimen (male) collected on 11 March 2018 from Gwadar (45 cm TL)

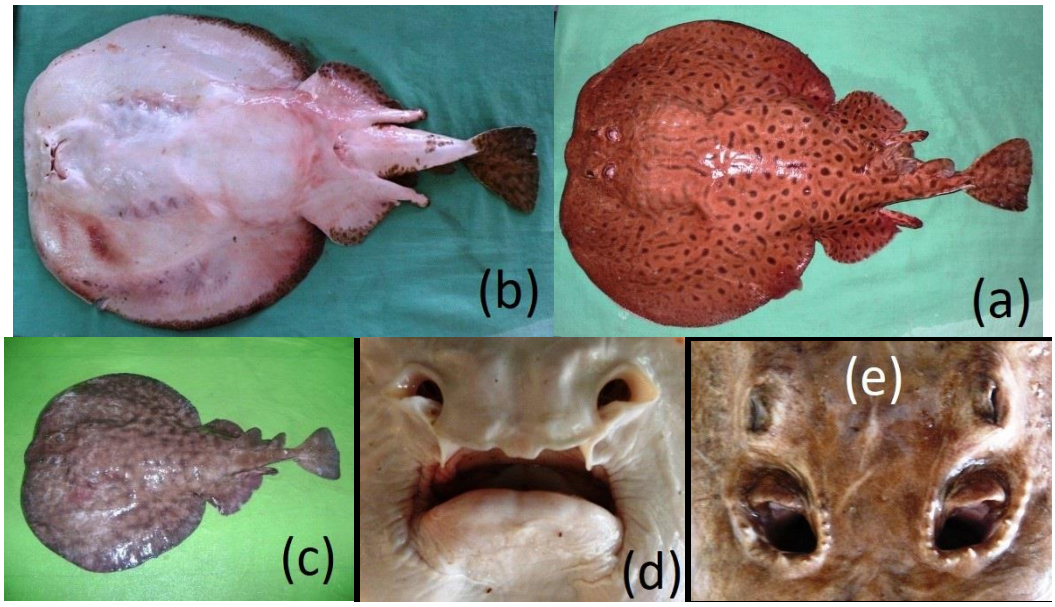

Fig. 3. *Torpedo fuscomaculata*. (a) dorsal view; (b) ventral view; (c) dorsal view (specimen from Balochistan dated 11 March, 2018); (d) mouth and nasal opening; (e) Spiracles and eyes.

This species is known as black-spotted torpedo and reported by Bianchi (1985) from Pakistan. It is medium sized electric ray with fleshy and thick, circular, as broad as long disc; widest slightly anterior to mid-disc; anterior margin straight with a slight median protuberance; snout very short. Eyes small, slightly bulging; eyes and spiracles separated by small space and eyes closer to spiracles than to snout anterior margin; orbit smaller than interspiracular space, slightly larger than spiracle. Spiracles rounded with up to 7 short papillae; posterior papilla longest. Nostrils with well-defined nasal flaps. Mouth arched. Electrical organs more clearly visibly on ventral than dorsal view. Pelvic fin broad, rounded posteriorly. Dorsal fin rounded to oval at apex. First dorsal broad, slightly taller than second; second dorsal more slender than first dorsal and more slanted anteriorly. First dorsal situated entirely over pelvic fin. Tail very short and stout; lateral skin fold moderately developed. Upper lobe of caudal fin larger and slightly more sloping than lower lobe; both upper and lower apices rounded to oval; posterior margin of fin straight to slightly rounded.

Colour: Highly variable, greyish, yellowish or reddish brown above, usually with numerous darker spots and blotches each smaller than interorbital space in size; sometimes with lighter outer rings forming ocelli; blotches form irregular reticulate pattern; margins of dorsal and caudal fins sometimes slightly coloured. Undersurface creamy white.

According to Last *et al.* (2016) this species can be distinguished from other species occurring in the Western Indian Ocean in colour pattern (though high variable in populations and regional forms). this species appears to be more restricted geographically distribution in the southeastern Atlantic and western Indian Ocean from South Africa to Zanzibar and perhaps as far north as the Kenyan coast, Madagascar, Seychelles, Mauritius western Mascarenes and (Odisha) India (Carvahlo *et al.*, 2002; Eschmeyer, 2021),

Torpedo marmorata Risso 1810

Material Examined

– None

This species is commonly known as spotted torpedo and reported from Karachi by Anonymous (1999) and Moazzam and Rizvi (1980) and from Balochistan by Fowler (1941) and Zugmeyer (1913). It was reported from Pakistan coast without identifying any specific location by Froese and Pauly (2021), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981) and Qureshi (1953, 1972).

This species is known from Western Baltic Sea; North Sea; Mediterranean Sea; eastern Atlantic as well as British Isles south to South Africa, including Madeira, Canary Islands, Cape Verde Islands and São Tomé and Principe. Its record from Pakistan are definitely based on misidentification.

Torpedo panthera Olfers, 1831
(Fig. 4)

Material Examined
- 1 specimen collected on 22 March 2007 from Karachi Fish Harbour (47 cm TL)
- 1 Specimen collected on 20 January 2016 from Karachi Fish Harbour (41 cm TL)

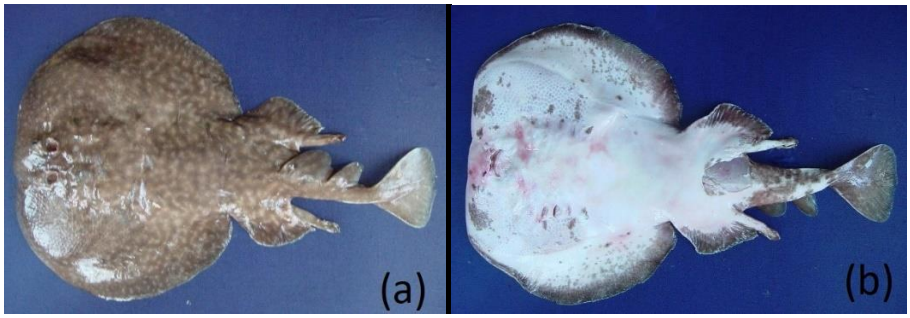

Fig.4. *Torpedo panthera.* (a) dorsal view; (b) ventral view/

It is commonly known as panther electric ray and reported from Pakistan by Ahmad and Niazi (1975), Anonymous (1999), Bianchi (1985), Froese and Pauly (2021), Khan and Quadri (1986), Misra (1969) and Psomadakis, *et al.*, (2015).

