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A first account of the elasmobranch fishery of Balochistan, south-west Pakistan

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Abstract

Pakistan was listed as eighth globally in its landings of sharks and other elasmobranchs during the 1990s. Balochistan occupies over three-quarters of the coast of Pakistan yet the nature of the elasmobranch fishery there remains undocumented. Landings of elasmobranchs at landing sites were surveyed; the main species recorded were blacktip shark (*Carcharhinus limbatus*), bull shark (*C. leucas*) and spot-tail shark (*C. sorrah*). Altogether 25 shark species were identified, of which nine are regionally vulnerable, eight endangered, and one (the sand tiger shark, *Carcharias taurus*) critically endangered. Of the thirteen other elasmobranchs recorded, five are regionally vulnerable, two are endangered and one (the sawfish, *Pristis pristis*) critically endangered. Local fishers and processors were interviewed about their industry. Sharks were caught using both long-lines and nets, largely in May – July. The fishers retained some meat (for consumption) or liver (for the oil used for waterproofing boats), but did not process the sharks themselves, instead selling them to agents of companies that exported fins and other elasmobranch products. Results showed that recorded landings in both Balochistan and the neighbouring Sindh Province have declined to a tenth or less of peak catch. Meanwhile, the numbers of registered fishermen continued to increase, a persistent threat to elasmobranchs stocks. It is recommended that a realistic national plan of action and widespread public awareness programme, with support to fishers and processors would help to alleviate this critical situation.

Keywords: economic value, elasmobranch overfishing, fishers, fisheries, population decline, processors

Introduction

The Indian Ocean and western Pacific contain the greatest diversity of living elasmobranchs (Fowler *et al*., 2005). These regions have also experienced widespread collapse in elasmobranch abundance (Dulvy *et al*., 2017), principally due to intensive fishing (Jabado *et al*., 2018) stimulated during recent decades by the far-eastern demand for shark fin (Davidson *et al*., 2015). Countries in the Western Indian Ocean and Arabian Gulf regions that developed significant shark fishing industries during that period include Iran (Gerami and Dastbaz, 2013; Nergi, 2014; Jabado and Spaet, 2017), Oman, Kuwait, Qatar and United Arab Emirates (Henderson *et al*. 2007, 2008; Moore *et al*., 2012), Yemen (Shaher, 2007; Jabado and Spaet, 2017) and India (Akhilesh *et al*., 2011; Varghese *et al*., 2017). Pakistan, along with neighbouring India and Iran, was among the top 20 countries for shark landings during the periods 2000 to 2008 (Lack and Sant, 2009) and 2009 to 2013 (Dulvy *et al*., 2017). However, until now very little has been documented of the nature of this fishery over the greater part of the Pakistan coast, which falls within the province of Balochistan (Fig. 1).

Estimated elasmobranch landings for the whole country have been reported annually by Pakistan to

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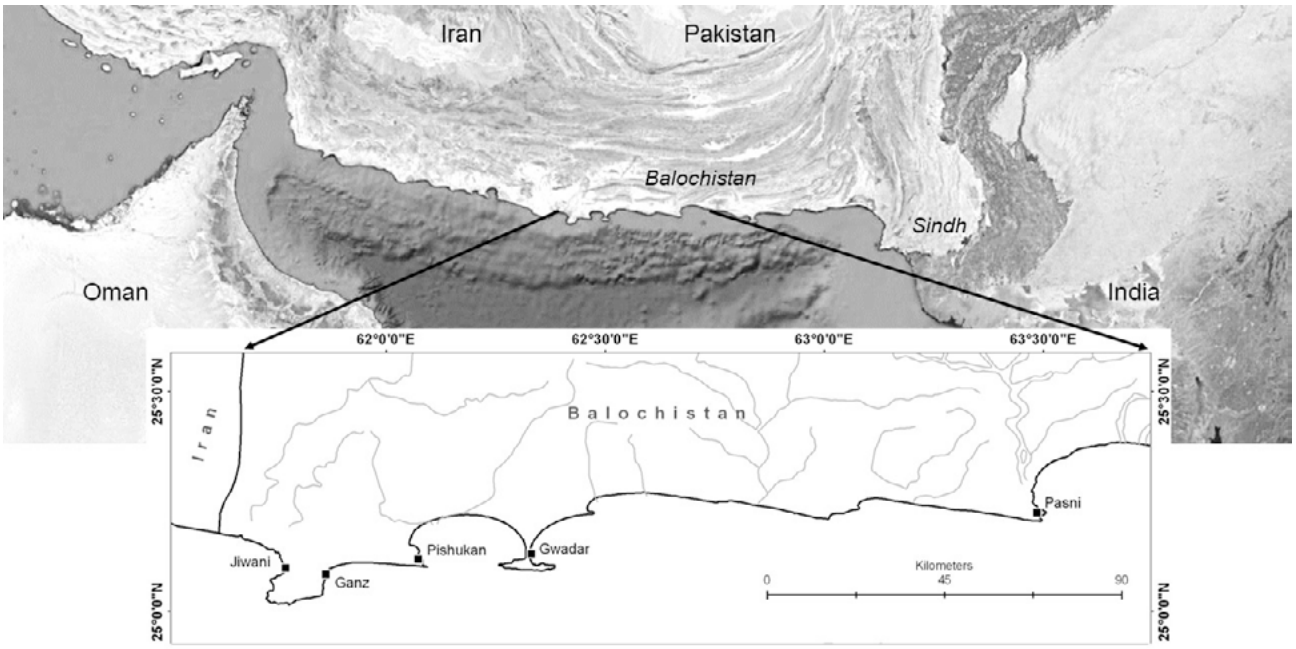

