Availability: 28 October 2014
IOTC-2014-WPEB10-INF25

WWF
REPORT
PAK
2014

Final Report

AN ASSESSMENT OF CETACEAN MORTALITY IN THE TUNA FISHERIES OF PAKISTAN

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Final Report

(subclause 9 and Schedule Item 5 of the Funding Agreement)

- **Project No**. –
- **Title** - An assessment of cetacean mortality in the tuna fisheries of Pakistan
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- **Organisation** –WWF-Pakistan, Karachi

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1. Project Summary

A clear, plain English summary of approximately 500 words outlining the work undertaken and any significant findings (for publication on the Department's web site). Include what was done, why and the key findings resulting in recommendations summarised from the sections below.
Pelagic gillnet used for catching tuna known for high bycatch and mortality of cetaceans. Pakistan is one of the few countries where gillnet is being used for catching tuna species, however, no information about bycatch especially of non-target species such as cetaceans and turtles is available. In order to collect the information about mortality of cetacean and other bycatch, the project was started. Monitoring of landings at Karachi Fish harbour which is the main landing centre was started as well as an observer programme was initiated. Observers were posted on four tuna gillnet vessels who collected round the year data of each haul and recorded related information. The data reveals that yellowfin is the main tuna species followed by longtail tuna. Skipjack, kawakawa and frigate tuna are other important species. Marked seasonal variation in tuna landings and species composition was noticed. It was also observed that bycatch substantially contribute to the commercial catches consisting mainly billfish (sailfish and marlins), dolphinfish, and sharks. In addition, large numbers of turtles and dolphins are also caught in the tuna gillnets. Only a few turtles was observed to die if enmeshed in the gillnets. Olive Ridley turtle was observed to be the most dominating turtle species followed by green turtle. It was interesting that most of the enmeshed turtles survive. Through this project, an awareness campaign was started to safely release enmeshed turtles which proved successful and now most turtles are careful disentangled from the gillnets and released in the sea. No nesting or stranding of olive Ridley turtle was recorded from Pakistan for the last 11 years, however, a large population of this turtles was observed in the offshore waters of Pakistan. Population of enmeshed olive Ridely turtles in the tuna gillnet was estimated to be about 31,000. It is speculated

that this population may be nesting in neighbouring countries.

All enmeshed dolphins were observed to die thus, discarded. It is estimated that about 12,000 dolphins are killed every year in tuna gillnet operation. Indo-Pacific humpback dolphin (*Sousa chinensis*), bottlenose dolphin (*Tursiops aduncus* and *T. truncatus*), spinner dolphin (*Stenella longirostris*), pan-tropical spotted dolphin (*Stenella attenuata*), long beaked common dolphin (*Delphinus capensis tropicalis*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*) and rough tooth dolphin (*Steno bredanensis*) were observed to die in the tuna gillnet operation in coastal and offshore waters of Pakistan. Marked seasonality was observed in the enmeshment of dolphin with maximum mortality in November. No mortality was observed in monsoon months (June and July) as no tuna gillnetting is done in thse two month. With the exception of mortality of one dwarf sperm whale (*Kogia sima*) no mortality of whales was recorded.

Considering exceptionally highly mortality of dolphins it is recommended to take appropriate management measures including ban on new entry in tuna gillnet fishing, compliance to UNGA Resolutions restricting gillnet length to 2.5 Km, conversion of gillnetting fleet to longlining, declaration of marine protected areas (MPAs), establishment of a regular data base of turtle and cetacean enmeshment and adherence to management measures suggested by tRFMO (IOTC).

2. The Outcomes and Objectives – Key Findings

List the Project Objectives and address each one, noting the degree to which the objective was achieved through the research and issues that may have hampered its success. Describe the key findings as they relate to the objectives and the management questions identified in the initial application.

MONTHLY LANDINGS OF TUNA AND BYCATCH SPECIES

Tuna Landings

A daily monitoring programme of tuna fishing vessel (gillnetters) was initiated in July 2012 at Karachi Fish Harbour which is main landing centre for tuna landings. With the exception of Sundays, data is collected on daily basis. Fishermen were interviewed to determine area of fishing, enmeshment of cetaceans, turtles and other bycatch species as well information pertaining to fishing operation and other related aspect was collected. The collected data indicates that tuna landings have bimodal distribution having a major peak of landings during February and May with maxima in March (Fig. 1). A small peak of tuna landings was observed during September and December. During June and July, landings of tuna declines because with the exception of a few vessels, all tuna gillnet vessel stops their operation because of intensive monsoon. Average data collected over 19 months of project period is given in Annexure-I.

An observer programme was initiated under the project whereby observers were posted on 4 tuna gillnetters operating from Karachi Fish harbour. A comparison of data recorded from commercial landing at Karachi Fish Harbour was compared with the information collected by the observers. While comparing the two set of data it may be kept in mind that a few tuna gillnet vessels sometime transship their catch to vessels from neighbouring country as well as retain themselves for later auction or dispose off their catch to other types of local vessels.

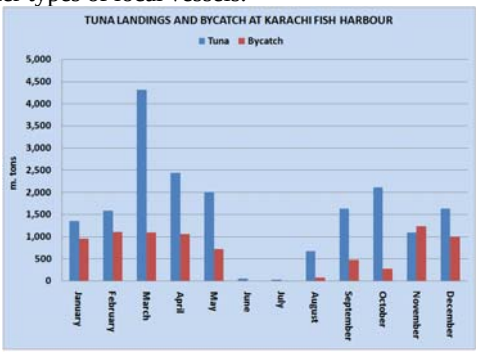

Fig. 1. Monthly landings data for tuna and bycatch species collected from Karachi Fish harbour.

It is evident from Fig. 2 that the tuna catch also has bimodal distribution having a major peak of landings during February and May with maxima in March. A small peak of tuna catch was observed during September and December. During June and July, no catch of tuna was recorded because all four vessels have stopped their operation.

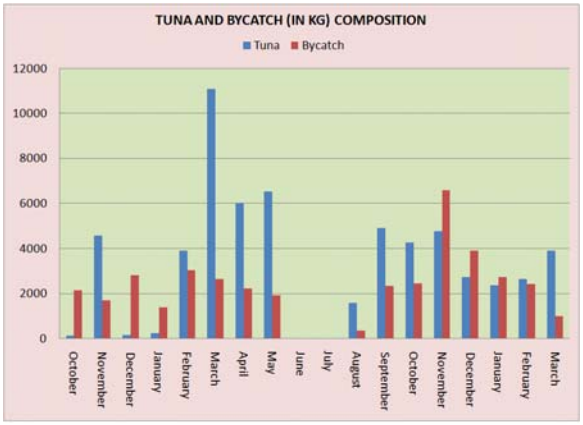

Fig. 2. Average monthly catch for tuna and bycatch species recorded by observers

According to annual statistical data provided by Government of Pakistan, total landings to tuna and bycatch species from province of Sindh (Karachi Fish Harbour being the major tuna landing centre) is reported to 32,156 m. tons whereas total bycatch was reported to 6,781 m. tons making a total landings of large pelagic to be 38,937 m. tons. The disparity in data is mainly because of inclusion of tuna catches that are transshipped at high seas in the Government statistics. In addition, it includes tuna and bycatch which are transported from other landing centres. Need not to mention that annual statistical data is not available on monthly basis making it difficult to make the comparison.

Species Composition of Tuna

Although 8 species of tuna are known from Pakistan, only six are commonly occurring in the commercial landings. The data collected from Karachi Fish Harbour reveals that yellowfin tuna (*Thunnus albacares*) is the most commonly occurring species contributing about 45 % in the total commercial landings. Longtail tuna (*Thunnus tonggol*) contributes about 25 % followed by kawakawa (*Euthynnus affinis*) contributing about 19 % (Fig. 3). Frigate tuna (*Auxis thazard*) contributes about 6 % whereas skipjack tuna (*Kutsuwonus pelamis*) contributes only five %. Bullet tuna (*Auxis rochei*) contributes less than 1 %. Data collected through observer programme does not differ grossly from the pattern observed from commercial landings.

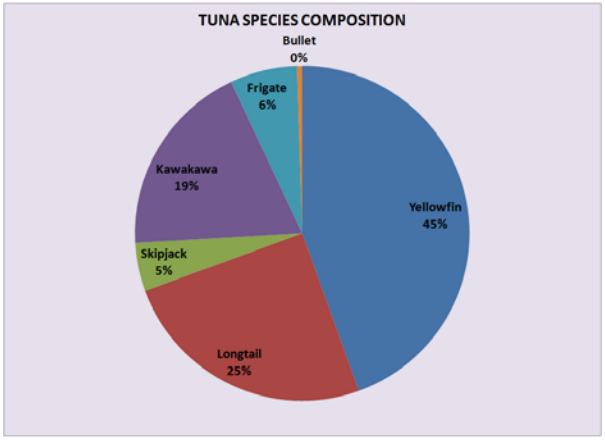

Fig.3. Pie diagram showing tuna species composition in commercial landings at Karachi Fish Harbour.

Kawakawa contributed 13 % which less than those observed at Karachi Harbour (19 %) whereas catches recorded by observers indicate about 13 % which is higher than reported from Karachi Fish harbour (Fig. 4). These disparity in percentage is mainly because of retention of frigate tuna by vessels monitored by observers. Usually frigate and bullet tunas are discarded. In addition to the commonly occurring species, stripped bonitos (*Sarda orientalis*) and bigeye tuna (*Thunnus obesus*) are also reported from Pakistan but these were not regularly reported in commercial catches.

Seasonal variation in tuna species composition was noticeable (Annexure-I).It was observed that yellowfin tuna was dominating between December and April whereas its landing was comparatively lower during May to November. This is mainly because fishermen ventures in the offshore waters during calm seasons (December to April) whereas their activities are restricted to neritic waters during summer when sea conditions are usually very rough. Longtail tuna was observed to be dominating during May whereas kawakawa was dominating in commercial catches during November. During June and July tuna gillnet activities are practically stopped except some landings of tuna by vessels operating in coastal area and engaged in surface or bottom set gillnetting.

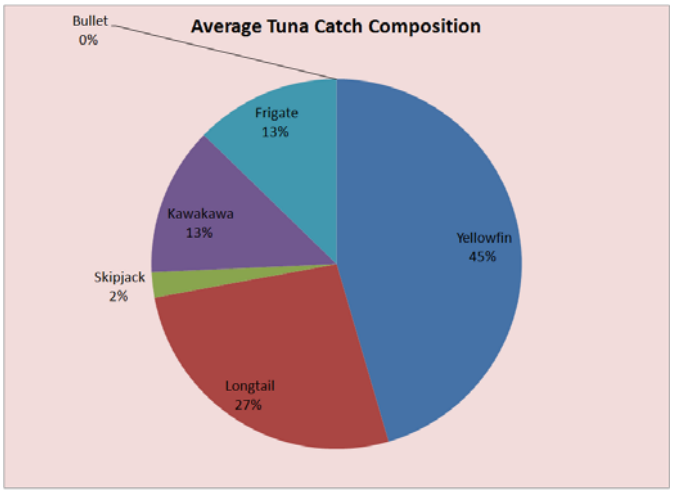

Fig.4. Pie diagram showing tuna species composition as recorded by observers

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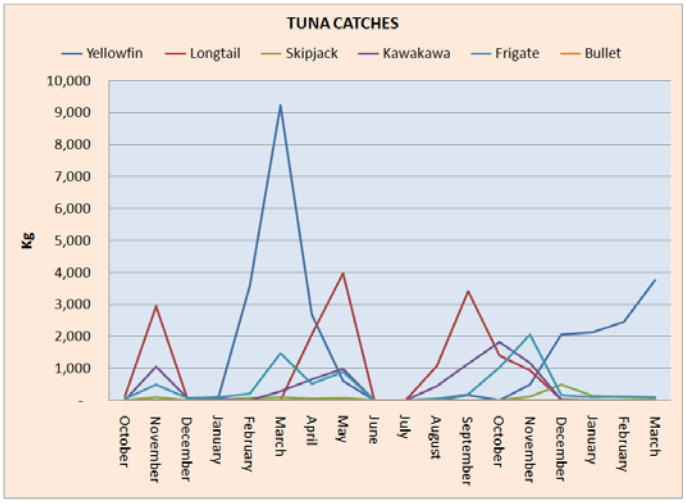


Fig.5. Pie diagram showing tuna species composition as recorded by observers

Fig 5 depicts the month-wise catches of tuna species which reveals that yellowfin tuna catches has a major peak in March and a a minor peak in November whereas longtail tuna have peaks in May and September. Bimodal pattern of catches was also observed in other species of tuna.

Bycatch of Tuna Gillnet Operations

In addition to tuna, a large number of other species of fishes as well as other animals are caught by gillnet vessels. The data revealed that about 30 % of the catch of tuna gillnet vessels consist of bycatch landed at Karachi Fish Harbour (Fig. 6). Data recorded by observes show the contribution of bycatch to be 40 % (Fig. 7). The disparity is on account of the same reasons as explained above. Dominating among fishes are Indo-Pacific sailfish (*Istiophorus platypterus*) and common dolphinfish (*Coryphaena hippurus*) followed by followed by sharks and marlins (Fig.4). There a number of other fish species including unicorn leatherjacket (*Alutrea monoceros*), rough triggerfish (*Canthidermis maculata*), narrow barred Spanish mackerel (*Scomberomorus commerson*), wahoo (*Acanthocybium solandri*), greater barracuda (*Sphyraena barracuda*), rainbow runner(*Elagatis bipinnulata*) and sickle pomfret (*Taractichthys steindachneri*) which are regularly caught by tuna gillnetters. It may be mentioned that those tuna vessels that occasionally operate in coastal waters also catch a number of demersal species whose names are not included in this reports.

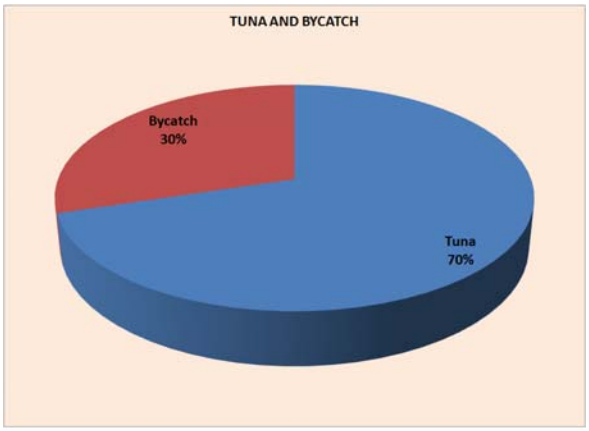


Fig.6. Pie diagram overall percentage of tuna and bycatch in commercial landings at Karachi Fish Harbour.