It is medium-sized electric ray with fleshy broadly circular, slightly wider than long disc; widest near mid-disc; anterior margin straight; median bulge inconspicuous; snout short. Eyes moderately sized; eyes and spiracles separated by a considerable space; orbit smaller than interspiracular distance, about equal to spiracle in size. Spiracles rounded, usually with seven papillae that do not extend to centre of spiracular opening; lateral papillae small, posterior papilla elongate. Mouth arched. Nostrils with well-defined nasal flaps. Electric organs more clearly visible on ventral than dorsal view. Pelvic fins broad and not noticeably elongate; rounded posteriorly. First dorsal with very broadly rounded apex, situated entirely over pelvic fins. Second dorsal fin smaller than first dorsal, more slender and slanted anteriorly, with an oval apex; second dorsal originates over pelvic fin posterior tip. Distance between second dorsal and caudal fin about equal to distance between dorsal fins. Tail short and moderately stout; skin folds rather well developed. Upper lobe of caudal fin larger and more sloping than lower lobe; both upper and lower apices rounded to oval; posterior margin of fin straight to rounded.

Colour: Pale brownish to reddish brown above, overlain with a complex pattern of irregular, white, diffuse-edged markings; white markings not clustered, smaller than eye. Ventral surface creamy white.

According to Carvahlo *et al.* (2002) report of Bianchi (1985) of this species from Pakistan perhaps not based on hard evidence, even though it probably does occur here. According to Carvahlo *et al.* (2002), *T. panthera* have small clusters of more or less isolated, and sometimes blurry, whitish spots over the disc, pelvic fins, and tail. In *T. panthera*, the inter-dorsal distance is roughly equal to the distance between the second dorsal and caudal fin.

This species is known from Red Sea, northern Indian Ocean: Gulf of Aden, Gulf of Oman and Persian Gulf east to Bay of Bengal (India) (Eschmeyer, 2021). According to Froese and Pauly (2021) reports from other parts of the western Indian Ocean (Bay of Bengal) probably refer to a different species.

Torpedo sinuspersici Olfers, 1831
(Fig/ 5)

Material Examined
- 1 specimen collected on 09 September 2006 from Karachi Fish Harbour (29 cm TL)
- 1 specimen collected on 15 February 2014 from Karachi Fish Harbour (34 cm TL)

– 1 Specimen collected on 30 November 2018 from Karachi Fish Harbour (36 cm TL)

This species is commonly known as variable torpedo ray and with fleshy, broadly circular, slightly wider than long, widest at about mid-disc; anterior margin almost straight with small median bulge at tip. Eyes moderately sized, eyes and spiracles separated by considerable space; orbit smaller than interspiracular distance, about equal to spiracle in size. Spiracles rounded, usually with 9-10 rather short, subcircular papillae that do not extend to center of spiracle opening; lateral papillae smaller, posterior papillae more elongate. Mouth arched. Nostrils with large nasal flaps. Electric organs more clearly visible on ventral than dorsal view. Pelvic fins broad and not very elongate; rounded posteriorly. First dorsal with very broadly rounded apex, not as tall as caudal fin, situated entirely over pelvic fins. Second dorsal fin smaller than first dorsal, more slender and anteriorly slanted with oval apex; second dorsal originates over pelvic fin posterior tip. Distance between second dorsal and caudal fin usually larger than between dorsal fins. Tail short and moderately stout; skin folds rather well developed. Upper lobe of caudal fin larger and more sloping than lower lobe; both upper and lower apices rounded to oval; posterior margin of fin straight to rounded.

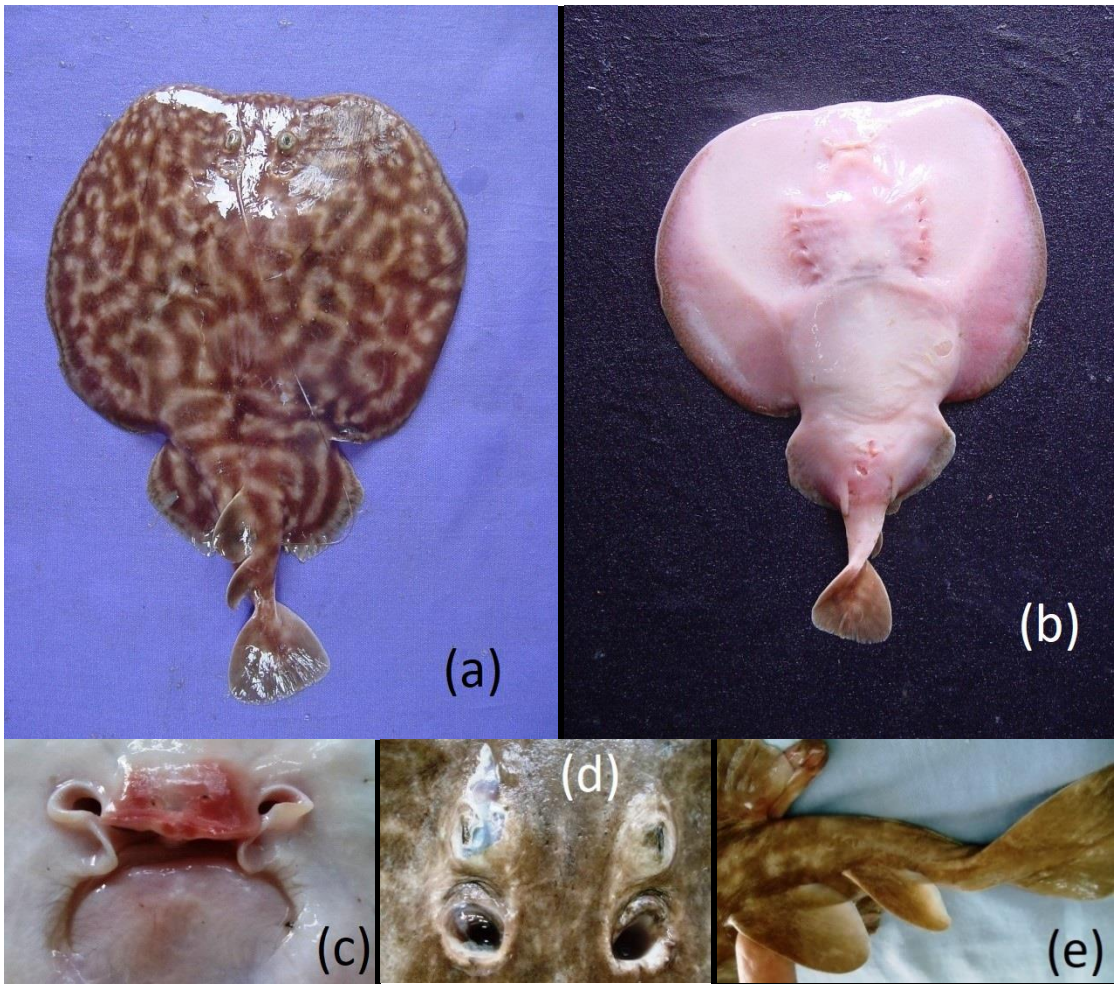

Fig. 5. *Torpedo sinuspersici.* (a) dorsal view; (b) ventral view; (c) mouth and nostrils; (d) spiracles and eyes; (e) dorsal fins.