Figure 1. Upper map shows the Northern Indian Ocean with the two coastal provinces of Pakistan, Balochistan and Sindh, adjacent to Iran and India (Google Earth). Lower map gives details of main fishing towns along the Balochistan coast (WWF-Pakistan).

the United Nations Food and Agricultural Organisation (FAO). Between 1985 and 2000, gross landings increased by about 35%, but subsequently appeared to decline (Davidson *et al*., 2015) and considerably more rapidly after 2007 (Fig. 13 in IOTC-2018-CoC15-RE). However, fisheries officers visiting landing places have normally only been able to make gross estimates of the combined weight of different classes, with neither the species fished nor the trade categories recorded by Pakistan's Marine Fisheries Department (2002, 2006, 2012). Until now, there has been minimal information on the species being caught in this region for commercial markets (see Clarke *et al*., 2006; Fischer *et al*., 2012). Without such basic data, stock assessments cannot be initiated, despite the impact of unsustainable fishing on elasmobranchs being of international concern (Stevens *et al*., 2000). An opportunity arose during cetacean surveys that the authors undertook in Balochistan to detail the landings of elasmobranchs at a series of coastal ports and landing sites, and also to interview local fishers and fish processors about the details of the fishery.

Materials and Methods

The Balochistan coast extends for 800 km between the border of Sindh Province and India in the east, and the border of Balochistan Province with Iran in the west. While the coast of Sindh is dominated by mangrove stands and mud flats around the Indus Delta, the coast of Balochistan consists mostly of alternating sandy and rocky shores, with sections of high cliffs. Below the shore, the seabed slopes to a shallow continental shelf, which is only 3km wide near Gwadar in the west but 73km wide near the Hub River in the east. Beyond the shelf, the seabed falls steeply to the Oman Abyssal Plain (Gore *et al*., 2012) (Fig. 1).

Data on elasmobranch exploitation were collected from: a) landing sites; b) fishers; c) fish processors and their agents; d) fish export companies; and e) government sources. Between 16 April 2007 and 14 May 2010, all coastal settlements were visited as frequently as practicable and notes made of the species landed. On a total of 68 occasions, quantitative data were collected at 12 landing sites: 1) Afzal Bakar Naseer (both near Ganz), Ganz; 2) Adam Bakar, Bangali Para, Hussain Abdul, Kanpa, KD Bakar, Kinara and Murad Bakar (all in or near Jiwani); and 3) Pasni. For analysis, the sites were grouped into three sub-areas; Ganz, Jiwani, and Pasni, and analysed statistically using non-parametric statistics. On these occasions, most specimens were identified to species, their total length (nose tip to tail end) measured, and where possible the individual weight recorded. The prices (in local currency – Pakistani Rupees) being paid to fishers by processing company agents for

the different species were also noted. On other occasions, either the visits to landing sites were brief, or the fishers or agents were not willing to allow time for quantitative data to be collected. On these occasions, attention was focused on noting any previously unrecorded species of shark that might be present and also on building a list of the species of other elasmobranchs that were also sometimes landed. A proportion of sharks could not, however, be identified with confidence; these have been recorded using the local terms pishik (small demersal sharks), pagas (medium bodied, coastal sharks), and warook (pelagic and large-bodied sharks).The length at maturity of species was referenced using Ebert *et al*. (2013).

Shark fishers, and processing plant managers and their agents, were interviewed using a standard list of questions covering their background, fishing method, catch statistics, prices paid to fishers, processing procedures, and prices paid to processors by exporting businesses. In addition, a workshop on shark fishing and conservation was held at WWF Jiwani, SW Balochistan, in November 2009. This was attended by 24 participants, including fishers, boat owners, processors' agents, fish processing company owners and exporters; the additional information gained was incorporated into the analyses. Government statistics on Pakistan's fishing industry were obtained from the Marine Fisheries Department in Karachi.