Marked seasonality in composition of fish bycatch species was noticed . With the exception of November when the quantity of bycatch is more than tuna landings, bycatch were observed to be only 30 to 40 % of the total catch/ In March, bycatch was observed to be only 20 % of the tuna landings. Common dolphin is the most frequently occurring bycatch species which seems to be present in substantial qualities throughout the year with their peak of landings during April and November. Indo-Pacific sailfish is also of common occurrence with maxima in March and a minor peak in November. The data collected from Karachi Fish harbour indicates only 4 species groups i.e. dolphinfish, sailfish, marlins and sharks (Fig. 8) whereas a detailed recording system was maintained under observer programme (Fig. 9). In Karachi Fish harbour bycatch of tuna gillnetters is disposed off through various marketing channels making it difficult to record data for all bycatch species. Considering two data sets are quite different therefore no comparison is made.

Sharks are also found to be occurring in bycatch throughout the year with a maxima in December. Among sharks, shotfin mako (*Isurus oxyrinchus*) and big-eye thresher (*Alopias superciliosus*) are dominating almost throughout the year. Other species of sharks that are caught as bycatch by tuna gillnetters are silky shark (*Carcharhinus falciformis*), graceful shark (*Carcharhinus amblyrhynchoides*) and oceanic whitetip shark (*Carcharhinus longimanus*). In addition to sharks, pelagic stingray (*Pteroplatytrygon violacea*), Japanese spiny mobula (*Mobula japonica*) and cownose ray (*Rhinoptera javanica*) are also sometimes caught by tuna gillnet vessels.

Since most bycatch species also fetches high prices, therefore, these are also retained onboard. Billfishes, sharks, dolphinfish and narrow-barred Spanish mackerel are preferred bycatch species, therefore, these are kept in chilled condition. There is generally no discard except smaller frigate and bullet tunas are discarded mainly because of their low prices. Similarly pelagic stingray and sometimes mobulids are also discarded. All other catch is retained.

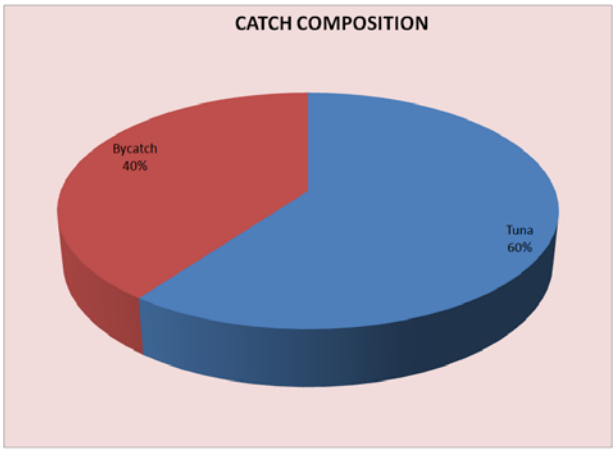


Fig.7. Pie diagram overall percentage of tuna and bycatch as recorded by observers.

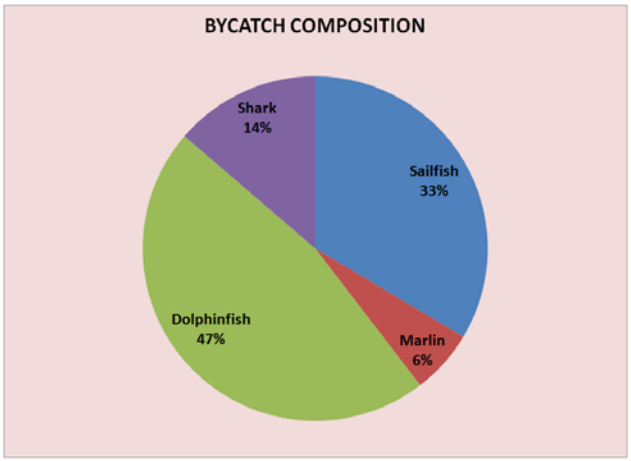


Fig.8. Pie diagram percentage of major component of fish bycatch in commercial landings at Karachi Fish Harbour.

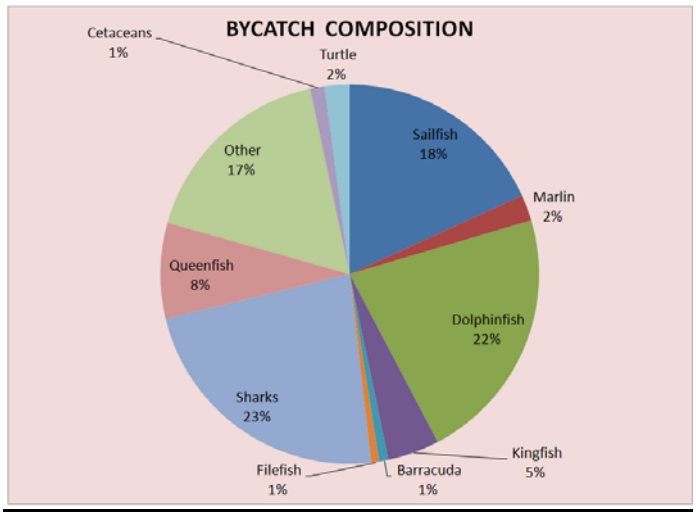


Fig.9. Pie diagram percentage of major component of fish bycatch as recorded by observers.

ESTIMATION OF FISHING EFFORT ENGAGED IN TUNA FISHING.

Pakistani tuna fleet consists entirely of locally made wooden boats. Majority of the tuna boats operating from Karachi are of large size; exceeding more than 15m LOA whereas dominating tuna fleet operating from Balochistan coast consists of comparatively smaller boats of less than 15m. Data collected by the project reveals that most of the boats operating from Karachi range between 15 to 20m whereas those operating from Balochistan range between 10 to 15m. There are about 160 large boats (ranging between 20 to 30m LOA) which have on board freezing facilities and have dual registration in Pakistan and neighboring country. These boats mostly ply from Balochistan but also sometime venture in Pakistani waters and offload part of their catch at Karachi.

Almost all tuna fishing boats operating from Karachi have a transom at the stern whereas tuna boats of Balochistan are mostly double keeled. Tuna boats operating from Karachi or Balochistan coast have inboard engine with 50hp to 500hp. The boats are not well equipped. Almost all of these boats have one or two hydraulically operated net haulers. However, only one net hauler is used at a time whereas the other is kept as spare. Previously, no navigational and communication gadgets were used on these boats but now most tuna boats carry fish finders, Global Positioning System (GPS), GPS plotters and satellite phones. Some boats also have Very High Frequency (VHF) and short-wave radios for communication purposes.

Most of these boats have fish hold consisting of 8 compartments (larger boats have 10) each with capacity to hold about 1to 2 tons of fish. Ice is carried on fishing trips and prime catch is placed with ice. Because of their smaller size, fishing boats of Balochistan have fewer fish holds. Surface gillnetting using polyamide nets are used for catching tuna in Pakistan. It has stretched mesh size ranging between 13cm to 17 (average 15cm) with a hanging ratio of 0.5. The length of the net varies from 5 to 30km. In most cases, the length of the net ranges between 5 and 10 km in inshore fisheries and between 10 and 25km in offshore fisheries. In some boats which have onboard freezing system, the length can be 25 to 30km. There are variation in the length and specification of net. If targetingsmall tuna in shallow waters smaller mesh net is used. The nets used in inshore and neretic waters have a length ranging between 2.4 and 12.0km, whereas in the those boats operating in the offshore waters have gillnets with length ranging from 6.0 to 12.6 km.

It is difficult to calculate fishing efforts because of different sizes of fishing boats and gears being used as well as duration of fishing. There are about 210 tuna fishing boats which are based in Karachi Fish (Annexure-II). Harbour. In addition, some fishing boats which are based in Balochistan land their catch in Karachi Fish Harbour as well as some boats may quit operation from Karachi Fish Harbour may get themselves based in any of five landing centres along Balochistan coast. It may also be added that on many occasions especially during January and April, a number of tuna gillnet boats change their operation to bottom set gillnetting in neritic waters.

Fishing effort is defined as amount of fishing gear of a specific type used on the fishing grounds over a given unit of time e.g. hours trawled per day, number of hooks set per day or number of hauls of a beach seine per day. In case of gillnets length of gillnet used per day is selected as unit of fishing effort. Since mesh size for tuna gillnetting is almost constant i.e. 15 cm (average) and breadth of the net is 14 m. In addition, net is laid down at starting at 16:00 Hours (evening) and kept in water for about 12 hours as heaving of the net is started at 04:00 Hours. Therefore, these factors were not taken into calculation and only length of gillnet in km/day was used as unit of fishing effort. With these limitation calculation of the effort of tuna gillnetter was calculated which is given in Table-I. This data is considered tentative and may be subject to a number of variables, therefore, it may be used with caution.

Table-I. Fishing effort (km/day) engaged in tuna fishing at Karachi Fish harbour

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Fishing effort	1,590	1,600	1,700	1,700	1,250	140	140	600	1,500	1,700	1700	1,650
Fishing Days/month	22	20	23	22	20	6	6	18	22	23	22	23
Total fishing effort/month	34,980	32,000	39,100	37,400	25,000	840	840	10,800	33,000	39,100	37,400	37,950

The data indicates that fishing efforts are highest during March to April and October and November. It started declining in May and reached to bare minimum during June and July. Fishing seasons starts in middle of August whereas a few boats start operation in September. Fishing activity slightly reduce during December and January because of prevailing low oxygen which affects tuna catches.

FREQUENCY AND QUANTIFICATION OF CETACEANS' MORTALITY IN TUNA GILLNET BOATS

It is an established fact that cetaceans are highly prone to the gillnet operation and die due to entanglement and suffocation. High mortality was reported by tuna gillnet operation but there frequency and quantification were not well known. Although tuna landings data and related information was initiated under the project but cetacean mortality was hardly reported by fishermen. In most cases, fishermen deny any enmeshment of cetaceans and even if they accept that one or two dolphins were entrapped, they always claim of releasing them alive.

Under the project surveyors were posted on the tuna gillnet vessels and reliable information about cetacean mortality was gathered which reveals than annually about 12,000 dolphins are killed in tuna gillnet operations along the coast of Pakistan. For the estimation of mortality of dolphins, average number of dolphin killed on the tuna vessels on which observers were deputed during a month which is multiplied by estimated number of vessels engaged in tuna gillnetting. No mortality of baleen whales was observed during the study and with the exception of one dwarf sperm whale (*Kogia sima*) no mortality of tooth whales was recorded.

It was observed that maximum mortality of dolphins occurs during November when a total of 3,300 dolphins were estimated to be killed in tuna gillnet operation (Fig. 10). This may be attributed to operation of tuna gillnet vessels in comparatively offshore waters. The study further reveals that there are two peaks of dolphin mortalities. First peak was observed in March and other between September and November. During June and July no mortality was reported because tuna gillnet fishing almost ceases during these months. Year-wise variation was also noticed, as mortality during January-March 2013 was observed to be much higher than those observed during same period in 2014. No specific reason for this disparity could be traced.

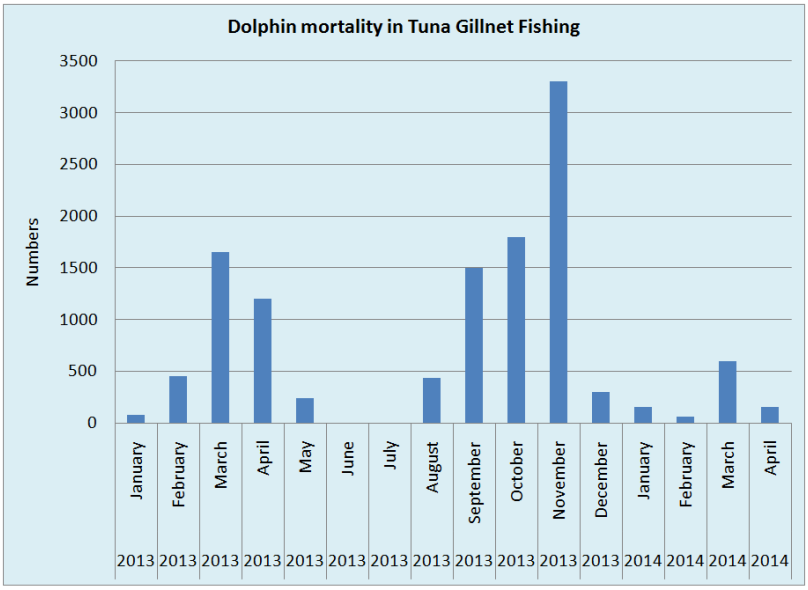


Fig. 10. Monthly estimate of number of dolphin killed in tuna gillnet operation.

SPECIES COMPOSITION OF CETACEANS KILLED IN TUNA GILL NET OPERATION IN PAKISTAN

There was serious difficulty in the identification of cetaceans killed during the fishing operation, however, all attempts were made to identify the enmeshed dolphins. No case of enmeshment of any baleen whale was recorded from the vessels on which observers were deputed. There was only one case

in which a toothed whale was enmeshed and killed. On March 19, 2013, a dwarf sperm whale (*Kogia sima*) was observed to enmeshed. Among dolphins, Indo-Pacific humpback dolphin (*Sousa chinensis*), bottlenose dolphin (*Tursiops aduncus* and *T. truncatus*), spinner dolphin (*Stenella longirostris*), pan-tropical spotted dolphin (*Stenella attenuata*), long beaked common dolphin (*Delphinus capensis tropicalis*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*) and rough tooth dolphin (*Steno bredanensis*) were observed to die in the tuna gillnet operation.

No enmeshment of finless porpoise (*Neophocaena phocaenoides*) was observed during the present study which is mainly because this species is found in shallow coastal waters. Although Indo-Pacific humpback dolphin (*Sousa chinensis*) is also a coastal species which is found along the coastline, lagoons and bays but one specimen of this species was found to have enmeshed in tuna gillnet in off Sapat along Balochistan coast in April 2013. The tuna vessel in question was operating in comparatively shallow waters. A list of species of cetaceans enmeshed in tuna gillnet operation is given in Table-II.

Table-II. Species of cetaceans enmeshed in the tuna gillnet operations along the coast of Pakistan.