Colour: Dorsally highly variable, adults usually brownish or blackish brown, covered with highly elongate pale reticulate pattern (formed by fused spots). Young specimens sometimes sparsely covered with white spots. Ventrally mostly creamy white.

This species can be identified with its typical colour pattern which is composed of strong cream or whitish and rather thick vermiculation (may be formed from fused irregular spots) .over disc, pelvic fins, and tail, with many

cream-colored and irregular spots, no larger than eye diameter, on anterior and lateral disc regions Carvahlo *et al* (2002). According to Carvahlo *et al.* (2016) it is highly variable and confused with the panther torpedo. Their coloration are distinct with Persian Gulf torpedo having a more reticulate pattern. Possibly a species complex

It was reported from Karachi by Niazi (2001). It was also reported from Pakistan coast without mentioning any specific location by Bianchi (1985), Fraser-Brunner (1949), Hoda (1985, 1988), Hussain (2003), Psomadakis, *et al.*, (2015) and Qureshi (1953). Qureshi (1953), and Hoda (1985, 1988) listed this species as *Torpedo sinus.* Fatima (2018) has reported a size of 34 cm for this species from Karachi Fish Harbour whereas Fatima *et al*., (2016) reported this species to be present at Karachi Fish Harbour in April 2016. It is known to be widely distributed in Indian Ocean including Natal, South Africa, Somalia, Red Sea, Arabian Sea, the Gulf of Oman, Persian Gulf, Sri Lanka, India (Odhisa) and Andaman Sea (Carvahlo *et al*, 2002; Eschmeyer, 2021).

Torpedo zugmayeri Englehardt, 1912
(Fig. 6)

Material Examined

- 1 specimen collected on 24 February 2014 from Karachi Fish Harbour (46 cm TL)
- 1 specimen collected on 11 December 2016 from Karachi Fish Harbour (51cm TL)

This species is commonly known as Zugmeyer's torpedo and reported from Gwadar, Balochistan by Carvalho *et al*. (2002), Compagno (1999), Englehardt (1912), Fowler (1941), Misra (1969), Mould (1997), Prashad (1920), Setna and Sarangdhar (1949) and Zugmayer (1913). This species was described from Gwader, Balochistan by Englehardt (1912) based on a single 330 mm female specimen, however, no type is known (Eschmeyer, 2021).

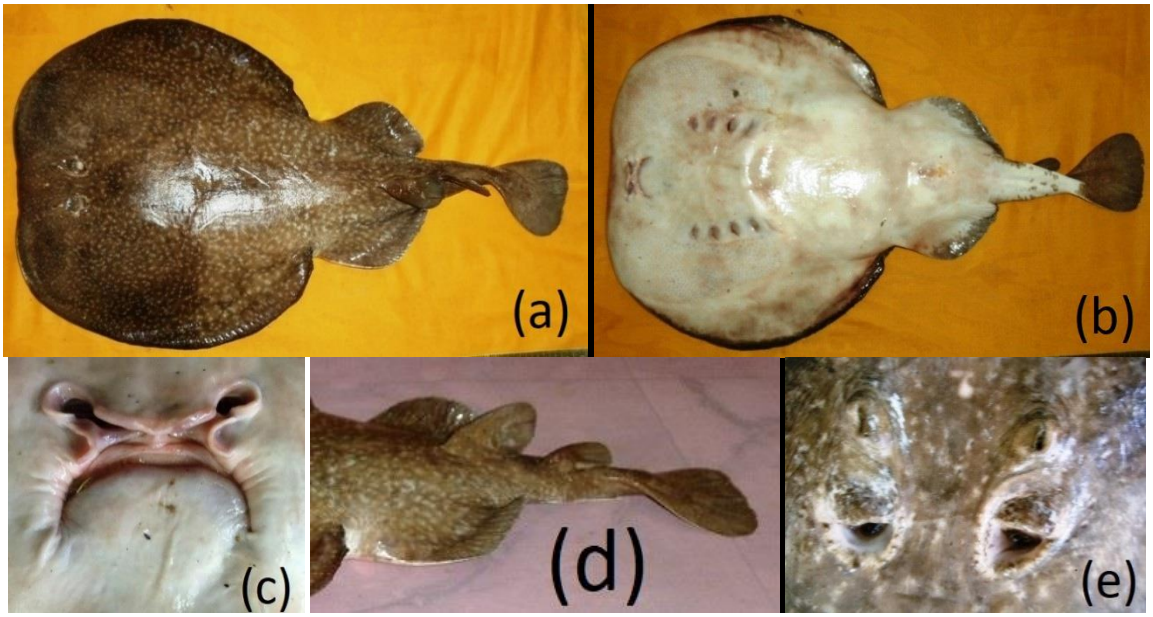

Fig.6. *Torpedo zugmayeri.* (s) dorsal surface; (b) ventral surface; (c) mouth and nostrils; (d) dorsal fins and tail; (e) spiracles and eyes.

This species may commonly be known as Zugmeyer's torpedo ray. This electric ray has fleshy, broadly circular, slightly wider than long, widest at about mid-disc; anterior margin almost straight with flattened and small median area at tip. Eyes small sized, eyes and spiracles separated by a narrow space; orbit much smaller than interspiracular distance, about equal to spiracle in size. Spiracles with a thick, fleshy bulge from the front narrowed so that only a narrow, crescent-shaped (semicircular) slit remains; much smaller though more numerous spiracular papillae. Mouth arched. Nostrils with large nasal flaps. Electric organs more clearly visible on ventral than dorsal view. Pelvic fins broad and not very elongate; rounded posteriorly. First dorsal with broadly rounded apex, situated entirely over pelvic fins. Second dorsal fin smaller than first dorsal, more slender and anteriorly slanted; second dorsal originates after pelvic fin posterior tip. Distance between second dorsal and caudal fin usually larger than

between dorsal fins. Tail short and moderately stout. Upper lobe of caudal fin larger and more sloping than lower lobe; both upper and lower apices rounded to oval; posterior margin of fin straight to rounded.