Table 1. Species of sharks and number recorded in 68 landings, separated into three sub-areas of Balochistan, between 16 April 2007 and 14 May 2010. Pishik is a local term for small bodied sharks including small demersal species, Pagas is the the term for medium sized coastal shark species, and Warook the term for large pelagic shark species.

Scientific name	English name	Ganz	Jiwani	Pasni	Total
Chiloscyllium griseum	Grey bamboo		1		1
Loxodon macrorhinus	Sliteye		9		9
Rhizoprionodon acutus	Milk	7			7
Rhizoprionodon oligolinx	Grey sharpnose		1		1
Scoliodon laticaudus	Spadenose		1		1
Other Pishik			43		43
Carcharhinus limbatus	Blacktip	*5*	196		201
Carcharhinus melanopterus	Reef blacktip		1		1
Carcharhinus sorrah	Spot-tail		26		26
Negaprion acutidens	Sharptooth lemon		9		9
Other Pagas		1	62		63
Alopias pelagicus	Pelagic thresher			1	1
Alopias superciliosus	Bigeye thresher			1	1
Carcharhinus leucas	Bull	39	*5*		44
Carcharias taurus	Sand tiger	2	1		3
Isurus oxyrinchus	Shortfin mako		11		11
Sphyrna lewini	Scalloped hammerhead		2		2
Sphyrna mokarran	Great hammerhead		*5*		*5*
Sphyrna zygaena	Smooth hammerhead		3		3
Other Warook		3	9		12
Total of individual sharks identified to species		*53*	271	2	326

Results

Shark landings

Twenty species of shark were recorded among landings, of which the most frequent by number were blacktip shark, *Carcharhinus limbatus* (61.7%), bull shark, *C. leucas* (13.5%), and spot-tail shark, *C. sorrah* (8.0%) (Table 1). Pagas (medium-bodied coastal sharks) accounted for the greatest part of the catch (66.1%) compared to pishik (small coastal) and warook (large-bodied pelagic) sharks. There was a significant difference in the number of sharks landed in different sub-areas, with the greatest numbers of sharks landed in the Jiwani area and the least in the Pasni area (Friedman ANOVA χ^2=16.1, N=20, df=2, p=0.0003).

The largest sharks landed were bull (*C. leucas*), shortfin mako (*Isurus oxyrinchus*) and sand tiger sharks (*Carcharias taurus*), the first of which varied considerably in size (Table 2). All individuals of the following species were mature: blacktip reef (*C. melanopterus*), grey bamboo (*Chiloscyllium griseum*), grey sharpnose (*Rhizoprionodon oligolinx*), spadenose (*Scoliodon laticaudus*), scalloped hammerhead (*Sphyrna lewini*), smooth hammerhead (*S. zygaena*) and spot-tail sharks, while all individuals of sharptooth lemon (*Negaprion acutidens*), milk (*R. acutus*) and great hammerhead (*S. mokarran*) were immature. In Jiwani, between April and May, both blacktip reef and spot-tail sharks were landed with 3-5 pups unborn, suggesting pupping occurred in that area.

In addition to the species recorded at landing sites, eight fishers from the Jiwani and Ganz sub-areas reported having in the past caught whale shark (*Rhincodon typus*). They stated that the species was seen regularly 20 to 25 years ago, when it was targeted for the liver, but that very few were seen currently and were only caught incidentally or as by-catch. Also, whitetip reef shark (*Triaenodon obesus*) were reported as having been caught by 36 of the fishers from the Jiwani and Ganz areas and Pishukan, but none were recorded during the landing site surveys.

Table 2. Lengths, mean weights and prices obtained by fishers for different species of sharks landed in Balochistan between 16/04/2007 and 14/05/2010. Max: maximum, Min: minimum, TL: total length, PKR: Pakistani rupees.

Shark Species	Max TL (m)	Min TL (m)	Mean Weight (kg)	Max price PKR kg^{-1}	Min price PKR kg-1
Chiloscyllium griseum	0.55	0.55			
Rhizoprionodon acutus	0.4	0.4			
Rhizoprionodon oligolinx	0.61	0.6			
Scoliodon laticaudus	0.5	0.46			
Other Pishik	0.46	0.3	1.31	50	50
Carcharhinus limbatus	1.52	0.6	10.59	145	70
Carcharhinus melanopterus	1.31	1.3			
Carcharhinus sorrah	1.52	1.2	27.5	140	40
Negaprion acutidens	1.04	1		160	160
Other Pagas	1.86	1.2	41.6	100	45
Carcharhinus leucas	4.3	1.52	176	150	120
Carcharias taurus	3.7	3.05	212	150	150
Isurus oxyrinchus	3.96				
Sphyrna lewini	3.1	2.74	175.5		
Sphyrna mokarran	2.29	2	300	140	140
Sphyrna zygaena	2.62	2.6			
Other Warook	2.74	2.1	146.8	150	100

Table 3. List of scientific, English and corresponding Baluchi names of sharks and rays recorded during the study together with their regional (Arabian Seas Region) IUCN Red List status (Jabado *et al*., 2017): CR = Critically Endangered, EN = Endangered, VU = Vulnerable and NT = Not Threatened. This list records elasmobranchs landed during dedicated surveys and opportunistic observations. *C. amboinensis* was observed landed in Sindh.