Common Name	Scientific Name	Remarks
Bryde's whale	*Balaenoptera edeni*	Only one record. Whale released
Arabian humpback whale	*Megaptera novaeangliae*	Only one record. Whale released
Dwarf sperm whale	*Kogia sima*	Only one specimen enmeshed on March 19, 2013 which died and discarded.
Indo-Pacific humpback dolphin	*Sousa chinensis*	Only one specimen enmeshed in April 1,2013 which died and discarded.
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*	Frequently enmeshed along coastal areas of Sindh and Balochistan.
Common bottlenose dolphin	*Tursiops truncatus*	Found in comparatively deeper waters. A few cases of enmeshment and death. Identification difficult.
Spinner dolphin	*Stenella longirostris*	Frequently enmeshed. Most common enmeshed species.
Pan-tropical spotted dolphin	*Stenella attenuata*	Also enmeshed frequently
Long beaked common dolphin	*Delphinus capensis tropicalis*	Also enmeshed frequently
Risso's dolphin	*Grampus griseus*	Three specimens recorded
Striped dolphin	*Stenella coeruleoalba*	Also enmeshed frequently
Rough tooth dolphin	*Steno bredanensis*	A few cases of enmeshment

FREQUENCY AND ITS QUANTIFICATION OF MORTALITIES OF OTHER NON-TARGET ANIMALS (SUCH AS TURTLES) IN TUNA GILLNET BOATS ON MONTHLY BASIS

Although a number of fish species are caught alongwith tuna by gillnetters operating in coastal and offshore waters of Pakistan. These bycatch species are commercially important and sometime fetches very high prices. These includes dolphinfish, billfishes, oceanic pomfrets, Spanish mackerels, barracudas, unicorn leatherjacket, queenfishes and a number of demerso-pelagic species. These species are retained and landed alongwith tuna catch. Sharks are also important bycatch species which is mainly represented by shotfin mako (*Isurus oxyrinchus*), big-eye thresher (*Alopias superciliosus*), silky shark (*Carcharhinus falciformis*), graceful shark (*Carcharhinus amblyrhynchoides*) and oceanic whitetip shark (*Carcharhinus longimanus*).

Since shark fetches high prices in local market, therefore, these are retained and landed at fish harbours. IOTC has issued a number of resolutions for catching of sharks especially IOTC Resolution

10/12 requires the nations to record incidental catches of sharks, to release live thresher sharks and conduct research to take appropriate measures on scientific data etc. However, implementation on these resolutions is not being done in Pakistan.

No enmeshment of marine birds has been reported from Pakistan. Observers deputed on tuna gillnet vessels under the project have also not reported any incidence of bird mortality. Marine turtles are however, entrapped frequently in the tuna gillnets operation in coastal and offshore waters of Pakistan. Green turtles (*Chelonia mydas*), olive Ridley turtle (*Lepidochelys olivacea*) and hawksbill turtle (*Eretmochelys imbricata*) were observed to enmesh in the tuna gillnets. Of these, hawksbill was recorded only on three occasions (interestingly these are first authentic record of this species from Pakistan. Other two species were previously known to occur and nest along the coast of Pakistan.
The data collected during the project reveals that olive Ridley turtle is the most dominating turtle species entrapped in Pakistan followed by green turtle. It is noteworthy that no nesting or dead olive Ridley turtle was recorded from Pakistan during last 11 years but still it is the most dominating turtle species enmeshed in tuna gillnets. Green turtles are mostly represented by juveniles or subadults and rarely any adult green turtle was enmeshed. Turtles were seldom found to be dead when heaved from sea alongwith gillnet. It was estimated that only 2.5 % of turtles were observed to be dead during enmeshment. Previously fishermen used to ignore these turtles either discarding them immediately or leave it to crawl on boat for a while and then thrown overboard. Because of mishandling and throwing them back in the sea, may kill some of these turtles but its estimate could not be made. It is, however, estimated that about 200 to 300 turtles mainly olive Ridley turtles are killed every year in the tuna gillnet operation along Pakistan coast which is mainly because of their mishandling on board or crude process of dumping them sea. Most of the turtle survive enmeshment in the gillnets and rough treatment onboard.

QUANTIFICATION OF LIVE ENMESHED CETACEANS SUCCESSFULLY RELEASED IN TUNA GILLNET OPERATION IN PAKISTAN

During the project period, it was observed that all enmeshed dolphin are killed immediately because they cannot come to surface to breathe. In no case, any dolphin was found to be alive in the gillnets. Fishermen have reported heavy depredation of dolphins on enmesh species especially tuna. Although no large cetaceans (baleen or tooth whale) was entrapped in the gillnets on the fishing boats on which observers were deputed. However, during the project period two cases was reported in which one Arabian humpback whale(*Megaptera novaeangliae*) and one possibly a Bryde's whale (*Balaenoptera brydei*)were enmeshed in tuna gillnets. The fishermen on both the occasions have strived hard and released these enmeshed whales. In one case in December, 2012, enmeshed Arabian humpback whale could not be disentangled at high seas, therefore, fishermen towed the whale to beach at Ganz, Balochistan and with the help of local community released the whale. Bryde's whale was released near Phor, Balochistan in March, 2013 at high seas. The identification is uncertain but from the description given by fishermen this species may be a Bryde;s whale. On both occasions, fishermen have lost a part of their net which was a financial loss for them. During the project period no other case of enmeshment of whales was reported by any fishermen.

QUANTIFICATION OF LIVE ENMESHED OTHER NON-TARGET ANIMALS (SUCH AS TURTLES) SUCCESSFULLY RELEASED IN TUNA GILL NET OPERATION IN PAKISTAN.

Since the inception of the project, fishermen were persuaded to carefully remove turtles from the nets and gentle release them in the sea. In the beginning the fishermen did not paid heed to this protocol, however, since almost last one and half year it is became a norm to remove the enmeshed from the net and gently release them live. **This is the most inspiring outcome of the project.** An estimate of the turtle enmeshed on monthly basis is made which is given in Table-III. It is estimated that about 4,200 green sea turtles are enmeshed annually whereas bulk of the entangled turtle (about 24,600) are olive Ridley sea turtles. Considering that no record of nesting in Pakistan during last 11 years, it is presumed that population of olive Ridley turtles may be nesting in Iran, Oman or India. This need further studies especially use of satellite tracking to ascertain their migration in the northern Arabian Sea.

Table-III. A monthly estimate of sea turtles enmeshed and released in tuna gillnets

Month	Olive Ridley Turtle	Green Turtle	Total
January	1,200	0	1,200
February	1,500	300	1,800
March	2,100	300	2,400
April	2,700	600	3,300
May	1,200	300	1,500
June	0	0	0
July	0	0	0
August	1,500	300	1,800
September	3,000	300	3,300
October	3,600	600	4,200
November	4,500	900	5,400
December	3,300	600	3,900
Total	24,600	4,200	28,800

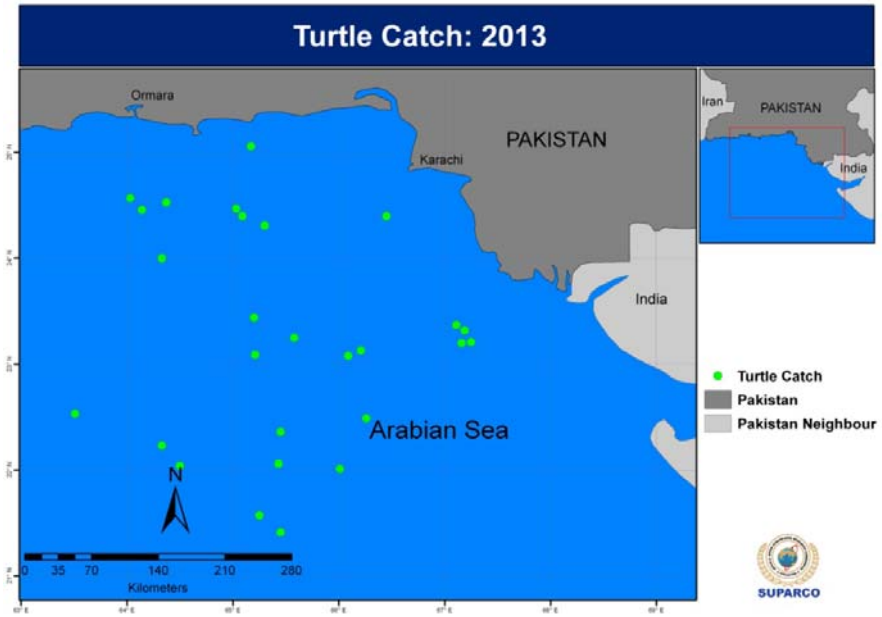


Fig. 11. Map of Northern Arabian Sea along Pakistan coast showing area of turtle enmeshment

Fig, 11 shows main area along the coast of Pakistan where turtle enmeshment have been reported. It is noteworthy that sea turtles are mainly enmeshed in the offshore tuna fishing ground with the exception a few records which were made from the coastal waters. It is also evident that the turtles are found beyond Exclusive Economic Zone of Pakistan (beyond 200 n. miles).

SPATIAL INFORMATION ABOUT CETACEANS' MORTALITY IN TUNA GILLNET BOATS IN THE COASTAL AND OFFSHORE WATERS OF PAKISTAN

Studies carried out under the project reveals that enmeshment of dolphins occur in both coastal and offshore waters of Pakistan (Fig. 12). Because of difficulties in field identification of dolphin, it was not possible to identify area for any mortality of any specific species. It is evident that dolphin mortalities are more common along Sindh coast whereas a few locations along Balochistan coast where such mortality are recorded. There are there are 26 location on the continental along Pakistan coast where dolphin mortality whereas 18 locations of dolphin mortality was observed to be on continental margin and deep sea. It is further noticeable that along Sindh coast, dolphin mortalities are reported from the areas which are regarded as hotspots. Similarly along Balochistan coast such mortality was observd to be around two hotspots i.e. Churna Island and area between Phor and Ormara. Considering very high mortality of dolphin because of enmeshment in the tuna gillnets, it is being stressed to

Government of Pakistan to declare some of these cetacean hotspots as marine protected areas (MPAs). In addition, Government of Pakistan is being asked to take strict management measures for tuna gillnet fisheries so as to minimize dolphin mortality in tuna gillnets.

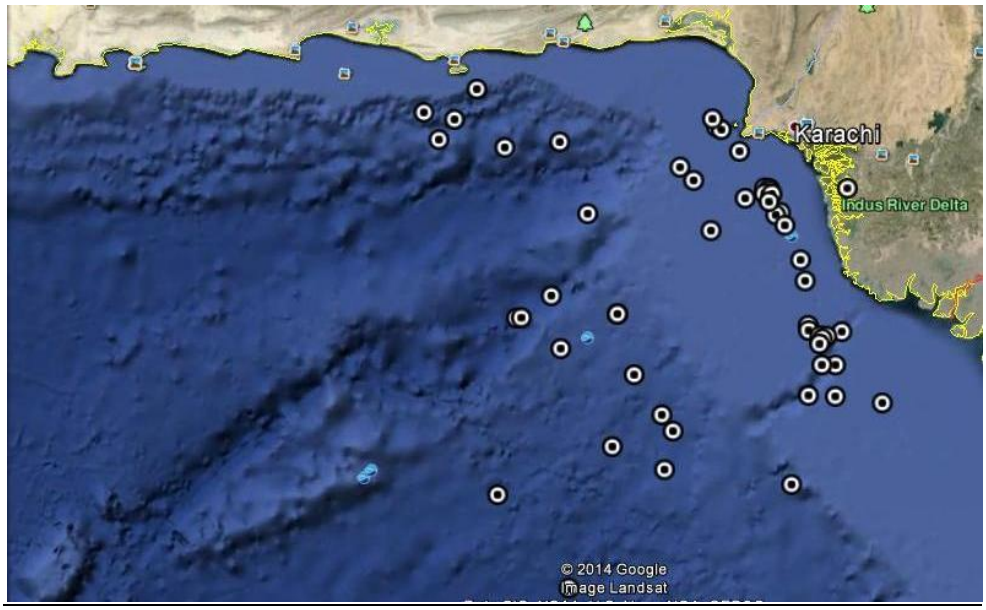


Fig. 12. Map of Pakistan coast showing the localities where dolphin mortality on account of enmeshment in tuna gillnet occurs.

SUPPLEMENTARY ON DISTRIBUTION AND ABUNDANCE OF CETACEANS IN THE COASTAL AND OFFSHORE WATER OF PAKISTAN.

Coastal and offshore waters of Pakistan are known to ne rich as far as cetacean fauna is concerned. So far 19 species of cetaceans including 3 species of baleen whales are reported from Pakistan. Occurrence of a few other species are expected but in the absence of any authenticated report, these are not included in the list of cetaceans species known from Pakistan. Among baleen whales the most common is the Arabian humpback whale(*Megaptera novaeangliae*) which are found in shallow coastal waters as well as offshore waters. Arabian Sea subpopulation is considered to be geographically, demographically and genetically isolated, with a unique year-round residency in sub-tropical waters of the Arabian Sea. It is estimated that total population of this species in Oman to be about 82and total population in the Arabian Sea to be between 250 and 400.

Arabian humpback whale is observed along Pakistan coast throughout the year. There are verifiable evidences that Arabian humpback whale feeds on sardinellas schools in shallow waters along the coast of Pakistan. Although the observers deputed under the project have any confirmed sighting of this whale but they have observed whale spouts on a number of occasions from offshore mouth of River Indus and along Sapat to Ormara along Balochistan coast. A number of reports of their feeding was made by tuna fishermen in these areas. The species has a specific name “Karambo” and identified on the basis of its long arms and display of tail during diving. Last such instant was reported from Ormara area during April, 2014.

Blue whale (*Balaenoptera musculus*) is possibly the second most dominating species of whale in Pakistan. A number of sightings were made from the area and a number of strandings were also observed. Most of the species observed and sighted wereobserved to be smaller size and it is presumed that they belonged to the pygmy race of blue whales. However, there are also reports of strandings of large specimens (18-19 m). The observers deputed under the project have not reported any confirmed sighting of this whale from Pakistani waters.

There are reports of a number of sighting of Bryde's whale (*Balaenoptera brydei)* from Pakistan as well as a number of strandings are also reported. A number of stranding reported previously attributed to fin whales (*Balaenoptera physalus*) are considered to be misidentification and now these are treated as Bryde's whales. This whale is the smallest of the baleen whale observed along the coast of Pakistan. The observers deputed under the project have recorded and photographed this species from Balochistan coast during March, 2014.

Among the toothed whale, *Physeter macrocephalus* (sperm whale) was reported to be strand on the coast of Pakistan on a number of occasions. One live sperm whale was beached at Ormara which was successfully released. Pygmy sperm whale (*Kogia breviceps*), dwarf sperm whale (*Kogia sima*), killer whale (*Orcinus orca*), false killer whale (*Pseudorca crassidens*) and Cuvier's beaked whale (*Ziphius cavirostris*) have also been reported from Pakistan coast. The observers deputed under the project have not reported any sighting or enmeshment of any of the species except on March 19, 2013 a specimen of dwarf sperm whale was enmeshed in the tuna gillnet which was photographed and discarded.

Among dolphins, Indo-Pacific humpback dolphin (*Sousa chinensis*), bottlenose dolphin (*Tursiops aduncus* and *T. truncatus*), spinner dolphin (*Stenella longirostris*), pan-tropical spotted dolphin (*Stenella attenuata*), long beaked common dolphin (*Delphinus capensis tropicalis*), Risso's dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*) and rough tooth dolphin (*Steno bredanensis*) were reported from Pakistan coast.