Colour: Above light bright brown dorsally with blackish mottles or a blackish marbled pattern. Ventrally yellowish white with brown-stained disc edges.

According to Prashad (1920) who examined a male specimen at Quetta Museum (now in Pakistan) considers *T. zugmayeri* to be valid species as it can be distinguished from closely related *T. marmorata* in having semilunar instead of circular spiracles, much smaller though more numerous spiracular papillae, proportionately much smaller tail, by general coloration and a much heavier build. Fowler (1941) considered this spices to be synonym of *T. marmorata.* Ahmad and Niazi (1975), Bigelow and Schroeder (1953), Belgvad (1944) and Mould (1997) consider this to be synonym of *Torpedo panthera*. Compagno (1999), Eschmeyer (2021), Prashad (1920) and Setna and Saranghdhar (1949) consider this to be a valid species.

Carvalho *et al.* (2002) made a detailed analysis of the status of *Torpedo zugmayeri* which was described by Engelhardt (1912) from a single 330 mm TL female specimen (not figured) from off Gwadar. This specimen apparently no longer exits. Engelhardt (1912) described its coloration as bright brown dorsally with blackish mottles or a blackish marbled pattern, and ventrally yellowish white with brown-stained disc edges. This darkly mottled or spotted colour pattern clearly distinguishes this species from *T. adenensis* as well as from *T. panthera*.

Bigelow and Schroeder (1953) placed *T. zugmayeri* in the synonymy of *T. panthera*, but without elaborating, and overlooking the clear distinctions in coloration present in the original description. According to Carvalho *et al.* (2002), it could be either a junior synonym of *T. fuscomaculata*, because of the described similarities in dorsal colour, a junior synonym of *T. sinuspersici*, or a valid species. Engelhardt (1912) compared his new species only to *T. marmorata*. The accounts of Blegvad (1944) and Kuronuma and Abe (1986) from the Persian Gulf described a species (misidentified as *T. panthera*) that is brownish with darker irregular spots. Both accounts were based on freshly captured specimens and do not mention white, cream-colored, or lighter spots, mottles, or vermiculations indicative of *T. sinuspersici*, originally described from the Persian Gulf. Belgvad (1944) even included *T. zugmayeri* as a synonym of *T. panthera*,. Blegvad's (1944) depiction of an adult male (350 mm TL) shows a specimen that slightly resembles *T. sinuspersici*, with some lightly coloured blotches, but this is inconclusive.

Family Narcinidae (Numbfishes)

Electric rays belonging to family Narcinidae have anteriorly rounded disc with head equipped with electric organs, developed from branchial muscles and have well developed pelvic and caudal fins. This family is represented in Pakistan by six species *Benthobatis moresbyi, Narcine brunnea, N. lingula, N. maculata, N. oculifera* and *N. timlei.*

Benthobatis moresbyi Alcock, 1898

Material Examined

– None

This is a medium sized to large blind numbfish with a thick oval disc which is widest posterior to the mid-length; head and snout flat. Snout elongate, about more than 40 % of the disc length. Eyes not visible externally; positioned anteriorly to inconspicuous spiracle, lacking rims and papillae. Nasal curtain wide and short; nostril small with slightly elevated rims. Mouth wide with thick lips and shallow circumoral groove. Tail slightly longer than disc, about half the total length; lateral ridges poorly defined. Dorsal fins with long fleshy bases; fin length about twice height; apices broad, sloping. First dorsal fin well anterior to posterior tip of pelvic fins, close to mid pelvic fin; interdorsal space narrower than length of dorsal fin bases. Distance between second dorsal fin and caudal fin much smaller than length of base of second dorsal fin. Caudal fin elongate, about half of tail length and with low upper and lower lobes.

Colour: Both dorsal and ventral surface uniformly dark brown to purplish black.

This species is commonly known as dark blind ray and reported from Pakistan by Qureshi (1953) and Hoda (1985, 1988). Carvalho (1999) described this species in detail. He mentioned that this species is so far known from five specimens collected from Arabian Sea (none from Pakistan). According to Carvalho and Last (2016) this

species is known from Arabian Sea, off India, Yemen and Somalia. It is a deep sea species that inhabits of 785 to 1070 m. The occurrence of this species, however, cannot be overruled.

Narcine atzi Carvalho and Randall, 2003

Material Examined

- None

This is commonly known as Oman numbfish was described from Gulf of Oman (Carvalho and Randall, 2003) . It is also known from east coast of India (Sujatha, *et al*., 2016) and Myanmar (Psomadakis *et al*., 2020)`/It is a medium-sized numbfish with a large subcircular to broadly oval to heart-shaped disc which is widest slightly posterior to its mid length; snout broadly rounded anteriorly. Eyes slightly bulging. Spiracles wider than long, with smooth elevated rims. Interspiracle distance much smaller than interorbital distance. Nostrils small and circular with elevated posterior rim, not divided into two separate openings. Nasal curtain wider than long, straight posteriorly, not covering upper tooth band. Mouths wider than internasal width. Pelvic fins with wide anterior margins. Dorsal fins large, first dorsal exceeding than second in height and base length, and with rounded apex, originating slightly anterior to pelvic fin insertions; second dorsal more tilted and with narrowly rounded apex. Tail stout at base, length shorter than disc length, lateral folds broad. Caudal fin tall with rounded apex and posterior margin.

Colour: Pale brown to greyish brown above, covered with small dark brown spots or vermicular markings; snout dusky grey or brownish. Ventrally creamy white, sometimes with dusky disc and pelvic fin margins. And blotches on tail.

It can be distinguish from congeners in its dorsal coloration composed of numerous small dark brown spots, equal to or smaller than eye diameter, oval disc and tail regions and within spiracular walls, coupled with faint large blotches, fewer in number, on dorsal disc area; first dorsal fin clearly taller, and with a longer base, than second dorsal fin; preorbital snout length not as great as preoral snout length; upper and lower tooth bands subequal in width and broadly circular in shape . Considering its broad distribution in Arabian Sea and Bay of Bengal, occurrence of *N. atzi* in Pakistan cannot be overruled.

Narcine brunnea Annandale, 1909

(Fig. 7)

Material Examined

- 1 specimen collected from Karachi Fish Harbour on 11 November 2012 (17 cm TL).
- 1 specimen collected from Karachi Fish Harbour on 03 March 2016 (18cm TL).