Scientific name	English name	Balochi name	Regional Status
Sharks			
Alopias pelagicus	pelagic thresher	dumbi	EN
Alopias superciliosus	bigeye thresher	dumbi mushk	EN
Carcharhinus amblyrhynchoides	graceful	kanater	VU
Carcharhinus amboinensis	pigeye		VU
Carcharhinus brevipinna	spinner		VU
Carcharhinus leucas	bull	Loand, warook, balanwad	EN
Carcharhinus limbatus	blacktip	kanater, kalwani	VU
Carcharhinus macloti	hardnose		NT
Carcharhinus melanopterus	blacktip reef		VU
Carcharhinus sorrah	spot-tail	knaitar, mangra	VU
Carcharias taurus	sand tiger	Lohar, lunad	CR
Chiloscyllium griseum	grey bamboo		NT
Echinorhinus brucus	bramble		VU
Galeocerdo cuvier	tiger	narmani	VU
Isurus oxyrinchus	shortfin mako	nar manger	NT
Loxodon macrorhinus	sliteye		NT
Negaprion acutidens	sharptooth lemon	balwand, jagri	EN
Rhincodon typus	whale	baren	EN
Rhizoprionodon acutus	milk	sorapi pishik	NT
Rhizoprionodon oligolinx	grey sharpnose	tailgo pishik	NT
Scoliodon laticaudus	spadenose	bhambol pishik	NT
Sphyrna lewini	scalloped hammerhead	mash bhuttar	EN
Sphyrna mokarran	great hammerhead	mahaish	EN
Sphyrna zygaena	smooth hammerhead	maish	EN
Triaenodon obesus	whitetip reef	lone	VU
Rays			
Gymnura poecilura	longtailed butterfly		NT
Himantura leoparda	leopard whipray		VU
Himantura uarnak	honeycomb stingray		VU
Pateobatus fai	pink whiptail		VU
Taeniurops meyeni	round ribbontail		NT
Torpediniformes			
Narke dipterygia	spot-tail sleeper		NT
Torpedo sinuspersici	Gulf torpedo		DD
Rhinopristiformes			
Rhina ancylostoma	bowmouth	baradari	VU
Glaucostegus granulatus	sharpnose	zahro	EN
Rhinobatos annandalei	Annandale's	zahro	NT
Rhynchobatus sp.	wedgefish	khali	EN
Glaucostegus halavi	halavi		VU
Sawfish			
Pristis	sawfish	bolundo	CR

Table 4. List of Pakistani companies exporting shark and stingray products in 2010, showing nature of products: fresh, frozen or other value added products. "Bones" is the term used for cartilaginous skeleton). * = companies known to be still operating in 2018.

Export Company	Fresh Products	Frozen Products	Other Value Added Products
Arham Group	fillets, fins		
A2Z Enterprise*			fins
Badran Import / Export			fins (dried)
Fairbright Company	meat & fins, stingray		fins, salted & unsalted "bones"
Forte	fins	fins	fins
Global Seafood			fins (dried)
Hansa			fins (dried)
Ocean Gold		fins	
Pakfish International	fins		
Sarah Brand*	fins		fins, "bones", stingray skin
Sea Gold	fins		
Zangi Fisheries*	fins, reef sharks	fins, reef sharks	fins, reef sharks

The price paid to the fishers, reported by the fishers, agents, managers and owners of fish processing plants, was obtained for 45 landings and ranged between 40 and 160 PKR kg^{-1} wet weight (Table 2).

Fisher Interviews

Fifty four fishers were interviewed in their home villages on 16 separate occasions. All the fishers surveyed reported that they used both set nets and long-lines to fish for sharks. The long-line (mungar sungle) comprised of a heavy, multi-filament 12mm diameter nylon rope as the main line, up to 1km long, with 2.5m branch lines attached to the substrate every 10m, with a Mustad No. 2 or 3 hook attached by steel wire to the end of each branch line (see also Hussain and Amir, 2006). Long-lines with 100 to 200 hooks were deployed in deep water of 100m or more. The nets (arrseegh) had a mesh size of up to 23cm and were anchored at each end and left in place overnight.