It may be pointed out that in case of bottlenose dolphins, there are evidences that oceanic congener (*Tursiops truncatus*) occurs in offshore waters but making distinction between the two species is difficult especially their field identification are sometimes not possible. Most of dolphins are frequently enmeshed in tuna gillnet operation in neritic and offshore waters. Schools of spinner, bottlenose and pan-tropical spotted dolphins were frequently observed by the observers posted on tuna fishing vessels during the project period.

Waters of Pakistan both coastal and offshore are known to be rich in cetacean diversity. However, there are some hotspots where some cetacean species can be found in considerable abundance. There are some areas along Pakistan coast where cetacean can be observed throughout the year whereas there are areas where cetacean species congregate during a particular season. There are three main hotspots along Sindh coast whereas there are four major hotspots for cetaceans along Balochistan coast.

Greater Khori Bank, Off Indus River and Hawks Bay-Cape Monz area may be considered as cetacean hotspot along Sindh coast whereas Churna Island, Phor-Ormara Area, Astola Island, Gwader-Ganz Area are main hotspots for cetaceans along Balochistan coast. In addition to the hotspots, cetaceans (both whales and dolphins) are frequently reported from off Karachi, Gaddani, Taq, Pasni Bay, Ras Shumal Bundar, Darran and Jiwani. Although some of these hotspots are near the coastline but in all other areas, large scale operation of tuna gillnetting is carried making the population vulnerable to enmeshment and death.

FREQUENCY AND ABUNDANCE OF BIRDS ASSOCIATED WITH CETACEAN IN THE COASTAL AND OFFSHORE WATERS OF PAKISTAN

Birds was found to be comparatively rare in the offshore waters. No association of marine bird species associated with cetaceans was observed during the project period. Only a few free schools of cetaceans were observed and no bird was associated with such free swimming school. The information about seabirds found in the fishing ground was also limited and only a few species were identified (Table-IV)

Since most bycatch species also fetches high prices, therefore, these are also retained onboard. Billfishes, sharks, dolphinfish and narrow-barred Spanish mackerel are preferred bycatch species, therefore, these are kept in chilled condition. There is generally no discard except smaller frigate and bullet tunas are discarded mainly because of their low prices. Similarly pelagic stingray and sometimes mobulids are also discarded. All other catch is retained.

Table-IV. Bird species observed during the project period.

Common Name	Scientific Name	Association/Remarks
Whiskered tern	*Chlidonias hybridus*	Mostly found in neritic areas
Little tern	*Sternula albifrons*	Mostly seen in neritic areas
Gull-billed tern	*Gelochelidon nilotica*	Common on Balochistan coastal and offshore areas.
Caspian tern	*Hydroprogne caspia*	Mostly seen in neritic areas
Sooty gull	*Ichthyaetus hemprichii*	Mostly seen in neritic areas, however, also following tuna fishing for discard and jetsam
Heuglin's gull	*Larus heuglini*	Found in coastal and offshore waters and following tuna fishing for discard and jetsam
Dalmatian pelican	*Pelecanus crispus*	Seen on a number of occasions in offshore water soaring high in the sky.
Great cormorant	*Phalacrocorax carbo*	Found in coastal and offshore waters. Large flocks seen in offshore waters.
Masked booby	*Sula dactylatra*	Frequently seen in offshore waters. Sometime taking rest on floats of gillnets
Red-necked phalarope	*Phalaropus lobatus*	Found in coastal and offshore waters. Sometimes in large flocks.
Red-billed tropic bird	*Phaethon aethereus*	Frequently seen in offshore waters soaring in the sky
White-tailed tropicbird	*Phaethon lepturus*	Frequently seen in offshore waters soaring in the sky
Flesh-footed shearwater	*Puffinus carneipes*	Found in offshore waters and following tuna fishing for discard and jetsam
Wedge-tailed shearwater	*Puffinus pacificus*	Found in offshore waters and following tuna fishing for discard and jetsam

No association of seabirds with tuna schools was also noticed during the project period. In most cases only small flocks and individual birds were observed. Some species such as gull-bill tern, Heuglin's gull and flesh-footed shearwater were found to follow tuna gillnetters for discards and jetsam. Some stragglers terrestrial birds like hoopoe (*Upupa epops*), white-throated kingfisher(*Halcyon smyrnensis*),green bee-eater (*Merops orientalis*) and cattle egret (*Bubulcus ibis*) were also observed to take rest on tuna fishing vessels.

3. Implications for Management

What are the key recommendations for management based on the findings.

- Legislation may be enacted to ensure that tuna gillnets being used in Pakistan may comply to United Nations General Assembly (UNGA) Resolution 46/215 and IOTC Resolution 12/12 which prohibit the use of large scale driftnets on the high seas and restricting it to 2.5 km.
- Presently tuna gillnet fishing is an open access and no limited entry, therefore, fleet is increasing. A cap may be imposed on construction of new fishing boats and no conversion from shrimp trawlers or other fishing types to tuna gillnetting operation may not be allowed. Proper legislation may be made for the purpose.
- An extensive programme for conversion of tuna gillnetting to longlining may be started by Government of Pakistan.
- Experiments on use of pingers and other devices on gillnets may be carried out to minimize enmeshment of non-target species specially cetaceans.

- A mass scale programme for awareness of fishermen and other stakeholders may be initiated all along the coast of Pakistan. This awareness programme may stress on the need on protection of cetaceans especially in minimizing their mortality.

- Regional observer scheme as required under IOTC Resolution 2009/04 may be initiated in Pakistan. In addition to their other duties, these observers may also monitor bycatch of cetacean. IOTC resolution required at t least 5 % of the vessels 24m overall length and over, and under 24m meters if they fish outside their EEZs, should have an observer programme.

- Data collection initiated under the IPCRCF project may be continued to collected by the Fisheries Department.

- Further research on cetacean mortality and aspects related to biology and population of commonly occurring cetacean may be initiated.

4. Other Benefits

How has this project advanced the field of research? (e.g. scientific discoveries, new methodologies)

Although it has long been established that gillnets especially pelagic gillnets entangle a number of non-target species especially cetaceans. However, such information was almost lacking from Arabian Sea (also Indian Ocean in general). The project, for the first time, has generated information (both in qualitative and quantitative terms) about the extent of mortality of cetaceans on account of large scale gillnetting in Pakistan. It has also generated authentic information about fishing area, catch per day, species composition, turtle entanglement and information about free swimming schools of cetaceans. Some information about marine birds found in the offshore waters of Pakistan was also generated. The information collected through this project will form basis for detailed investigations about cetaceans, turtles and other marine animals.

5. Problems Encountered (if any)

Describe any major problems encountered during the Activity and how they were addressed.

No major obstacle was encountered in the project execution except in the beginning of the project, it was not possible to recruit data samplers for working on the tuna gillnetters (owing to long fishing trip and facilities on board such vessels), however, WWF-Pakistan was able to resolve this issue and regular data collection was started in October 2012.

Tuna gillnet operation ceases from middle of May to August; therefore, seasonal data pertaining to landings, cetacean mortality and other parameters was limited during this period.

No association of marine bird species associated with cetaceans was observed during the project period. Only a few free schools of cetaceans were observed and no bird was associated with such free swimming school.

6. Communication

How will results be communicated to management

The information generated through this project is being shared with federal and provincial Wildlife and Fisheries Departments. On all possible forums WWF-Pakistan, is persuading concerned agencies to implement on the resolutions of tuna RFMO's especially those pertaining to protection of cetaceans. In Pakistan, WWF-Pakistan is engaged in conversion of tuna gillnetting fleet to longlining which seems to less harmful for cetaceans. WWF-Pakistan has also engaged regional countries such as Iran, Oman, Yemen and Somalia in similar conversion programme. Findings of the project provide tangible data collected for the first time which confirms high cetacean mortality on account of gillnet operation. A part of data is presented in IOTC Working Party of Ecosystem and Bycatch and also in IOTC Working Part on Neritic Tuna.

In is planned that communicate the findings of the project to all concerned departments in form of "Fact Sheets" so as to ensure that information generated through this project may be used in management decision and protection of cetaceans.

WWF-Pakistan, since past few years is engaged in development of an action plan for cetacean conservation plan for Pakistan. The draft Plan of Action was discussed with relevant Government Departments informally and a workshop of major stakeholders was arranged in Karachi on 22 May, 2013. The project, WWF-Pakistan, National Centre for Maritime Policy and Research, Bahria University (NCMPR) and Pakistan Whales and Dolphin Society have sponsored holding of this workshop. Findings made during July 2012 and May 2013 was shared with the participants of the workshop.

The workshop fully endorsed the draft action plan and also stressed the need for early declaration of Marine Protected Areas at Miani Hor and Astola Island at the earliest.. Because of major amendments in the Constitution of Pakistan, management regime has changed and now major responsibility of management in coastal waters (territorial waters) now lies with the provincial governments of Sindh and Balochistan. Wildlife protection legislations of both maritime provinces are being revised, therefore, implementation and incorporation of the Action Plan for the Cetaceans is being delayed.

Since there is no legislative cover for cetacean protection under any federal legislation, therefore, the Action Plan as such cannot be effectively implemented in the Exclusive Economic Zone of Pakistan. WWF-Pakistan is working closely with the Ministry of Climate Change to enact a federal legislation for protection of threatened species including cetaceans in the EEZ of Pakistan so as to ensure that Action Plan for the Cetaceans may be implemented. WWF-Pakistan is liaising with both federal and provincial governments for making interim arrangements for approval and implementation of the Cetacean Action Plan.

Stakeholder engagement feedback (plain English for feedback to stakeholders)

The information gathered through this project was shared with stakeholders since inception. Stakeholders especially fishermen were made aware of the importance of cetaceans and other bycatch species and it was stressed to take all effort to release enmeshed protected animals. Continuous persuasion and awareness created by WWF-Pakistan has started yielding results. A large number of fishermen now carefully release entrapped animals mainly turtles and whale sharks. Unfortunately almost all cetacean entrapped in the gillnet die, therefore, these could not be released. There are, however, at least two confirmed cases in which fishermen have carefully disentangled the gillnet from Arabian humpback whale and released them Fishermen were also persuaded not to lay down their nets in the area known for concentration of cetaceans or in their migratory routes. There are recent reports in which fishermen have cut their nets to make a safe passage for migrating dolphin school, Later on they were able to track down the left over part of the net to remove commercial catch.

WWF-Pakistan, as part of the activity of this project, is making other stakeholders aware of the mortality of cetaceans caused by use of large scale gillnets. In this context, participants of a skipper workshop which was held in 2011, were again invited and the results of the project was shared with them. It is intended that information generated through the project will be published in ,local language for creating a mass level awareness about cetacean mortality in tuna gillnet operations.

Students supported (if any)

Although no student was directly supported through this project, however, a number of presentations were made in Institute of Marine Sciences and in Centre of Excellence in Marine Biology, University of Karachi in which information generated through project was shared with students.

PhD Theses and dissertations (if any)

A Ph. D. Thesis entitled "Studies on marine cetaceans in coastal waters of Pakistan" is submitted in the University of Karachi. Mr.Kiyani was one of the Co-Principal Investigator of this project. Some information generated through this IPCRCF project forms a part of this dissertation.

Publications (other than theses and dissertations)

- Kiani,M. S., Iqbal, P., Siddiqui1, P. J. A., and M. Moazzam, 2013. First Records of the Striped Dolphin (*Stenellacoeruleoalba*) and Rough-Toothed Dolphin (*Steno bredanensis*) in Pakistani Waters:Review of Occurrence and Conservation Status in the Indian Ocean. *Pakistan J. Zool., vol. 45(4), pp. 1113-1123* (Annexure-III).

Planned publications

It is intended to publish a number of publications based on the information collected through this project, however, a few which are being drafted are listed hereunder. These will be published in peer review scientific journals of international repute.

- Moazzam, M., Nawaz, R., Kiani, M. S., and Mahmood, K., 2014. A review on the status of cetacean occurring in coastal and offshore waters of Pakistan (under preparation)
- Kiani,M. S. and M. Moazzam, 2014. An analysis of the sightings and beached Bryde's whale (*Balaenopterabrydei*) in Pakistan (under preparation)
- Moazzam, M., and Nawaz, R., 2014. Tuna gillnetting: a major threats to protected and threatened species along the coast of Pakistan (under preparation)
- Moazzam, M., and Nawaz, R., 2014. An assessment of dolphin mortality in tuna gillnet operation in coastal and offshore waters of Pakistan.
- Moazzam, M., 2014. Tuna gillnetting in Pakistan-An assessment (under preparation).

Presentations

- Moazzam, M., 2012. Status of fisheries of neritic tuna in Pakistan. Presented in the "Second Session of the Working Party on Neritic Tuna (WPNT02)" 19-21 November, 2012. Penang, Malaysia (**IOTC-2012-WPNT02-13.pdf**)-Annexure-IV.

- Moazzam, M., 2013. An assessment of cetacean mortality in the gillnet fishery of the northern Arabian Sea. Presented at the Ninth "Session of the Working Party on Ecosystems and Bycatch" 12–16 September 2013. La Réunion, France (**IOTC-2013-WPEB09-28_-_Cetaceans_and_gillnets.pdf**)-Annexure-V.
- Moazzam, M., 2013. Proposal for species identification guide for cetaceans (whale and dolphins) occurring in the Indian Ocean. Presented at the Ninth "Session of the Working Party on Ecosystems and Bycatch" 12–16 September 2013. La Réunion, France (**IOTC-2013-WPEB09-29_-_Cetacean_ID_guide.pdf**)-Annexure-VI.

- Moazzam, M., 2013. Billfish: an important part of the pelagic gillnet fisheries of Pakistan. Presented at the "Eleventh Session of the Working Party on Billfish" 18–22 September 2013. La Réunion, France (**IOTC-2013-WPB11-11.pdf**)-Annexure-VII.

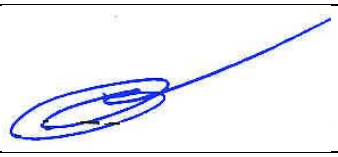
7. Project Outputs

A list of the actual outputs of the research including milestones, progress reports and data products such as models etc.	Proposed date of completion	Actual date of completion
Progress Report No. 1	01-03-2013	26-03-2013
Progress Report No. 2	01-09-2013	17-09-2013
Project Final Report	01-05-2014	14-05-2014

No dates was specified in the project document for dates for research publications.