It is commonly known as brown electric ray and reported from Karachi by Ahmad *et al.* (1973), Anonymous (2001), Fatima (2018) and Fatima *et al*. (2016) and from Makran coast by Ahmad *et al.* (1973). It was reported from Pakistan coast without mentioning any specific location by Ahmad and Niazi (1975), Bianchi (1985), Carvalho *et al*. (1999), Froese and Pauly (2021), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Khan and Quadri (1986) and Qureshi (1953, 1972). Fatima (2018) has reported a size of 17-20 cm for this species from Karachi Fish Harbour whereas Fatima *et al*. (2016) reported this species to be present at Karachi Fish Harbour in March 2016.

It is commonly known as brown numbfish which has an oval disc, widest just posterior to its mid-length, body fleshy with thick margin. Eyes large and slightly bulging. . Spiracle large and circular; wide elevated rims completely surrounding spiracle opening. Interspiracular distance much smaller than interorbital distance. Nostrils small, circular, with low posterior nasal flaps. The free edge of the nasal flap has a distinct projection in the middle line. Mouth width equal to internasal width. Claspers slender and flat, distal tip somewhat rounded. Dorsal fin tall, taller than long, with narrowly rounded apices and almost straight posterior margins, second dorsal larger than first in height. Tail almost equal to disc. Caudal fin tall, with narrowly rounded apex and straight posterior margin.

Colour: The dorsal surface is of a warm chocolate-brown without .spots, the ventral surface creamy white. A narrow margin of the latter shade runs round the disk, being more distinct anteriorly than posteriorly: the dorsal and caudal fins, as well as the lateral ones, are edged with greyish white.

This species is considered to a synonym of *Narcine timlei* (Carvalho, and Last, 2016) whereas Eschmeyer (2021), Froese and Pauly (2021) and Weigmann (2016) considered it to be a valid species. It is known to be distributed from off Pakistan to the Gulf of Thailand (Froese and Pauly, 2021).

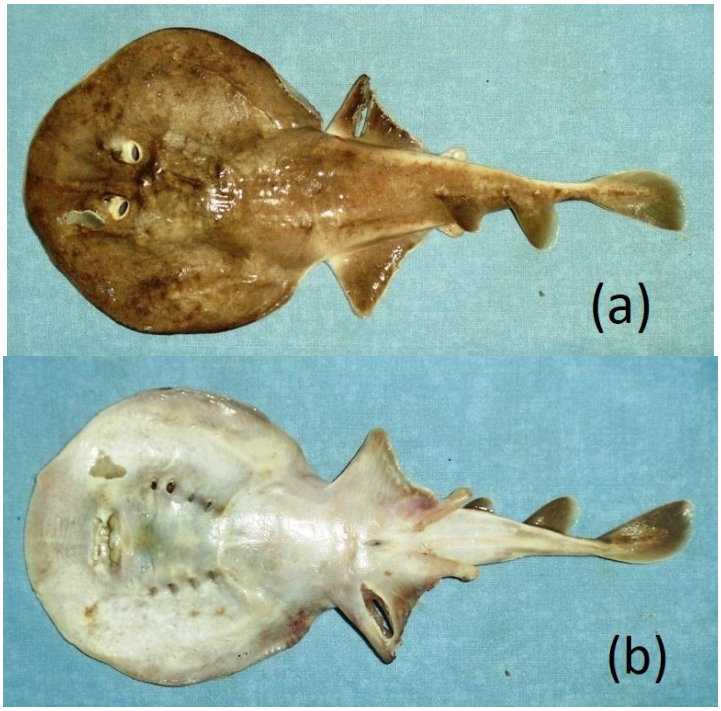

Fig.7. *Narcine brunnea.* (a) dorsal view; (b) ventral view

Narcine lingula Richardson 1846

Material Examined

– None

It is commonly known as Chinese numbfish which is medium sized species with a large ovoid to rounded or heart shaped disc (usually slightly wider than long) with rounded to angular lateral corners and widest near mid-disc. Snout broad, rounded to suboval anteriorly. Eyes and spiracles subequal in size, not enlarged. Spiracles subcircular with thin, elevated rims ; sometimes oblique in relation to eyes. Nostrils circular, medium sized, nasal flaps moderate. Nasal curtain short and wide with faint median lobe, partially covering upper tooth bands. Mouth about equal to internasal width. Pelvic fins wider than long, with broadly convex posterior margins. Claspers slender, flattened in adult males. Dorsal fin medium sized, with rounded apices and rounded to straight posterior margins; similar in size, second dorsal more tilted anteriorly. Tail moderately stout at base, shorter than disc length; lateral folds not especially wide. Caudal fin not especially tall, with slanted upper lobe, narrowly rounded apex, rounded ventral margin, and almost straight posterior margin.

Colour: Dorsal surface pale brownish, densely covered with large dark brown, oval, circular or crescent-shaped spots of varying shapes and sizes; marking present on body and fins. Ventrally entirely creamy white, frequently with darker disc margins.

This species is known to be distributed in the Indo-West Pacific area including from Pakistan to China and off Cambodia, including Taiwan and possibly Japan and Philippines (Eschmeyer, 2021; Froese and Pauly, 2021). During the present study no specimen of this species was examined, though it was reported from Pakistan by Carvalho and Randall (2003), Eschmeyer (2021) and Froese and Pauly (2021).

Narcine maculata (Shaw, 1804)

Material Examine

- None

This species is commonly known as small-spot or dark-finned numbfish and reported from Pakistan by Ahmad and Niazi (1975), Jalil and Khaliluddin (1981) and Khan and Quadri (1986). It is medium-sized broadly oval to heart-shaped disc (usually slightly wider than long) with rounded to anglular lateral corners, widest at about mid-disc. Snout broad, rounded anteriorly. Eyes medium-sized, barely larger than spiracles. Spiracles subcircular, with thin elevated rims, sometimes oblique in relation to eyes. Nostrils large and circular, nasal flaps well-developed. Distance between outer margins of nostrils slightly exceeding mouth width. Nasal curtain very short, wide with faint median lobe, partially covering upper tooth band. Pelvic fins wide, very broadly convex posterior margins. Claspers slender, flattened in adult males. Dorsal fins medium-sized with rounded apices and usually straight posterior margins, second dorsal fin with slightly longer base than the first, more tilted anteriorly. Tail moderately stout at base, shorter than disc length; lateral folds narrow. Caudal fin large, dorsal lobe taller and more slanted than lower lobe, apex narrowly rounded to angular, rounded ventral margin and convex posterior margin.