All the fishers reported that the best period for shark fishing was during the hot season, largely June and July. They caught a variety of species, which were sold un-finned to agents from fish processing companies; fishers considered finning to be specialist work. All, except one of the fishers, occasionally retained sharks liver for caulking their boats. Fishers reported that shark was not a preferred fish, although 23 (43%) also retained shark meat on occasion for eating. The fishers from the Jiwani and Ganz areas all sold their shark catch to Jiwani (50% of all fishers). Those from Pasni, however, sold their shark catch to Gwadar and Karachi (44.4%), or only Karachi (37.0%), or Jiwani (14.8%), while a few sold the catch in Pasni (3.7%). Most fishers could identify sharks to the genus level and some to the species level and used Balochi names (Table 3). Some local names were unusual or of biological interest. For example, variations on maish and bhuttar ("beautiful doll" and "toy-like") were used for the hammerhead (*Sphyrna* spp.), and nar mangar ("dangerous") for short-fin mako (*Isurus oxyrinchus)*. Whale sharks were called baren ("innocent"). One of the landing sites was in the village of Pishukan, which translates as "pup of sharks", because sharks in pup were often landed there.

Interviews with Fish Processors

Forty two visits were carried out to 15 fish processing plants; all of these plants bought sharks. Ten plants in Jiwani sent their products to Karachi and one also sent products to Gwadar. The four Ganz plants sent their products to Jiwani, and the Pishukan plant sent their products to Karachi. All plants appeared to process sharks of a wide range of sizes and species and mostly during June and July, with the product mainly being frozen prior to further use. The mean mass of shark a plant received per season (June – July) to process was 4408kg (range 200 – 25,000kg) and the price paid to agents by the processing plant ranged between 150 and 200 $PKRkg^{-1}$. Four of the plant owners/managers

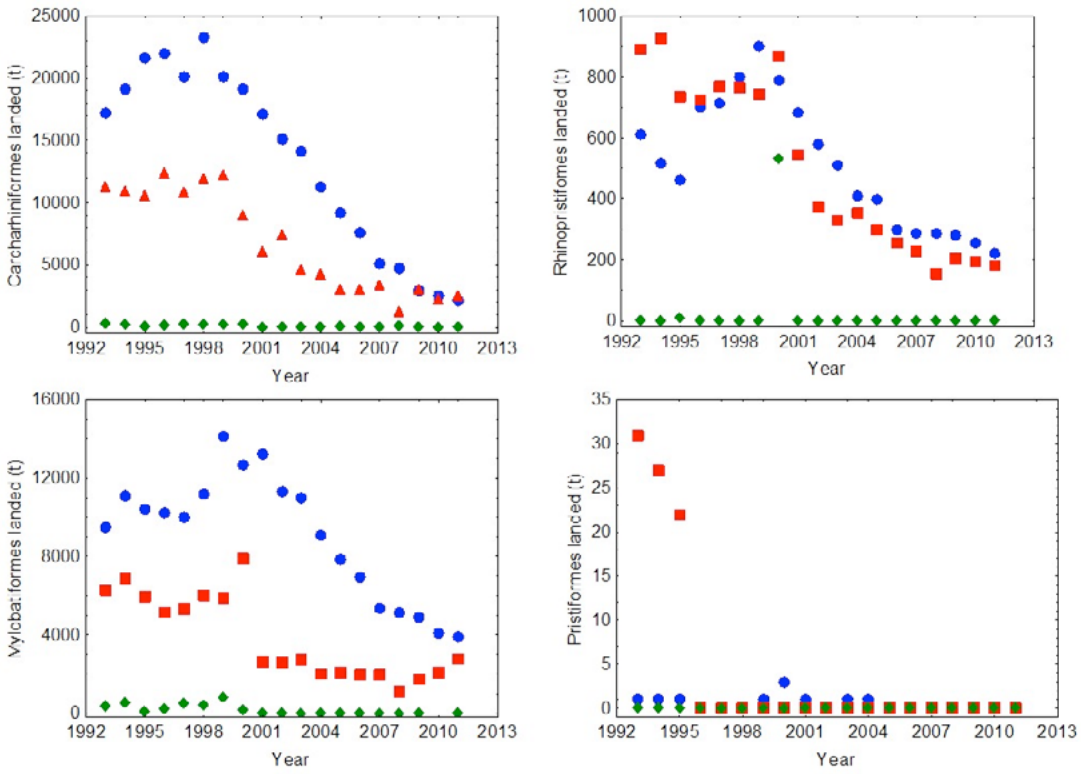

Figure 2. The estimated total wet weight landings (t) between 1993 and 2011 of each of four groups of elasmobranchs: sharks (Carcharhiniformes), guitarfish (Rhinopristiformes), rays (Mylobatiformes) and sawfish (Pristiformes) – separately for the two coastal provinces, Sindh (circles), Balochistan (triangles) and Pakistan's Exclusive Economic Zone (EEZ) (diamonds) collated from records of the Pakistan Government's Marine Fisheries Department.

reported also sourcing and selling their sharks on occasion from or to the port of Chabahar in Iran.