8. Financial Account of the Activity

Include reasons for any variation to the budget, underspends and difficulties

Signature of Chief Investigator	
Name	Rab Nawaz
Date	May 15, 2014
Signature of Organisation Representative	
Name	Rab Nawaz
Date	May 15, 2014

Please forward 1 hard copy, and one electronic Word document of this report to:

Coordinator
Australian Marine Mammal Centre
Australian Antarctic Division
203 Channel Highway
KINGSTON TAS 7050
ammccoordinator@aad.gov.au

AUSTRALIAN MARINE MAMMAL CENTRE

STATEMENT OF INCOME & EXPENDITURE

Name of Grantee:			
Organisation:			
Project No.:			
Project Title:			
FUNDING AGREEMENT BUDGET			
Amount of Grant	**Exclusive of GST**	**GST**	**Total including GST**
Commonwealth Government Contributions			
Organisation Contributions			
Other Contributions			

EXPENDITURE TO DATE - Commonwealth Government Contributions			
A. Item	**B. Expenditure ($ GST incl)**	**C. Committed ($ GST incl)**	**D. Unspent ($GST incl)**
Total expenditure			

EXPENDITURE TO DATE - Organisation Contributions

A. Item	B. Expenditure ($ GST incl)	C. Committed ($ GST incl)	D. Unspent ($GST incl)
Total expenditure			

EXPENDITURE TO DATE - Other Contributions			
A. Item	**B. Expenditure ($ GST incl)**	**C. Committed ($ GST incl)**	**D. Unspent ($GST incl)**
Total expenditure			

Legal Commitments

A statement of how much the Organisation needs to meet current liabilities under legal commitments entered into for the purposes of the Activity and pursuant to the Funding Agreement.

I certify that:

(a) all Funding received was spent for the purpose of the Activity and in accordance with the Funding Agreement and that the Organisation has complied with the Funding Agreement;

(b) salaries and allowances paid to persons involved in the Activity are in accordance with any applicable award or agreement in force under any relevant law on industrial or workplace relations;

(c) unless the Activity Period has expired or the Agreement has been terminated, the unspent portion of the Funds (if any) is available for use within the next Reporting period;

(d) the financial information is presented in accordance with any other financial Reporting requirements the Department may notify to the Organisation;

(e) where an Asset has been acquired with the Funds, paragraphs 7.5(d) and (g) (where applicable) have been complied with in respect to the Asset.

Signature of Responsible Person (as defined by subclause 9.6 of the Funding Agreement)	
Name	
Position	
Date	

ANNEXURE-I

ANNEXURE-I

LANDINGS OF TUNA AND BYCATCH (AVERAGED ON MONTHLY BASIS) COLLECTED FROM KARACHI FISH HARBOUR

Species	**January**	**February**	**March**	**April**	**May**	**June**	**July**	**August**	**September**	**October**	**November**	**December**	**Total**
Yellowfin	1,024	1,330	3,233	1,069	522	11	9	21	28	32	205	961	8,445
Longtail	64	23	789	893	1,011	21	14	581	833	312	134	49	4,724
Skipjack	96	58	92	64	72	3	4	9	3	42	121	321	885
Kawakawa	17	20	23	154	199	11	8	21	691	1651	567	231	3593
Frigate	149	156	167	250	186	9	5	39	65	72	65	66	1229
Bullet	4	2	6	11	18	0	0	11	12	11	8	12	95
Subtotal	**1,354**	**1,589**	**4,310**	**2,441**	**2,008**	**55**	**40**	**682**	**1,632**	**2,120**	**1,100**	**1,640**	**18,971**
Sailfish	354	523	437	410	214	2	3	16	76	32	412	222	2701
Marlin	54	25	32	54	45	1	2	3	11	6	141	111	485
Dolphinfish	415	489	471	510	421	8	3	52	354	213	512	312	3760
Sharks	137	67	152	93	38	5	3	11	38	29	168	361	1102
Subtotal	**960**	**1,104**	**1,092**	**1,067**	**718**	**16**	**11**	**82**	**479**	**280**	**1,233**	**1,006**	**8,048**
Grand Total	**2,314**	**2,693**	**5,402**	**3,508**	**2,726**	**71**	**51**	**764**	**2,111**	**2,400**	**2,333**	**2,646**	**27,019**

During June and July almost all tuna gillnet operations stop.

ANNEXURE-II

Annexure-II

Name of Tuna fishing vessels operating from Karachi Fish Harbour

Name of Fishing Vessel	Registration No.	Name of Fishing Vessel	Registration No.
Al Ahmadi	BFD-10080	Al Khair	BFD-5766
Al Amarat	BFD-1078	Al Khuda Bux	BFD-6272
Al Ameen	BFD-7270	Al Madina	BFD-11315
Al Ameer	BFD-8292	Al Madina	BFD-18370
Al Ameer	not mentioned on boat	Al Madina	BFD-16655
Al Anas	BFD-11073	Al Manzori	BFD-11317
Al Anas	not mentioned on boat	AL Marjan	BFD-7460
Al Arfat	BFD-8604	Al Meer	BFD-6375
Al Arif	BFD-10032	Al Meeraj	BFD-7578
Al Ayyubi	BFD-3338	Al Mehboob	BFD-9207
Al Azhar	BFD-11318	Al Meraj	BFD-8251
Al Baadil	BFD-8179	Al Muawa	BFD-11954
Al Baba	BFD-8926	Al Mubarak	BFD-11457
Al Baboo	BFD-8977	Al Muhammad Sami	B-16945
Al Badash	BFD-6057	Al Muhammadi	BFD-7145
Al Bakar	BFD-12356	Al Muhammadi	BFD-7770
Al Baloch	BDD-9961	Al Muhammadi	BFD-7145
Al Bar	BFD-7288	Al Mula Baksh	BFD-8141
Al Bilal	BFD-12265	Al Mulk	BFD-1116
Al Dastageer	BFD-10487	Al Muqadir	B-14218
Al Dua	BFD-11969	Al Muquddar	BFD-3954
Al Eemaan	BFD-11806	Al Murad	B-18783
Al Farhan	BFD-8935	Al Murtaza	B-10390
Al Feza	not mentioned on boat	Al Mushtaq	B-10283
Al Firdos	BFD-7793	Al Mustafa	B-7805
Al Ganj	BFD-9339	Al Naeem	BFD-12374
Al Ghazi	BFD-13964	Al Nagira	BFD-70787
Al Hameed	BFD-5131	Al Najamb	BFD-1256
Al Hashumi	BFD-4498	Al Nake Bukht	BFD-11722
Al Hasni	not mentioned on boat	Al Nasar	BFD-8256
Al Ibasit	BFD-9745	Al Naseeb	BFD-10718
Al Idrees	B-14528	Al Nasr	BFD-12350
Al Imran	BFD-8175	Al Nazuk	BFD-8564
Al Imtiaz	not mentioned on boat	Al Neyabi	BFD-10814
Al Iqbal	B-12921	Al Noor	BFD-7756
Al Irada	BFD-10047	Al Nori	BFD-3669
Al Jalal	BFD-11303	Al Parinda	BFD-13903
Al Jannat	BFD-11060	Al Pasni	BFD-13003
Al Javaid	BFD-12605	Al Qasim	BFD-5658
Al Javed	BFD-11210	Al Qasumi	BFD-7284
Al Kabir	B-14622	Al Raees	BFD-8912
Al Kamal	BFD-18745	Al Rahim	not mentioned on boat
Al Kamal	BFD-9805	Al Rahimi	BFD-5564
Al Kamal	BFD-9805	Al Rahmani	BFD-9944
Al Karimi	BFD-17990	Al Rahuf	BFD-3352
Al Karsaaz	BFD-5896	Al Raj	BFD-6707
Al Khair	BFD-5766	Al Rashdi	BFD-11220
Al Khair	B-14050	Al Razdar	BFD-11980
Al Khair	BFD-7830	Al Rehan	BFD-11965

Name of Fishing Vessel	Registration No.	Name of Fishing Vessel	Registration No.
Al Rehman	BFD-12703	Be Gunah	BFD-11056
Al Rozi	BFD-11660	Bismillah	BFD-13463
Al Saagar	BFD-10957	Chandni	BFD-3950
Al Sadaqa	BFD-136700	Dad Karim	BFD-9032
Al Sadaqa	BFD-11039	Desko	BFD-15653
Al Safeen	BFD-10775	Dolti	BFD-12336
Al Sahara	BFD-7890	Gul e Ateeq	BFD-12555
Al Sahil	BFD-13903	Gul e Shahbaz	BFD-14624
Al Saif	BFD-13086	Gul e Shahir	BFD-11361
Al Sajidi	BFD-3616	Gule Aslam	B-17247
Al Sajidi	BFD-5430	Gule Aslam	BFD-13052
Al Sakina	BFD-11302	Gule Asmat	BFD-14817
Al Salam	B-1238	Gule Sameer	BFD-10983
Al Salam	B-15864	Gule Sami	BFD-10983
Al Salam	BFD-12098	Gule Sarwari	BFD-18507
Al Saleem	BFD-10028	Gule Sarweri	B-18507
Al Salman	BFD-15864	Gule Shehzad	not mentioned on boat
Al Salman	BFD-15864	Gule sher yar	B-17805
Al Samandar	BFD-8976	Gule Sudais	B-18804
Al Sameer	BFD-6985	Gulysahi	BFD-11361
Al Saraha	B-10319	Gulzari Madina	BFD-19113
Al Sarkaar	BFD-12632	Hameed	BFD-6744
Al Sarwar	BFD-5387	Inshah Allah	BFD-9340
Al Saud	B-10691	Jalal	BFD-11917
Al Shah Dust	BFD-10821	Jangzaib	not mentioned on boat
Al shaheen	BFD-5106	Jungali	BFD-6635
Al Shaheen	BFD-4589	Junon	BFD-12707
Al Shakeel	BFD-7806	Mohafiz	B-13629
Al Shakeel	BFD-12263	Moula Madad	BFD-8900
Al Shakoor	BFD-6904	Mujeeb Hussain	BFD-14818
Al Siraj	BFD-11968	not mentioned on boat	BFD-11232
Al Siraj	BFD-12290	not mentioned on boat	BFD-8952
Al Subhan	BFD-7037	not mentioned on boat	B-14623
Al Suhraab	BFD-9605	not mentioned on boat	BFD-10788
Al Taef	BFD-7804	not mentioned on boat	BFD-12555
Al Tariq	BFD-11358	Omay Murrium	B-18406
Al Wahidi	BFD-6756	Owais Karni	BFD-12311
Al Yasir	BFD-7055	Rahman	BFD-10752
Al Yousaf	BFD-8407	Ramazani	BFD-11005
Al Zaheer	BFD-11675	Raza	BFD-8901
Al Zaman	BFD-17419	Raza	BFD-7145
Al Zar-4	B-17594	Raza Hussain	BFD-11232
Al Zubairi	BFD-5659	Sada Bahaar	BFD-19950
Al-Daryalal	BFD-11956	Safeena Abdullah	B-16520
Allah Madad	BFD-11941	Safeena Ijaz	BFD-8987
Allah Madat	not mentioned on boat	Sarwar	BFD-8927
Allah Neighban	BFD-7810	Seraj-3	BFD-7806
Al-Zakir	BFD-10029	Shaman Khan	not mentioned on boat
Asim	BFD-12218	Shamsheer	BFD-5841
Azan	not mentioned on boat	Shehbaz	BFD-7949
Baba Isaq	BFD-11336	Sindbaad	BFD-11580
Baba Lal	B-18579	Suban Allah	BFD-11366

Name of Fishing Vessel	Registration No.	Name of Fishing Vessel	Registration No.
Subhaan	BFD-3397		
Tahir	not mentioned on boat		
Usmani	BFD-8313		
Wahidi	BFD-11107		
Zerak Shyan	BFD-11967		
Zubari	BFD-11159		

ANNEXURE-III

Pakistan J. Zool., vol. 45(4), pp. 1113-1123, 2013

First Records of the Striped Dolphin (*Stenella coeruleoalba*) and Rough-Toothed Dolphin (*Steno bredanensis*) in Pakistani Waters: A Review of Occurrence and Conservation Status in the Indian Ocean

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Abstract.- The skull of a striped dolphin *Stenella coeruleoalba* (Meyen, 1833) was found in the Indus delta creek system of Pakistan during a beach survey. The subsequent morphometric investigations revealed that the skull was that of a juvenile/subadult striped dolphin. Coincidentally, a video of two live individuals and pictures of an entangled animal of the same species were captured in the open sea by the crew of a tuna fishing vessel off the same general area where the skull was retrieved. This video clearly depicts the species' unique colour pattern and supports the skeletal evidence of presence of striped dolphins in Pakistani waters. In addition, three videos of a small pod of rough-toothed dolphins *Steno bredanensis* (G. Cuvier in Lesson, 1828) were received from a captain of another tuna fishing vessel. This account documents the only records of these two species from Pakistan. Other records from the Indian Ocean region are discussed. Issues pertaining to conservation in Pakistan such as rampant and illegal use of very long gillnets by tuna fishers and overfishing are examined.

Key words: Morphometric, Indus delta, striped dolphin, rough-toothed dolphin.

INTRODUCTION

The striped dolphin *Stenella coeruleoalba* (Meyen, 1833) is known to occur in tropical, subtropical and warm temperate waters of the world in both hemispheres (Archer and Perrin, 1999; Van Waerebeek *et al*., 1999). The species can be seen in the deeper waters, including those that are close to the coastline. The species belongs to the family Delphinidae and is generally gregarious in nature; however, smaller group sizes are recorded from the Mediterranean (Notarbartolo di Sciara *et al*., 1993). The species is usually observed in deep offshore waters (Perrin *et al*., 1994; Gannier, 2003). The literature reveals that striped dolphins may be more susceptible to pollutants, heavy metals and parasite infestations (Aguilar, 2000; Cardellicchio, 2000) which make them important for conservation and management studies.

Several stocks but no subspecies are identified throughout its range (Mitchell, 1975; Perrin, 1975; Mead and Brownell, 1993). The genus *Stenella* is considered paraphyletic according to recent genetic analyses, therefore there is a possibility that this species might be moved to a different genus (Leduc *et al*., 1999). The IUCN Red List of Threatened Species classifies the species as 'Of Least Concern' (Hammond *et al*., 2008). The species is listed in Appendix II of Convention on the International Trade in Endangered Species (CITES) which means, that the species is not necessarily threatened with extinction at present but it may happen unless the trade is carefully controlled.

The rough-toothed dolphin is found in tropical and subtropical waters from the western Pacific to the Mediterranean in deeper waters, rarely seen beyond 40° N and 35° S (Jefferson, 2002). The species is reported from semi-enclosed waters and also shallow coastal waters in some areas, for example off Brazil and West Africa (Ritter, 2002; Hammond *et al*., 2012). The IUCN Red List of Threatened Species classifies the species as 'Of Least Concern' (Hammond *et al*., 2012). The species is also listed under Appendix II of CITES.