Colour: brownish with dark reddish brown to blackish brown spots. Markings covering dorsal, pelvic and caudal fins, varying both shape and size but generally circular to ovoid, close in size to eye diameter (occasionally smaller) or slightly larger (anterior to first dorsal fin on tail base)some spots merge into elongate blotches. Ventrally creamy white, sometimes with darker disc margins.

Generally considered to be a synonym of *Narcine timlei* (Carvalho and Randall, 2003; Carvalho. 2002; Froese and Pauly, 2021). Monkolprasit (1990), Carvalho and Last (2016), Carvalho (1999, 2001), Compagno (1999), Compagno (2000) and Sujatha (2002) maintain it as valid species.

This species closely resembles *Narcine lingula* with which it can be distinguished in morphology of oronasal region. This species is reported from Indo-Pacific area including Sri Lanka and eastern India east to Philippines, north to southern China, Taiwan Thailand and the Philippines (Eschmeyer, 2021; Froese and Pauly (2021). No specimen of this species was examined during the present study, however, records from Pakistan may possibly be based on misidentification as the species is not known from the Arabian Sea.

Narcine oculifera Carvalho, Compagno and Mee, 2002
(Fig. 8)

Material Examined

- 1 specimen female collected on 12 October 2015 from Karachi Fish Harbour (19 cm TL)

It is commonly known as bigeye numbfish which has an oval to heart shaped disc, widest just posterior to its mid-length, body fleshy with thick margin. Sound rounded anteriorly but not especially wide. Eyes very large and bulging. . Spiracle large and circular; wide elevated rims completely surrounding spiracle opening. Interspiracular distance much smaller than interorbital distance. Nostrils small, circular to oval, with low posterior nasal flaps; not divided into two separate openings. Nasal curtain short and wide, margin straight posteriorly; not covering upper tooth band. Mouth width equal to internasal width.. Dorsal fin very tall, taller than long, with narrowly rounded apices and rounded posterior margins, first dorsal slightly larger than second in height and base length, originating near pelvic mid length; second dorsal more tilted. Tail stout at base, longer than disc; lateral folds very wide. Caudal fin tall, with narrowly rounded apex and convex posterior margin.

Colour: Dorsal surface with irregular pale brown to reddish brown reticulate pattern delimited by pale oval, kidney shaped and circular blotches of variable sizes; dorsal and caudal fins white-spotted and with whitish posterior margins. Ventrally with darker disc and pelvic fins margins.

- This species was previously recorded from north-west Indian Ocean; northern Somalia and Oman (Eschmeyer, 2021; Froese and Pauly, 2021). It is reordered for the first time from coast of Pakistan. Three term fetuses were found in body of female.

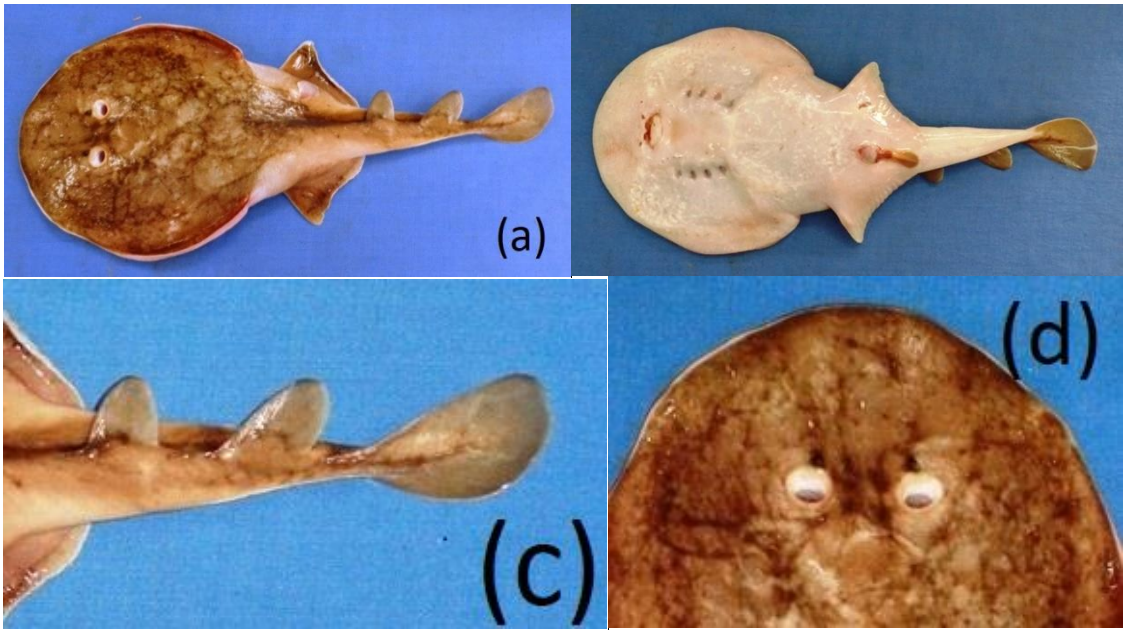

Fig. 8. *Narcine oculifera.* (a) dorsal view; (b) ventral view with pup protruding from anus; (c) tail and dorsal fins; (d) head showing spiracles and eyes.

Narcine timlei (Bloch and Schneider, 1801)
(Fig. 9)

Material Examined

- 1 specimen female collected on 11 September 2003 from Karachi Fish Harbour (17 cm TL)
- 1 specimen female collected on 05 January 2005 from Karachi Fish Harbour (18 cm TL)
- 1 specimen female collected on 22 October 2015 from Karachi Fish Harbour (21 cm TL)

It is commonly known as spotted numbfish which has an oval or subtrapezoidal disc which is widest closed to mid-length and plain coloured upper surface. Snout long and broad, evenly rounded anteriorly/ Eyes small, not protruding, usually smaller than spiracles; eyes and spiracles joined together. Spiracles rounded, with elevated smooth borders. Nasal curtain short, much wider than long; sometimes with subtriangular median lobe. Mouth small, slightly wider than internasal distance. Nostrils large and circular, with small folds posteriorly. Pelvic fins broad, much wider than long. Tail stout at base, its length slightly shorter than disc length; lateral fold low. Dorsal fins small, subequal in height and length, or second dorsal slightly tall than first; first dorsal with broad and rounded apex, originating slightly posterior to pelvic fin insertion; second dorsal with a more tilted anterior margin and slightly more pointed apex. Caudal fin with slanted upper lobe and narrowly rounded apex; posterior margin convex to more or less straight.