Export of Shark Products

Up until September 2012, there were at least 12 businesses that exported shark products from Pakistan, either as fresh or frozen portions or as value added products, such as dried shark fin (Table 4). Two companies also sold stingrays. Shark fins were being exported to Asia (China, Hong Kong, South Korea and Japan), South Asia (Bangladesh, Sri Lanka, Myanmar, Singapore, Thailand and the Philippines), the Gulf region (Dubai) and Australia. Until at least 2000, shark fins were also being exported to the Czech Republic, France, Germany, Norway, Spain, Switzerland and the U.K. (Marine Fisheries Department, 2002, 2006, 2012). By July 2018, however, only three of these firms still had websites advertising shark products, including fins.

Government Fisheries Data

Nineteen years of data on elasmobranch catches were provided by the Pakistan Marine Fisheries Department; these comprised 7–8% of total fish landings, the bulk of which were in Sindh. Elasmobranchs landed in Sindh and Balochistan and within Pakistan's Exclusive Economic Zone (EEZ outside of coastal waters) were recorded separately under four taxonomic groups: sharks (Carcharhiniformes); guitarfish (Rhinopristiformes); rays (Mylobatiformes); and sawfish (Pristiformes) (Marine Fisheries Department, 2002, 2006, 2012) (Fig. 2). The landings of sharks and rays in both provinces appeared to have increased slightly from

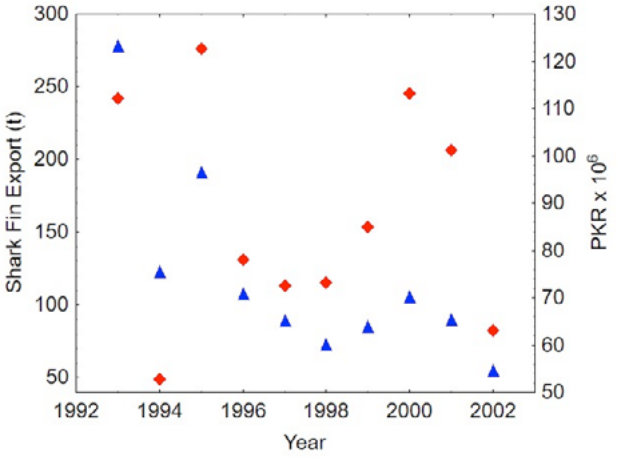

Figure 3. The weights of shark fin (t) (left axis, triangles) and its value (in Pakistani Rupees, PKR) (right axis, diamonds) between 1992 and 2002, from Pakistan government records.

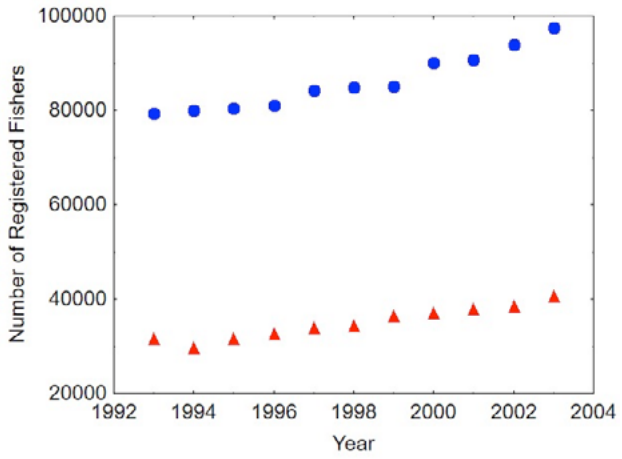

Figure 4. Numbers of registered fishers in the two Pakistan coastal provinces of Sindh (circles) and Balochistan (triangles) between 1993 and 2003.

1992 to about 1998 or 1999, and declined thereafter. Landings of guitarfish, on a much smaller scale (maximum < 1000t), varied irregularly until 2000, but then declined steadily. Landings of sawfish were even lower (maximum < 35t) and were confined almost entirely to Balochistan (where the stocks reportedly collapsed within three or four years during the early 1990s).

Shark fin exports peaked at over 250t in 1995 before declining until 1998. Stocks recovered somewhat in 2000 and 2001 and then declined further (Fig. 3). The monetary value of the shark fins exported appears to have increased in relation to its weight from 1999 to 2001, which may explain the temporary recovery of exports during this period.