No previously documented records of occurrence and/or strandings of either of these species are known for Pakistan (de Boer *et al*., 2002). Although de Silva (1987) mentions the rough-toothed dolphin as a species occurring in

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0030-9923/2013/0004-1113 $ 8.00/0

Pakistani waters based on several stranding records provided by Dr. Farooq (ex-Director of the Zoological Survey Department of Pakistan), but later Dr. Farooq confirmed that these records were not reported by him and their inclusion in de Silva (1987) is erroneous. Miyazaki and Perrin (1994) also mentioned the presence of rough toothed dolphin in waters of the Pakistan coast, but no verification is available (Van Waerebeek *et al*., 1999).

MATERIALS AND METHODS

Recovery of skull of striped dolphin from the Indus delta

A dolphin skull was collected from a beach between Chhan east mouth and Khuddi creek (24°38′229N, 67°11′825E) of the Indus delta during a 11.94 km long beach survey on 15 April 2009 (spring inter-monsoonal period) (Fig. 1).

The skull was identified using guidelines by Perrin (1975). The identification is made on the basis of measurements and morphological features. Literature consulted and used for comparison: Van Waerebeek *et al.*, 1998; Ott and Danileewicz, 1996; McFee *et al.*, 1998. In addition, the species identification was also confirmed by W. F. Perrin at the Southwest Fisheries Science Center in La Jolla California, USA. The skull was photographed and archived in the laboratory at the Centre of Excellence in Marine Biology, University of Karachi (Fig.1).

Measurements were made using a vernier calliper and ruler. Methods developed by Perrin (1975) for measurement of skull morphometrics were followed.

Sightings of striped dolphins as supporting evidence

A live sighting of 2-3 striped dolphins was recorded by a captain of a tuna fishing vessel (Gul-e-Muhammad No. 14623-B) off the Indus delta in the Swatch area (23°18.750′N 67°12.566E) on 20 December, 2012 at 1350 PM (Fig. 2a). An animal of the same species became entangled and died in a tuna gillnet in deep waters off the Indus delta well beyond the shelf (GPS coordinates: 20° 49.172′N 65°16.150E) on 16 January 2013, also shown in Figure 2b.

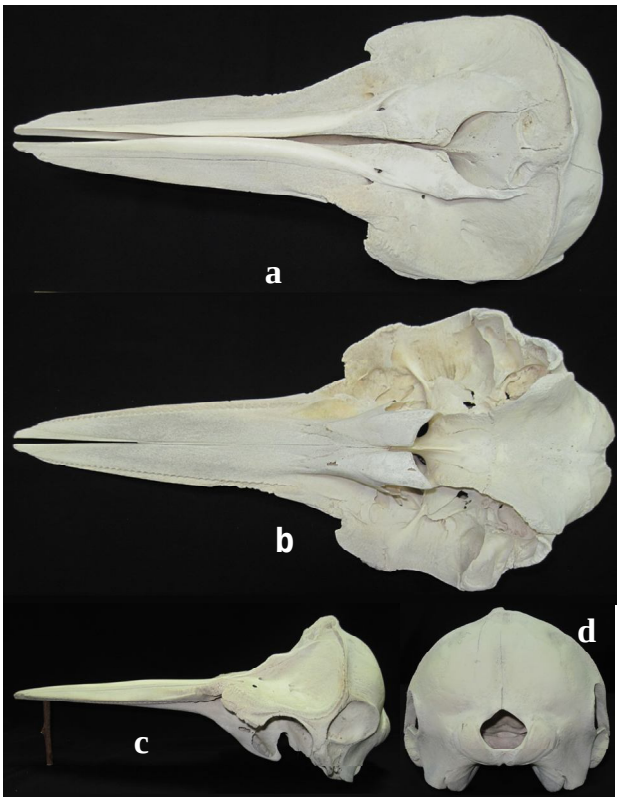


Fig. 1. Skull of striped dolphin: (a) dorsal view, (b) ventral view, (c) lateral view and (d) posterior cranial view. **Note:** the lack of distal fusion of pre-maxilla and maxilla shows that the specimen was a juvenile/subadult (Calzada *et al*., 1997 and W. F. Perrin, pers. comm.).

Rough-toothed dolphin

Three short videos by a tuna fishing vessel (Al-Saira No. 10319-B) depict a small pod (6 animals) of rough-toothed dolphins in deep waters, well beyond the continental shelf edge, on 21 January 2013 (21°47.141′N 65°21.416′E) at 11 AM.

RESULTS

Striped dolphin

No lower jaw bones or any other parts of the skeleton were recovered. The skull showed a series of small serrations/ cuts visible at 1/4th length of the upper jaw on both right and left sides.

The skull measurements revealed it to be a juvenile or subadult striped dolphin. A total of 32 measurements were taken (Table I).

Table I.- Measurements and meristics (in mm) for striped dolphin (*Stenella coeruleoalba*) skull compared with reported ranges (McFee *et al*., 1998).

S. No.	Measurements	(mm)	Range
1	Condylobasal length - from tip of rostrum to hindmost margin of occipital condyles	437	442-479
2	Length of rostrum - from tip to line across hindmost limits of antorbital notches	257	233-293
3	Width of rostrum at base - along line across hindmost limits of antorbital notches	114	93-120
4	Width of rostrum at ¼ length of rostrum	69	N/A
5	Width of rostrum at mid length	63	51-67
6	Width of premaxillaries at midlength of rostrum	29	N/A
7	Width of rostrum at 3/4 length, measured from posterior end	45	36-54
8	Distance from tip of rostrum to external nares (to mesial end of anterior transverse margin of right nares)	314	N/A
9	Distance from tip of rostrum to internal nares (to mesial end of posterior margin of right pterygoid)	309.5	N/A
10	Greatest preorbital width	184	178-213
11	Greatest postorbital width	198	189-233
12	Least supraorbital width	182	N/A
13	Greatest width of external nares	51	N/A
14	Greatest width of internal nares	55	N/A
15	Greatest width across zygomatic processes of squamosal	198	193-227
16	Greatest width of premaxillaries	85	77-92
17	Greatest parietal width, within postemporal fossae	187	147-200
18	Vertical external height of braincase (from midline of basisphenoid to summit of supraoccipital)	114.5	N/A
19	Internal length of braincase from hindmost limit of occipital condyles to foremost limit of cranial cavity along midline	121	N/A
20	Greatest length of left posttemporal fossa, measured to external margin of raised suture	60	N/A
21	Greatest width of left posttemporal fossa at right angles to greatest length	40	N/A
22	Major diameter of left temporal fossa proper	36	N/A
23	Minor diameter of left temporal fossa proper	31	N/A
24	Projection of premaxillaries beyond maxillaries (tip of rostrum to line across foremost tips of maxillaries)	21	N/A
25	Distance from foremost end of junction between nasals to hindmost point of margin of supraoccipital crest	30.1	N/A
26	Length of left orbit-from apex of preorbital process of frontal to apex of postorbital process	54	N/A
27	Length of antorbital process of left lacrimal	55	N/A
28	Greatest length of left pterygoid	82	N/A
29	Length of upper left tooth row - from hindmost margin of hindmost alveolus to tip of rostrum	227	216-254*
30	Number of teeth - upper left	46	39-53
31	Number of teeth - upper right	47	N/A
32	Deviation of skull from symmetry in dorsal view, in degrees	8°	N/A

* =(Perrin *et al*., 1981)

The evidence provided for sighting of striped dolphin was a video which is available as supplementary material for reference with lead author of this publication. According to information gathered from the captain, more than 50 dolphins were around the boat at various distances. The identification of the more distant animals is not confirmed.

Rough-toothed dolphin

Three short videos by a tuna fishing vessel (Al-Saira No. 10319-B) depict a small pod (6 animals) of rough-toothed dolphins in deep waters, well beyond the continental shelf edge, on 21 January 2013 (21°47.141′N 65°21.416′E) at 11 AM (Fig. 3). The videos are available as supplementary material for reference with lead author of this publication. The dolphins can be seen swimming very actively just under the surface and skimming through the water. They stayed close to the slow moving tuna fishing boat for more than an hour and engaged in bow-riding most of the time. The

animals remianed in a tight group formation exhibiting a synchronous swimming and surfacing pattern with frequent tactile associations.

Fig. 2: a) A striped dolphin in the Swatch, 20 December 2012 (photo: M. Ismail) and b) A dead striped dolphin that that died due to entanglement in a tuna gillnet in deep waters, 16 January 2013 (photo: Shahzameen Khan).

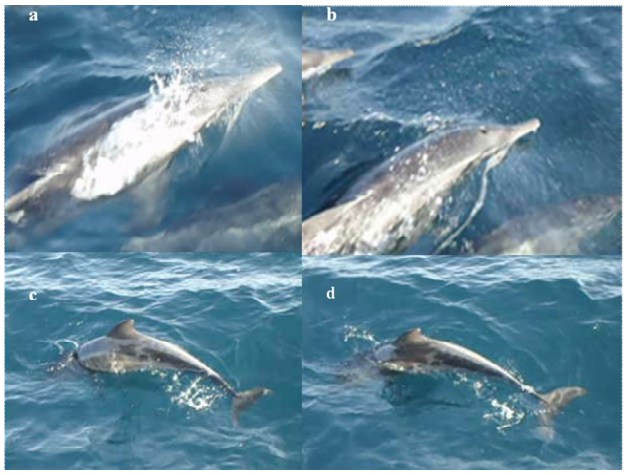


Fig. 3. Rough-toothed dolphin (Photo: Shahzameen Khan).

Rough-toothed dolphins have white colouration on their undersides, lower jaws and lips. A darker marking extends over the eyes to the upper part of their flanks. Additionally, a very obvious and distinct feature is the shape of head, which slopes gently to the beak tip. This character is diagnostic if the dolphins are observed at a close distance, but at a distance they may be confused with bottlenose (*Tursiops* sp.), spinner (*Stenella longirostris*) or pantropical spotted (*Stenella attenuata*) dolphins. A map showing the locations of recovery of skull and sightings of both species are given below (Fig. 4).

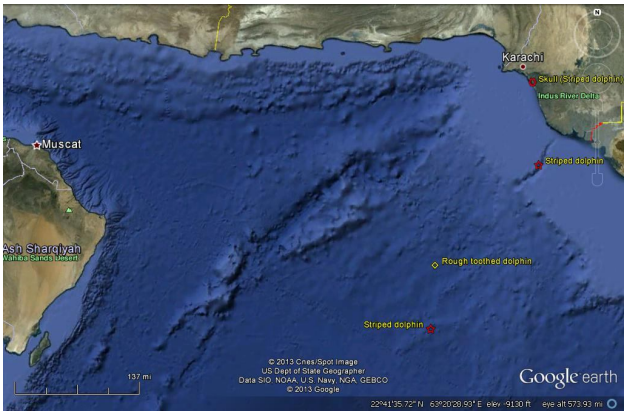


Fig. 4. Map showing location of recovery of skull and sightings of striped dolphin and rough-toothed dolphin.

Review of previous records in Indian Ocean

Striped dolphin

The striped dolphin is well known from all the ocean basins particularly the Mediterranean Sea (Reeves and Notarbartolo di Sciara, 2006). However, the information on this species from the Indian Ocean is very limited due to absence of species-focused research. This may also be due to the preference for the oceanic domain by this species that makes it difficult to study. The areas in the Indian Ocean from where the information is available on the striped dolphin include Australia (Bannister *et al*., 1996; Ross, 2006), Thailand (Chantrapornsyl *et al*., 1999; de Boer *et al*., 2002), Maldives (Ballance, *et al*., 1996; Ballance *et al*., 2001; Anderson, 2005), Sri Lanka (Mead, 1986; Alling, 1986; de Silva, 1987; Alling, 1988; Leatherwood and Reeves, 1989; Dayaratne and Joseph, 1993; Ballance, *et al*., 1996; Ilangakoon, 1997 and 2002; De Vos *et al*., 2012), India (Ballance *et al*., 1996; Kumaran, 2003; Afsaal *et al*., 2008; Kumaran, 2012 and references therein), Iran

(Braulik *et al.*, 2007; Braulik *et al.*, 2010), Oman (Alling, 1983 and 1986; Leatherwood, 1986; Ballance and Pitman, 1998; Gallagher 1991; Ponnampalam, 2009), UAE (anecdotal reports), Somalia (Ballance, *et al*., 1996; Ballance and Pitman, 1998), Seychelles (Ballance and Pitman, 1998), Mauritius (Corbett, 1994) Madagascar (Ballance *et al*., 1996), Kenya (Wamukoya *et al*., 1996), Mozambique (de Boer *et al*., 2002; Everet *et al*., 2008), South Africa (Ballance *et al*., 1996). Ballance *et al.* (1996) reported sightings from south of Socotra and in the Arabian Sea. Ballance and Pitman (1998) reported that *S. coeruleoalba* was the second most abundant species sighted in the western tropical Indian Ocean (14% of all cetaceans) in their survey. Striped dolphins are rare in the Gulf of Oman and the Arabian Sea and appear to be more common in northern and central Indian Ocean according to Baldwin (2003). However, recently a mass stranding (73 striped dolphins) was reported that occurred on October 24, 2007, 60km west of Jask port, southern Iran. In addition, a striped dolphin skull (reported from the same vicinity) is archived at the Department of Environment, Jask, Iran (Braulik *et al*., 2010). This species is not known through sightings and/or strandings but expected to be present in the territorial waters of Indonesia, Malaysia, Myanmar, Bangladesh, Yemen, Union of Comoros, Mayotte (France), Tanzania and Reunion Island. There are extralimital records from the Persian Gulf and the Red Sea (J. Gordon and C. Smeenk, pers. comm. in Frazier *et al.* 1987; Hammond *et al*., 2008).

Rough-toothed dolphin

The status of information on the rough-toothed dolphin in the Indian Ocean is not very different from that for the striped dolphin. Although it is known from the Indian Ocean, only a handful of records of sightings are available. Most of the information comes from beach-cast remains from many of the coastlines bordering the Indian Ocean. No active research is being carried out in any of the regional nations on this species, possibly due to its offshore distribution. The available records from the Indian Ocean include Australia (Bannister *et al*., 1996; V.M. Peddemors and R. Harcourt 2006 pers. comm.), Indonesia (de Boer *et al*., 2002), Thailand (Chantrapornsyl *et al*., 1995; Chantrapornsyl *et al*., 1996; de Boer *et al*., 2002), Maldives (Ballance *et al*., 2001; Anderson, 2005); Sri lanka (Leatherwood and Reeves, 1989; Dayaratne and Joseph, 1993; Illangakoon, 2002); India (Blanford, 1888-91; Leatherwood, 1986; De Silva, 1987; Afsaal *et al*., 2008; Kumaran, 2012), Oman (Ballance *et al*., 1996; Leatherwood, 1986; Ballance and Pitman, 1998; Van Waerebeek *et al*., 1999; Minton, 2004; Ponnampalam, 2009, Minton *et al*., 2011, Oman Whale and Dolphin research Group unpublished data), Iran (Braulik *et al*., 2010), South of Socotra (Ballance *et al*., 1996), Gulf of Aden and Red Sea (Hershkovitz, 1966; Miyazaki and Perrin, 1994; Frazier *et al*., 1997), Seychelles (Ballance and Pitman, 1998), Madagascar (Ballance *et al*., 1996), Tanzania (Chande *et al*., 1994; Berggren *et al*., 2001), Zanzibar (Berggren *et al*., 2001), Mozambique (Peddmors *et al*., 1997), South Africa (Peddmors, 1999). There is no evidence of rough-toothed dolphins occurring in the Persian Gulf, and it is unlikely that this is suitable habitat for this deep-water species (Robineau, 1998). Though occurrence of this species is unknown in Malaysia, Myanmar, Bangladesh, UAE, Yemen, Somalia, Kenya, Comoros, Mauritius and Reunion, but it is expected to be present in their territorial waters.