Colour: Dorsally uniform yellowish, brownish or purplish brown, without any elaborate markings; posterior margin of dorsal fins, lateral tail region and posterior pelvic borders whitish. Creamy white ventral coloration.

This species was reported from Sindh by Ahmad *et al.* (1973) and Anonymous (1955), from Karachi by Ahmad *et al.* (1973), Anonymous (1953; 1955; 2000, 2001), from Makarn coast by Ahmad *et al*. (1973) and Anonymous (1953, 1955). It is reported from Pakistan without mentioning any specific location by Ahmad and Niazi (1975), Bianchi (1985), Carvalho and Randall (2003), Carvalho (2001), Froese and Pauly (2021), Hoda (1985, 1988), Hussain (2003), JaIil and Khaliluddin (1972, 1981), Khan and Quadri (1986), Misra (1969), Psomadakis, *et al.*, (2015) and Qureshi (1953, 1972).

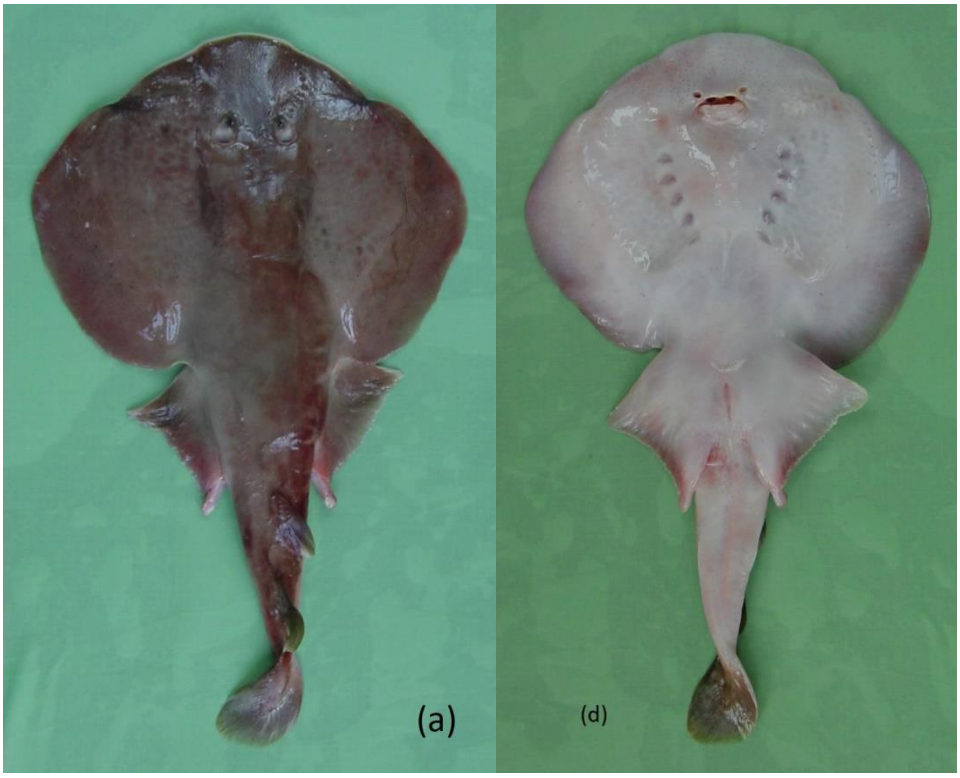

Fig. 9. *Narcine timlei*. (a) dorsal view; (b) ventral view

Narcine indica Henle, 1834 is reported from Karachi and Sindh Coast by Anonymous (1955) and from Makran coast by Anonymous (1955) and Qureshi (1952; 1957). It was also reported from Pakistan coast without mentioning any specific location by Bianchi (1985), Hoda (1985, 1988), Jalil and Khaliluddin (1972, 1981), Qureshi (1953) and Siddiqi (1956). This species is generally considered to be a synonym of *Narcine timlei* (Carvalho and Randall, 2003; Carvalho *et al*, 2002; Eschmeyer, 2021; Froese and Pauly, 2021). However, Monkolprasit (1990), Carvalho *et al* (1999), Compagno (1999) and Compagno (2000) maintain *Narcine indica* as valid species. Main characters which make *Narcine timlei* distinguishable from all other *Narcine* species are its small maximum size, very small eyes and plain coloration, Pakistani specimens resemble holotypes of *Narcine indica* housed in the Muséum National d'Histoire Naturelle, Paris, as given in Fishbase (Froese and Pauly, 2021).

Narcine timlei is widely distributed in Indo-West Pacific area including Arabian Sea (Pakistan) to Thailand, Malaysia, Singapore, Indonesia, southern China and Vietnam and (Eschmeyer, 2021; Froese and Pauly, 2021)..

Family Narkidae (sleeper rays)

The members of this family have anteriorly rounded disc and head equipped with electric organs, developed from branchial muscles; eyes small; jaws stout, short and weakly protractile; rostrum narrow; shallow groove around mouth and usually have a single dorsal fin. It is represented in Pakistan by one species *Narke dipterygia* which is most common electric ray found in Pakistan.

Narke dipterygia (Bloch and Schneider, 1801)
(Fig, 10)

Material Examined

- 1 specimen female collected on 09 April 2004 from Karachi Fish Harbour (19 cm TL)
- 1 specimen female collected on 26 June 2013 from Karachi Fish Harbour (21 cm TL)
- 1 specimen female collected on 30 May 2016 from Karachi Fish Harbour (24 cm TL)

Fig. 10. *Narke dipterygia*. (a) dorsal view; (b) ventral view

It is commonly known as soft-tail sleeper ray which has a subcircular disc which is longer than wide; anterior margin broadly rounded to somewhat straight. Head small with eyes and spiracles tightly adjacent. Eyes small, sometimes concealed by spiracular rim. Spiracle s much larger than eyes, spiracular rim usually low. Nostrils circular. Nasal curtain short and wide, wide posteriorly; usually with many pores and strong median groove, posterior margin more or less straight. Pelvic fin broad. Claspers short and flat in adult males, extending past beyond pelvic fin rear tips. Single dorsal fin, rounded to oval at apex, smaller than caudal fin, originating over pelvic fin free rear tips. Tail broad and flat; lateral tail fold slender to moderately broad. Caudal fin broadly rounded to oval or slightly trapezoidal, with low ventral lobe and straight to broad posterior margin.

Colour: Medium to dark brown or reddish brown above, usually well define creamy blotches above pelvic fins bases, pectoral fin insertions along base of tail. Ventral surface white, sometimes posterior disc margins brownish.