The Marine Fisheries Department also registered and issued licenses to all fishing craft operating in Pakistan's territorial waters (Hussain and Amir, 2006). Data were available for the period 1992 to 2004. During that period the number of registered fishers in Balochistan steadily increased, while in Sindh there was an even steeper rise (Fig. 4).

Discussion

In Pakistan, as in many other jurisdictions, elasmobranch landings have not been reported to species or even genus level by government fisheries officers, nor have individual shark weights and lengths generally been recorded. This lack of detail makes monitoring and management of individual stocks problematic, not least since the early decline of some species can be completely masked by increased exploitation of others. The present study provides a report of the shark species constituting the catch in Balochistan, the province accounting for the greater portion of the Pakistani coast.

Not only is species level information required for fisheries management purposes, but the status of many species is also a conservation issue. Of the 25 species of sharks encountered in the present study, nine are now regarded regionally as vulnerable, eight as endangered (including whale shark), and one (the sand tiger shark, *Carcharias taurus*) as critically endangered. Of the rays, guitarfishes and sawfishes, five are considered regionally as vulnerable, two as endangered and one (the sawfish, *Pristis pristis*) as critically endangered (IUCN Red List in Jabado *et al*., 2017) (Table 3). Sawfish appear to have once been relatively abundant in Balochistan, judging by the extensive fencing made of their rostrums around houses in Ganz and neighbouring communities before 2004 (MG pers. obs.). A very steep decline in sawfish landings in Balochistan occurred over as little as three years in the early 1990s. Other scarce species may have been present, as it was not possible to confirm the identification of every individual in the time permitted by the fishers or the agents to whom they were being sold. A report of a rare bramble shark, *Echinorhinus brucus* (IUCN Red listed as Vulnerable: Jabado *et al*., 2017), caught in Sindh's Swatch area, was featured in a leading local newspaper (http://dawn.com/ news/1048126/rare-bramble-shark-brought-to-fish-harbour); it was sold to fish meal manufacturers.

Given the Pakistan Marine Fisheries Department data and the accounts of fishers and fish processors, there is little doubt that there has been a general collapse in landings of all, or nearly all, elasmobranchs in both Balochistan and Sindh since about the turn of the century. By the time the present study was undertaken, total shark landings had returned to numbers similar to those being recorded in the 1950s (IOTC-2018-CoC15-RE), presumably before the demand for shark products led to their accelerating exploitation globally. However, catch rates did not necessarily increase monotonically since that time, as data reported by Pakistan to FAO indicated a sharp drop in the annual landings of both requiem sharks and batoids from about 70,000t to 20,000t in around 1983 (Fowler *et al.*, 2005). This finding suggests that these larger more vulnerable species began to be over-exploited from this earlier date. The more recent data reported here also shows temporary levelling, or even a drop, both in the landings of sharks (Carcharhiniformes), guitarfish

(Rhinopristiformes), and most clearly, rays (Mylobatiformes) (Fig. 2), and in the export of fins (Fig. 3) during the mid-1990s. These data suggested that sustained demand for and increased value of shark fin products probably encouraged fishers to extend their efforts to additional stocks and fishing areas. As a consequence, many species of shark landed did not exceed 1m in length, while the maximum length of even medium-bodied species rarely exceeded 1.5m (Table 2).

It was noticeable that almost all the blacktip, great hammerhead, sharptooth lemon and milk sharks landed were immature, suggesting that the areas being exploited were nursery grounds. Similarly, the blacktip reef and spot-tail sharks landed were typically gravid, giving birth to young on landing, with the pups being discarded as having no value. Clearly, the exploitation of nursery grounds represents a wasted resource, as these sharks would be better caught at a larger size. The landing of gravid females in particular represents a severe threat to stocks, as it also involves the loss of future breeding potential. Similarly, the discovery linked to the present study of two neonatal whale sharks that had been caught in fishing nets in 2000 off Ormara, Balochistan, (Rowat *et al*., 2007) suggested that there might be a pupping area for whale sharks in that region. However, fishers reported that for 20 or more years whale sharks were no longer frequently seen along the western Balochistan coast. This was despite whale sharks still appearing to be reported regularly in the Gulf of Oman and Arabian Gulf (Robinson *et al*., 2017).

Despite the declining stocks of elasmobranchs and also other fish, the number of fishing vessels and fishers in both Balochistan and Sindh continued to increase (Fig. 4), a trend also noted by Khan and Khan (2011). The fisher interviews showed that all the fishers in Balochistan operated on a full-time basis. These findings imply that pressure on stocks continued to increase during the period when there was a drastic decline in the numbers of sharks, guitarfish, and rays being landed (Fig. 2). Almost all fishers reported that since near shore areas were increasingly depleted of sharks and fish generally, they had to work in increasingly deeper waters. A similar shift from inshore to deep sea shark fishing in neighbouring India has also been ascribed to a reduction in coastal species (Akhilesh *et al*., 2011).