DISCUSSION

Knowledge on marine cetaceans in Pakistan has improved considerably since 2005 when a dedicated cetacean research project, Cetacean Conservation Pakistan (CCP), was initiated jointly by the Centre of Excellence in Marine Biology (CEMB), University of Karachi, World Wildlife Fund (WWF)-Pakistan and University Marine Biological Station Millport (UMBSM), Scotland. As a result, information on already known species from Pakistan was updated with more recent knowledge (Gore *et al.*, 2012), and in addition three new species, sperm whale *Physeter macrocephalus* (Gore *et al.*, 2007a), Cuvier's beaked whale *Ziphius cavirostris* (Gore *et al.*, 2007b) and pantropical spotted dolphin have been confirmed to occur in the Pakistani EEZ (Kiani *et al.*, 2011). Since completion of the CCP project in 2008, an action plan has been prepared (Gore, 2008) and efforts have been

directed to ensure the continuity of research on marine cetaceans of Pakistan to facilitate the process of development of a proper national cetacean conservation policy and also for promoting their sustainable use through whale and dolphin watching ecotourism by highlighting the need for their conservation. As an extension of such efforts regular beach surveys are organized by CEMB of the University of Karachi along different sections of the Pakistan coastline for collection of first-hand information on beach cast remains of cetaceans. Information on threats being faced by local marine cetaceans, causes of mortality and areas of conflict with fisheries is also collected.

Striped dolphin

The area from where the skull of a striped dolphin was retrieved is very near to a famous deep water area "the Swatch" along the Sindh coast (Figure 1). This area is very interesting as it spans over the Indus river delta with a total length of about 117 km, having depth ranging from ca. 41 to 727 m. The Swatch starts ca. 12 km from the coast. This area attracts deep-water species of fish, cetaceans and other large marine vertebrates (Ahmed, 1985; Mikhalev, 1997 and 2000; Aziz Agha, a local game fisher, pers. comm.). Large whales such as the famous but endangered Arabian Sea humpback whale (*Megaptera novaeangliae*) are well known from this area, specifically from Russian illegal whaling data (Mikhalev, 1997 and 2000). It is possible that the striped dolphins may be using "the Swatch" area for their nearshore incursions in order to benefit from the rich food resources offered by rich mangrove ecosystem of the Indus delta. This is in agreement with Archer (2002) who states that the habitat of the striped dolphin is mainly oceanic but some occurrences over the continental shelf are also recorded throughout the range of the species. Moreover, the depths found in the Swatch area fall in the preferred foraging and diving range of the striped dolphin *i.e.* 200-700m. However, species' diving and foraging behaviour has not been extensively studied (Archer, 2002). Its distribution also seems to be associated with areas where seasonal changes in thermocline depth occur, as reported from the eastern tropical Pacific (Reilly and Fiedler, 1993). The literature also indicates that striped dolphins are commonly recorded from riverine mouth areas, which is in line with findings of the present study (Perrin, 1975 and references therein). Striped dolphins are known to feed on a wide variety of small, midwater and pelagic or benthopelagic fish, especially lanternfish (*Myctophidae*), cod (*Gadus morhua*) and cephalopods (Archer, 2002). Lanternfish and squids are present in the Pakistani EEZ (FAO, 2011) and thus can support a striped dolphin population.

The pattern of wind driven circulation in the Indus delta favours deposition of dead cetaceans, and their remains, on the beaches just before the start of the turbulent southwest monsoon (mid June to September) which is thought to wash these specimens from the beaches. Fishing activities also decrease considerably during this period, which reduces the chances of cetaceans and other large marine vertebrate entanglements in fishing gear. The present specimen was found before the onset of the SW monsoon in the spring intermonsoonal period (March to May). Salm (1991) states that many beaches are swept clean during the annual SW monsoonal period and the peak abundances of dead dolphins and other taxa on the Arabian Sea coasts are just before the onset of the SW monsoon.

The skull measurements were compared with those in MeFee *et al*. (1998) and were found to be within the reported range. Though it is difficult to establish the cause of death of this dolphin, a series of serrations on rostrum are visible which may be an indication of negative interaction with fisheries (e.g. entanglement and/or a propeller strike). This pattern of injuries is similar to those found in some other dead dolphins found during beach surveys (Kiani, M.S. and Pervaiz, I., unpublished data). The Swatch area is one of the most important fishing grounds along the Pakistan coastline, being very productive due to its close proximity to the nursery grounds found in the world's largest arid mangrove ecosystem. Due to this reason fishers come from several different locations to this area, *e.g.* from Karachi to Keti Bunder (Indus delta) and from India as well. This results in concentration of more fishing activities in a small area during the peak fishing season, *i.e.* predominantly during the northeast monsoon (November to February) and increases the chances of entanglement of cetaceans and other

large marine vertebrates in fishing gear.

Some commonly practiced fishing methods in this area include gillnets of various kinds/sizes and trawling. There is no or little information that shrimp trawling is associated with cetacean by-catch in Pakistan (Niazi, 1990; M. Moazzam Khan, ex-Director General Marine Fisheries Department of Pakistan MFD, pers. comm.). The gillnets are the most harmful fishing gear for cetaceans in Pakistani waters, as reported from other parts of the world (Jefferson and Curry, 1994; Perrin *et al*., 1994). The lengths of medium (100-120mm) and large mesh (150-240mm) sized gillnets, used for catching pomfrets, groupers, snappers, grunts, queenfish, seabreams, shads, catfish, croakers, tuna and other scombrids respectively in shelf and high seas, exceed the limits set by the United Nations General Assembly Resolution 44/225 1991 (M. Moazzam Khan, pers. comm.). According to the resolution, the length of gillnets should not exceed 2.5km on the high seas. However, the nets being used in Pakistan range from 7 to10 km in length and can be up to 26 km long (M. Moazzam Khan, pers. comm.). These nets are functioning as "walls of death" and causing mortality of cetaceans of all sizes, turtles and other non-target species. Striped dolphins are not frequently associated with tuna and thus small numbers are killed in tuna fisheries (DeMaster *et al.*, 1992; Perryman and Lynn, 1994). The live sighting reported in this paper (Figure 2a) and a dead specimen that died as a result of entanglement (Figure 2b) were recorded by a captain of a boat catching large pelagic fish, including tuna. This demonstrates that the species may get entangled in the large gillnets being used by such boats in Pakistani waters and that striped dolphins are getting affected by tuna fishing operations in Pakistan. The extent of this issue is still to be studied.

Rough toothed dolphin

The absence of information on rough-toothed dolphins in Pakistan is possibly due to lack of effort in deep offshore waters previously as well as in recently conducted surveys by the CCP project. As in the case of the present sighting, it is possible that the fishers fishing in offshore waters interact with this species frequently but due to lack of experience in proper species identification none of the fishers mentioned having seen them in a comprehensive fisher community interviews conducted by the CCP project 2005-2008 (Gore *et al*., 2012; Kiani, Ph.D. thesis). Such close interactions with fishing vessels render this species vulnerable to entanglements in fishing gear as well as boat strikes. Although no information on by-catch levels of this species are in hand, the animals may be getting killed in deeper waters and the carcasses may be sinking at sea instead of reaching the coastline due to the great distances involved. This may be the reason for absence of this species in beach cast remains data (Kiani, M.S. and Pervaiz, I. unpublished data). The first record of this species is a new consideration for Pakistan's Biodiversity Action Plan and for future development of a proper strategy for cetacean conservation in Pakistan since this new record is reported by a tuna gillnet fishing vessel which are cause of high levels of by-catch of non-target species specifically marine turtles and cetaceans (M. Moazzam Khan, pers. comm.). Proper mitigation measures are required for their future survival.

Strict implementation of relevant laws to disperse the concentration of fishing activities, particularly in the Swatch, is important for conservation of cetaceans in Pakistan. Data on by-catch have not been accumulated by any of the relevant departments, and observer programmes by the Marine Fisheries department are not effective in recording cetacean interactions, being focused only on monitoring illegal fish catch and enforcement of fishing area restrictions. Detailed observations on the status, diversity, distribution of marine mammals, especially offshore cetaceans should be done extensively with the collaboration of relevant departments of the country and regionally active research groups.

ACKNOWLEDGEMENTS

Funding from Higher Education Commission of Pakistan (HEC) under 5000 Indigenous Fellowship Scheme is gratefully acknowledged. Technical and logistic assistance provided by the Centre of Excellence in Marine Biology (CEMB), University of Karachi is highly appreciated. W. F. Perrin reviewed the manuscript and offered

suggestions for its improvement. The authors also recognize the inputs of the anonymous reviewers.

REFERENCES

AFSAL, V.V., YOUSUF, K.S.S.M., ANOOP, B., ANOOP, A.K., KANNAN, P., RAJAGOPALAN, M. AND VIVEKANANDAN, E., 2008. A note on cetacean distribution in the Indian EEZ and contiguous seas during 2003–07. *J. Cetacean Res. Manage.*, **10**: 209–16.

AGUILAR, A., 2000. Population biology, conservation threats and status of Mediterranean striped dolphins (*Stenella coeruleoalba*). *J. Cetacean Res. Manage.*, **2**: 17-26.

AHMED, M., 1985. *Marine Fisheries of Pakistan. Status paper*. Centre of Excellence in Marine Biology University of Karachi and PARC, Islamabad. 150pp.

ALLING, A., 1983. *A preliminary report of marine mammal fisheries in Djibouti, Oman and Sri Lanka*. Paper NARA/SMMIO/SP32 presented to the Symposium on Marine Mammals of the Indian Ocean, Colombo, Sri Lanka (unpublished). 4pp.

ALLING, A., 1986. Records of odontocetes in the northern Indian Ocean (1981–1982) and off the coast of Sri Lanka (1982–1984). *J. Bombay nat. Hist. Soc.*, **83**: 376–94.

ALLING, A.K., 1988. A preliminary report on the incidental entrapment of odontocetes by Sri Lanka's coastal drift net fishery. *J. Bombay nat. Hist. Soc.*, **85**: 538–50.

ANDERSON, R.C., 2005. Observations of cetaceans in the Maldives, 1990– 2002. *J. Cetacean Res. Manage.*, **7**: 119–136.

ARCHER, F.I., 2002. Striped dolphin *Stenella coeruleoalba*. In: *Encyclopaedia of marine mammals* (eds. W. F. Perrin, B. W¨ursig and J. G. M. Thewissen). Academic Press, San Diego, CA, pp 1201–1203.

ARCHER, F. I., II. AND PERRIN, W.F., 1999. *Stenella coeruleoalba*. *Mammalian Species*, **603**: 1-9.

BALDWIN, R., 2003. *Whales and Dolphins of Arabia.* Mazoon Printing Press L.L.C., Muscat, Oman. 116p.FAO Fisheries and Aquaculture Report. 2011. No. 971. Karachi, pp. 58.

BALLANCE, L.T. AND PITMAN, R.L., 1998. Cetaceans of the Western Tropical Indian Ocean: distribution, relative abundance, and comparisons with cetacean communities of two other tropical ecosystems. *Mar. Mammal Sci.*, **14**:429-59.

BALLANCE, L.T., ANDERSON, R.C., PITMAN, R.L., STAFFORD, K., SHAAN, A., WAHEED, Z. AND BROWNELL, Jr. R.L., 2001. Cetacean sightings around the Republic of the Maldives, April 1998. *J. Cetacean Res. Manage.*, **3**:213-218.

BALLANCE, L.T., PITMAN, R.L. AND FIEDLER, P.C., 2006. Oceanographic influences on seabirds and cetaceans of the eastern tropical Pacific: a review. *Prog Oceanogr*, **69**:360–390.

BALLANCE, L.T., PITMAN, R.L., REILLY, S.B. AND FORCE, M.P., 1996. *Report of a cetacean, seabird, marine turtle and flying fish survey of the Western tropical Indian Ocean aboard the research vessel Malcolm Baldridge*, March 21 – July 26, 1995. NOAA Technical Memorandum NMFS (NOAA-TM-NMFSSWFSC- 224), pp. 132.

BANNISTER, J.L., KEMPER, C.M. AND WARNEKE, R.M. 1996. *The action plan for Australian cetaceans.* Australian Nature Conservation Agency. Wildlife Australia. 242 pp.

BERGGREN, P., AMIR, O.A., STENSLAND, E. AND JIDDAWI, N.S., 2001. *Marine mammals in Zanzibar: A resource in need of conservation and management.* Paper Presented at the Wiomsa Second Scientific Symposium, 22 – 25th October 2001, Karimjee Hall, Dar es Salaam, Tanzania.

BLANFORD, W.T. 1888–91. Order: Cetacea. In: *The fauna of British India, Ceylon and Burma* (ed. W.T. Blandford). *9*. Taylor and Francis, London. pp.564–591.

BRAULIK, G.T., RANJBAR, S., OWFI, F., AMINRAD, T., DAKHTEH, S.M.H., KAMRANI, E. AND MOHSENIZADEH, F., 2010. Marine mammal records from Iran. *J. Cetacean Res. Manage.*, **11**:49–63.

BRAULIK, G.T., SEDIGHI, O., FADAKAR, S., MOHAMMADI, H., BROWNELL, R.L., Jr., REEVES, R.R., NABAVI, S.M.B. AND FERNANDEZ, A., 2007. A retrospective investigation of two dolphin mass mortality events in Iran, autumn 2007. *Zool. Middle East*, vol. missing.

CALZADA, N., AGUILER, A., LOCKYER, C., GRAU, E. 1997. Patterns of growth and physical maturity in the western Mediterranean striped dolphins *Stenella coeruleoalba* (Cetacea: Odontoceti). *Canadian J. Zool*., **75**: 632-637.