This species is the most common electric ray found in Pakistan which was reported from Sindh by Ahmad *et al* (1973), Anonymous (1955) and Murray (1880), from Karachi by Ahmad *et al.* (1973), Anonymous (1955) and Punwani (1934) and from Makran coast by Ahmad *et al.* (1973), Anonymous (1955), Fowler (1941), Qureshi, 1952; 1957) and Zugmayer (1913). It is reported from Pakistan without mentioning any specific location by Ahmad and Niazi (1975), Bianchi (1985), Froese and Pauly (2021), Hoda (1985, 1988), Hussain (2003), Jalil and Khaliluddin (1972, 1981), Khan (1924), Khan and Quadri (1986), Misra (1969), Psomadakis, *et al.*, (2015), Qureshi (1953, 1957, 1972) and Siddiqi (1956). Khan (1924), Punwani (1934b) and Zugmayer (1913) listed this species as *Astrape dipterygia* whereas Murray (1880) reported it as *Raja dipterygia.*

This species is distributed in the Indo-West Pacific area including Oman and the Arabian Sea eastward to Japan and south to Singapore and Indonesia (Eschmeyer, 2021; Froese and Pauly, 2021). According to Carvalho (2016)

this may a species group considering variation in its coloration. Arabian Sea specimens were considered to be larger and more reddish (Carvalho, 2016).

DISCUSSION

Although electric rays belonging to order Torpedoniformes are commonly occurring in benthic habitat in shallow as well as deep oceanic waters, but little attention has been paid on understanding their role in the ecosystem dynamic (Flowers *et al*., 2021; Pierce, 2005)/ Along the coast of Pakistan 13 species of electric rays belonging to 4 genera and 3 families are reported from Pakistan. Another species *Torpedo marmorata* was reported from Pakistan by many workers but its records seems to be not correct as this species is known from Mediterranean Sea and Atlantic Ocean. From Pakistan, genus *Narcine* is reported by 6 species, *Torpedo* by 5 species whereas *Benthobatis* and *Narke* by 1 species each, However, biology, distribution and ecology of none of the species are studies from Pakistan.

Torpedo zugmayeri was described from Gwadar Pakistan by Englehardt (1912) which was generally included in the synonym of *T. panthera, T. fuscomaculata* or *T. sinuspersici*, however, during the present study a number of specimens collected from Pakistan were examined and it was concluded that it is valid species as already pointed out by Eschmeyer (2021), Manilo and Bogorodsky (2003), and Weigmann (2016).

Based on the available specimens, *Narcine oculifera* is reported for the first time from Pakistan coast which is known to be widely distributed in the Indian Ocean. Although no specimen of *Narcine atzi* from Pakistan was examined but considering its wide distribution in the Arabian Sea and Bay of Bengal, its presence in Pakistan cannot be overruled.

There seems to be little knowledge available about abundance and distribution of various species of electric ray occurring in the area. Evaluation for International Union for Conservation of Nature *(*IUCN) Red list is available for 11 out of 13 species occurring Pakistan. Two species *Torpedo zugmayeri* and *Narcine brunnea* were not evaluated mainly because, these were included in synonym of other species whereas one species *Benthobatis moresbyi* was rated as least concern (LC). *Torpedo adenensis* was rated as Endangered (EN) (B1ab(v)) because the species was considered endemic in Gulf of Aden. Now that the species is known from Pakistan (Moazzam and Osmany, in press), there is a need for reassessment of this species. All other species are considered as data deficient (DD). None of the species of electric rays are included in any appendices of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and Convention on Migratory Species (CMS) mainly because there is no international trade and none of the species is known to be migratory.

Table 1. IUCN Red List Assessment of Electric Rays species reported from Pakistan.

No.	Species	IUCN Red List Status	Date assessed
1	*Torpedo adenensis*	Endangered (EN) (B1ab(v))	05 February 2017
2	*Torpedo fuscomaculata*	Data deficient (DD)	24 April 2018
3	*Torpedo marmorata*	Data deficient (DD)	30 September 2003
4	*Torpedo panthera*	Data deficient (DD)	31 January 2006
5	*Torpedo sinuspersici*	Data deficient (DD)	07 February 2017
6	*Torpedo zugmayeri*	Not evaluated	
7	*Benthobatis moresbyi*	Least Concern (LC)	09 February 2017
8	*Narcine atzi*	Data deficient (DD)	12 September 2004
9	*Narcine brunnea*	Not evaluated	
10	*Narcine lingula*	Data deficient (DD)	01 January 2007
11	*Narcine maculata*	Data deficient (DD)	01 January 2007
12	*Narcine oculifera*	Data deficient (DD)	07 February 2017
13	*Narcine timlei*	Data deficient (DD)	01 July 2007
14	*Narke dipterygia*	Data deficient (DD)	29 June 2007

None of the species are evaluated for CITES and CMS Appendices.

Shark fauna of Pakistan is now well documented through the studies of Moazzam and Osmany (2014, 2020, 2021a, 2021b, 2021c, 2021d and present paper). In addition to the species included in these studies two species of skates are reported from Pakistan. Reversed skate *Amblyraja reversa* (Lloyd, 1906) with type locality, Arabian Sea off the Balochistan coast (Deep-water; 18°N - 20°N, 68°E - 71°E) is known from Pakistan. In addition, Indian ring skate *Orbiraja powelli* (Alcock, 1898) was reported from Pakistan by Bianchi (1985) as *Raja* (*Okamejei*) *powelli* and Hussain (2003) as *Raja kamejei* (wrongly spelled), however, there seems to be no authentic record of this species from Pakistan.

Hussain (2003) reported Arabian sicklefin chimaera *Neoharriotta pumila* Didier and Stehmann 1996. (*Neoharriotta quraishii*, Ali-Khan and Hussain 1999) from Pakistan coast. Originally *Neoharriotta quraishii* was described from Northern Arabian Sea, off "El-Arar", Somalian coast, 4°58'N, 46°37'E (Gulf of Aden) by Ali-Khan and Hussain (1999) but Hussain (2003) included this in the list of fishes from Pakistan in 1993 which seems to be unjustified because Ali-Khan and Hussain (1999 which was published at a later stage and have not include any report from Pakistan.

Elasmobranch fishes including sharks, stingrays, myliobatid rays, sawfishes and electric rays play important role in coastal and oceanic ecosystems, however, their ecological, biology, stock status and other aspects of biology are not well studied globally as well as in Pakistan. Now with available information about the taxonomy of the species from Pakistan, these aspects can be easily studied which will help in deciphering their important role in marine environment.

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