Lack and Sant (2009) have indicated that shark finning was not practiced in Pakistan, yet Vannuccini (1999) reported that Pakistan exported dried shark fins to Singapore and other Asian countries. Fowler *et al.* (2005) noted that Pakistan was responsible for 85% of the global dried or salted shark meat. The division of the industry in Balochistan (and similarly in Sindh) as described in the present study explains these apparent contradictions. As noted, fishers regarded shark finning as specialist work and sold elasmobranchs whole to agents, who in turn sold the catch on to processing plants. Thus, the fishers did not fin sharks (or rays). Further, while the processors interviewed all froze their sharks, exporters advertised fresh shark as well. However, the bulk of the shark body was of limited commercial value and it was shark fins that were the main interest for export companies. The price paid to Balochi fishers for whole sharks did not necessarily reflect the value of the fins on the export market, but it was noticeable that the price paid was greater for some species, ranging from the equivalent of US \$0.56–2.26kg^{-1}. Shortfin mako, *Isurus oxyrinchus*, and thresher shark, *Alopias spp*., are reported to be the most highly prized species in the wider shark fin market, presumably because of their proportionately much larger fins, but bull, spot-tail, great and scalloped hammerhead, and sharptooth lemon sharks are also preferred (Vanuccini, 1999) and found in the present study among the species being landed in Balochistan.

It is now widely appreciated that because of their low fecundities and slow growth rates, elasmobranchs generally are considerably more vulnerable to over-exploitation than other highly productive and heavily exploited stocks, such as anchoveta *(Cetengraulis mysticetus*) or shrimp *spp*. (CEA, 2012). CEA concluded that the main factor predicting stock decline was high susceptibility to fishing pressure, rather than high fishing pressure or low fishery productivity. This understanding, together with the realisation that threatened or endangered species of shark and ray are worth protecting for their own sake, has led to the introduction of a wide range of conservation measures by many countries. Size and catch limits have been enacted (e.g. South Africa - http://www.fishthesea.co.za/baglimits.htm) and bans on finning at sea (e.g. South Africa (1998), United Arab Emirates (1999), and India (2013) https://awionline.org/content/international-shark-finning-bans-and-policies), and a series of countries and territories including Egypt (2005), Palau (2009), the Maldives (2010) (https://awionline.org/content/international-shark-finning-bans-and-policies) and the Cayman Islands (Ormond *et al*., 2016) have established shark sanctuaries by giving full protection to sharks throughout their waters, and the most endangered species afforded global protection

under the Convention on Trade in Endangered Species (CITES, www.cites.org) and the Convention on Migratory Species (CMS, www.cms.int). While the scope of such measures may seem limited, Ward-Paige and Worms (2017) found that banning commercial shark fishing and instituting laws that prohibit the possession, trade or sale of sharks and shark products led to less pronounced shark population declines. Thus, it was hoped that Pakistan would take steps to ensure the sustainability of its elasmobranch resources and of the associated benefits to fishers, processors and exporters. It was discouraging therefore to find that, according to Schmidt (2014), the Pakistan Marine Fisheries Department/FAO Fisheries Resource Appraisal Project have listed sharks as an extinct resource in Pakistan, except for coastal demersal species.

As a first stage in introducing effective management, the FAO encourages the development of both country (national) and (global) regional shark management plans (Polidoro *et al.*, 2008). Although a national plan of action for sharks (NPOA-sharks) was under discussion in late October 2004 (Cavanaugh *et al.*, 2009), Pakistan has still not introduced such a measure (Davidson *et al.*, 2015). Pakistan is a signatory to CITES, but it is not a signatory to the CMS Shark Memorandum of Understanding (https://www.cms.int/en/ legalinstrument/sharks-mou). Most recently there was a report that Pakistan had legislated (27 April 2018) a ban on shark finning (IOTC-2018-CoC15-RE). However, the Balochistan legislation bans catching, retention, marketing and trade of only five families of pelagic shark, together with pristids, mobulids, rhinids, rhinobatids and rhynchobatids (Balochistan: No. 50 (Coord:) Fish/2-1/2013/3148-54 dated 08 September 2016). Further action to alleviate the situation is critical, beginning with a realistic national plan of action (NPOA-sharks). This will need buttressing by a widespread public awareness programme and targeted support for fishers and processors. Even partial success will be a worthwhile achievement given that much of Pakistan, including especially Balochistan, is much more ethnically diverse and more difficult to access than generally presumed.

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