CARDELLICCHIO, N., GIANDOMENICO, S., RAGONE, P., AND DILEO, A. 2000. Tissue distribution of metals in striped dolphins (*Stenella coeruleoalba*) from the Apulian coasts, Southern Italy. *Mar. Env. Res.*, **49**: 55-66.

CHANDE, A.I., MTOKA, G.F., MHITHU, H.A. 1994. Marine mammals and fisheries interactions in Tanzania. Tanzania Fisheries Research Institute. Unpublished Report to UNEP. 39 pp.

CHANTRAPORNSYL, B.S., ADULYANUKOSOL, K. AND KITTIWATHANAWONG, K., 1996. Records of cetaceans in Thailand. *Phuket mar. biol. Cent. Res. Bull*., **61**: 39-63.

CHANTRAPORNSYL, S. AND ANDERSEN, M., 1995. *The small cetaceans in Thai waters*. Working paper UNEP/SEA95/WP11 presented at the United Nations Environment Programme Workshop on the Biology and Conservation of Small Cetaceans and Dugongs of Southeast Asia, 27-30 June, Dumaguete, Philippines.

CORBETT, H.D., 1994. The occurrence of cetaceans of Mauritius and in adjacent waters. *Rep. Int. Whal. Commn.*, **44**:393-97.

CULIK, B., 2003. *Stenella coeruleoalba* (Meyen, 1833). *Review on Small Cetaceans: Distribution, behaviour, Migration and Threats*. [Online]. Available from:http://www.cms.int/reports/small_cetaceans/data/S_ceoruleoalba/s_coeruleoalba.htm.

DAYARATNE, P. AND JOSEPH, L., 1993. A study of dolphin catches in Sri Lanka. *Bay of Bengal Programme, Madras* BOBP/REP/56: 47pp.

DE BOER, M.N., BALDWIN, R., BURTON, C.L.K., EYRE, E.L., JENNER, K.C.S., JENNER, M.N.M., KEITH, S.G., MCABE, K.A., PARSONS, E.C.M., PEDDMORS, V.M., ROSENBAUM, H.C., RUDOLPH, P., AND SIMMONDS, M.P., 2002. Cetaceans in the Indian Ocean Sanctuary: A Review. Whale and Dolphin Conservation Society Science Report, pp. 1-52.

DE SILVA, P.H.D.H. 1987. Cetaceans (Whales, Dolphins and Porpoises) Recorded off Sri Lanka, India from the Arabian Sea and Gulf of Aden and from the Red Sea. *J. Bombay nat. Hist. Soc.*, **84**: 505-525.

DE VOS, A., CLARK, R., JOHNSON, C., JOHNSON, G., KERR, I., PAYNE, R. AND MADSEN, P.T., 2012. Cetacean sightings and acoustic detections in the offshore waters of Sri Lanka: March–June 2003. *J. Cetacean Res. Manage.*, **12**: 185–193.

DEMASTER, D.P., EDWARDS, E.F., WADE, P. AND SISSON, J.E., 1992. Status of dolphin stocks in the astern tropical Pacific. In: *Wildlife 2001: Populations* (eds. D. R. McCullough and R. H. Barrett). Elsevier Applied Science, London, pp. 1038-1050

EVERETT, B.I., VAN DER ELST, R.P. AND SCHLEYER, M.H., 2008. *A natural history of the Bazaruto Archipelago, Mozambique.* 118 pp. Special publication, no 8. 110-111.

FANNING, L.P., KHAN, M.W., KIDWAI, S. AND MACAULEY, G.J. 2011. Surveys of the offshore fisheries resources of Pakistan – 2010. *FAO Fish. Aquacult. Circ.* No. 1065. Karachi, FAO. 87 pp.

FRAZIER, J.G., BERTRAM, G.C. AND EVANS, P.G.H., 1987. Turtles and Marine Mammals. In: *Red Sea* (eds. A.J. Edwards and S.M. Head). Pergammon Press, Oxford, pp. 288-314.

GALLAGHER, M.D., 1991. Collections of Skulls of Cetacea: Odontoceti from Bahrain. United Arab Emirates and Oman, 1969-1990. In: *Cetaceans and cetacean research in the Indian Ocean sanctuary* (eds. S. Leatherwood and G. P. Donovan). Marine Mammal Technical Report No. 3. UNEP, Nairobi, Kenya, pp. 90-97.

GANNIER A., 2000. Distribution of Cetaceans off the Society Islands (French Polynesia) as obtained from dedicated survey. *Aquat. Mamma.*, **26**: 111-126.

GORE, M., 2008. Action plan for the conservation of marine cetaceans of Pakistan. Report for DEFRA Darwin Initiative Programme, 26pp.

GORE, M., AHMAD, E., ALI, Q.M., CULLOCH, R.M., HAMEED, S., HASNAIN, S.A., HUSSAIN, B., KIANI, S., SHAIK, N., SIDDIQUI, P.J. AND ORMOND, R.F., 2007a. Sperm whale, *Physeter macrocephalus*, stranding on the Pakistani coast. *J. Mar. biol. Assoc. U.K.* **87**:363-364.

GORE, M.A., AHMED, E., ALI, Q.M., CULLOCH, R.M., HASNAIN, S.A, HUSSAIN, B., IQBAL, P., KIANI, S., MACLEOD, C.D., PARSONS, E.C.M, SIDDIQUI, P.J., ORMOND, R.F. AND WAQAS, U., 2007b. Cuvier's beaked whale, *Ziphius cavirostris*, remains recovered on the Pakistani coast. *J. Mar. biol. Assoc. U.K.* JMBA2 Biodiversity records online, 5920, Pdf.

GORE, M.A., KIANI, M.S., AHMAD, E., HUSSAIN, B., ORMOND, R.F., SIDDIQUI, J., WAQAS, U. AND CULLOCH, R., 2012. Occurrence of whales and dolphins in Pakistan with reference to fishers' knowledge and impacts. *J. Cetacean Res. Manage.*, **12**: 235–247.

HAMMOND, P.S., BEARZI, G., BJøRGE, A., FORNEY, K.A., KARCZMARSKI, L., KASUYA, T., PERRIN, W.F., SCOTT, M.D., WANG, J.Y., WELLS, R.S. AND WILSON, B., 2012. *Steno bredanensis*. In: *IUCN 2012. IUCN Red list of threatened species*. Version 2012.2. <www.iucnredlist.org>. Downloaded on 09 March 2013.

HERSHKOVITZ, P., 1966. Catalog of living whales. *Bull. U.S. Nat. Mus. Nat. Hist.*, **246**: 1-259.

ILLANGAKOON, A., 1997. Species composition, seasonal variation, sex ratio and body length of small cetaceans caught off the west, south-west and south coast of Sri Lanka. *J. Bombay nat. Hist. Soc.*, **94**: 298–306.

ILLANGAKOON, A., 2002. *Whales and Dolphins of Sri lanka*. WHT Publications, Sri Lanka. 99pp.

JEFFERSON, T.A., 2002. Rough-toothed dolphin *Steno bredanensis*. In: *Encyclopaedia of marine mammals* (eds. W.F. Perrin, B. Wursig. and J.G.M. Thewissen). Academic Press, New York, pp. 1055-1059.

JEFFERSON, T.A. AND CURRY, B.E., 1994. A global review of porpoise (Cetacea: Phocoenidae) mortality in gillnets. *Biol. Conserv.*, **67**: 167–83.

KIANI, M.S., 2013. *Studies on marine cetaceans of Pakistan with a special emphasis on the Indus delta Indo-Pacific humpback dolphin,* Sousa chinensis *(Osbeck, 1765) in the Indus delta creek system of Pakistan.* Ph.D. thesis, University of Karachi (*in progress*).

KIANI, M.S., PERVAIZ, I. AND SIDDIQUI, P.J.A., 2011. First confirmation of occurrence of the pan-tropical spotted dolphin, *Stenella attenuata* in Pakistani waters through a mass stranding event. *Mar. Biodiv. Rec.*, page 1 of 3. Marine Biological Association of the United Kingdom.doi:10.1017/S1755267211000601; Vol. 4;

e60; published online.

KUMARAN, P.L., 2003. First confirmed record of striped dolphin, *Stenella coeruleoalba* (Meyen, 1883) from India. *J. Mar. biol. Assoc. India*, **45**: 115–20.

KUMARAN, R.P., 2012. Cetaceans and cetacean research in India. *J. Cetacean Res. Manage.*, **12**: 159–172.

LEATHERWOOD, S., 1986. *Whales, Dolphins and Porpoises of the Indian Ocean Sanctuary. A catalogue of available information.* Hubbs Marine Research Centre Technical Report No. 87-197. San Diego: Hubbs Marine Research Center. 207pp.

LEATHERWOOD, S. AND REEVES, R.R., 1989. Marine mammal research and Conservation in Sri Lanka 1985-1986. *Mar. Mammal Tech. Rep. No.* 1, UNEP, Nairobi, Kenya.

LEDUC, R.G., PERRIN, W.F. AND DIZON, A.E., 1999. Phylogenetic relationships among the delphinid cetaceans based on full cytochrome b sequences. *Mar. Mammal. Sci.*, **15**:619-648.

MCFEE, W.E., ROBERTSON, K.M. and LUX, C., 1998. Records of the striped dolphin, *Stenella coeruleoalba* stranded in South Carolina. *J. Elisha Mitchell scient. Soc*., **114**:119-124.

MEAD, J., 1986. U.S.N.M. computerized specimen catalog.

MEAD, J.G. AND BROWNELL, Jr. R.L., 1993. Order Cetacea, In: *Mammal species of the world: A taxonomic and geographic reference* (eds. D.E. Wilson and D.M. Reeder), Smithsonian Institution, Smithsonian Press, Washington, D.C. pp. 349-364

MIKHALEV, Y., 1997. Humpback whales *Megaptera novaeangliae* in the Arabian Sea. *Mar. Ecol. Progr. Ser.*, **149**: 13-21.

MIKHALEV, Y.A., 2000. Whaling in the Arabian Sea by the whaling fleets *Slava* and *Sovetskaya Ukraina*. In:. *Soviet Whaling Data (1949–1979)*. (eds. A.V. Yablokov, V.A. Zemsky and D.D. Tormosov), pp.141–181.

MINTON, G., 2004. *Population ecology and conservation of cetaceans in Oman, with particular reference to humpback whales, Megaptera novaeangliae (*Borowski 1781*)*. Ph.D. Thesis, University of London.

MINTON, G., COLLINS, T., FINDLAY, K. AND BALDWIN, R., 2010. Cetacean distribution in the coastal waters of the Sultanate of Oman. *J. Cetacean Res. Manage.* (in press).

MINTON, G., COLLINS, T.J.Q., FINDLAY, K.P. AND BALDWIN, R., 2011. Cetacean distribution in the coastal waters of the Sultanate of Oman. *J. Cetacean Res. Manage.*, **11**: 301−313.

MITCHELL, E.D., 1975. Porpoise, dolphin, and small whale fisheries of the world: status and problems. *Int. Union Conserv. Nat. nat. Res.*, **3**:1-129.

MIYAZAKI, N. AND PERRIN, W.F. 1994. Rough-toothed dolphin – *Steno bredanensis* (Lesson, 1828). pp. 1-21. In: *Handbook of Marine Mammals Vol. 5. The First Book of Dolphins* (eds. S.H. Ridgway and R. Harrison). Academic Press, London and San Diego.416pp.

NIAZI, M.S., 1990. *Information on fisheries of Pakistan.* Paper SC/O90/G30 presented to the IWC Symposium on Mortality of Cetaceans in Passive Fishing Nets and Traps, La Jolla, California, October 1990 (unpublished). 8pp + Add. [Paper available from the Office of this Journal].

NOTARBARTOLO DI SCIARA, G., VENTURINO, M.C., ZANARDELLI, M., BEARZI, G., BORSANI, F. AND CAVALLONI, B., 1993. Cetaceans in the central Mediterranean Sea: distribution and sighting frequencies. *Boll. Zool*., **60**: 131-138.

OTT, P.H. AND DANILEWICZ, D., 1996. Southward range extensions of *Steno bredanensis* in the Southwest Atlantic and new records of *Stenella coeruleoalba* for Brazilian waters. *Aquat. Mammals*, **22**: 185–189.

PEDDMORS, V.M., 1999. Delphinids of southern Africa: a review of their distribution, status and life history. *J. Cetacean Res. Manage*., **1**: 157-165.

PEDDMORS, V.M., 2006. *Personal Communications*. Graduate School of the Environment, Macquarie University, Sydney.

PEDDMORS, V.M., BEST, P.B., FINDLEY, K.P., GOVE, D., RAKOTONIRINA, B., ROSSAUW, A. AND SEKIGUCHI, K., 1997. Small cetaceans of the Southwest Indian *Ocean*. Paper SC49/SM33 presented to the IWC Scientific Committee.

PERRIN, W.F., 1975. Variation of spotted and spinner porpoise (genus *Stenella*) in the eastern tropical Pacific and Hawaii. *Bull. Scripps Inst. Oceanogr*., **21**: 1-206.

PERRIN, W.F., DONOVAN, G.P. AND BARLOW, J., 1994. Report of the workshop on mortality of cetaceans in passive fishing nets and traps. In: *Gillnets and cetaceans* (eds. W.F. Perrin, G.P. Donovan and J. Barlow). Rep. Int. Whal. Commn. (Special Issue 15), pp. 1-72

PERRIN, W.F., MITCHELL, E.D., MEAD, J.G., CALDWELL, D.K. AND VAN BREE, P.J.H., 1981. *Stenella clymene*, a rediscovered tropical dolphin of the Atlantic. *J. Mammal*., **62**: 583–598.

PERRYMAN, W.L. AND LYNN, M.S., 1994. Examination of stock and school structure of striped dolphins *(Stenella coeruleoalba)* in the eastern Pacific from aerial photogrammetry. *Fish. Bull. U.S*., **92**:122-131.

PONNAMPALAM, L.S., 2009. *Ecological studies and conservation of small cetaceans in the Sultanate of Oman, with special reference to spinner dolphins,* Stenella longirostris *(Gray, 1828).* Ph.D. thesis. University of London.

REEVES, R. AND NOTARBARTOLO DI SCIARA, G., 2006. *The status and distribution of Cetaceans in the Black Sea and Mediterranean Sea*. IUCN Centre for Mediterranean Cooperation, Málaga, Spain, pp. 137.

REILLY, S.B. AND FIEDLER, P.C., 1993. Interannual variability of dolphin habitats in the eastern tropical Pacific. I. Research vessel surveys, 1986–1990. *Fish. Bull (Wash DC)*, **92**:434–450.

RITTER, F., 2002. Behavioural observations of rough toothed dolphin (*Steno bredanensis*) off La Gomera (Canary Islands) with a special reference to their interaction with humans. *Aquat. Mammals*, **28**: 46-59.

ROBINEAU, D., 1998. *The cetaceans of the Arabo-Persian Gulf: a review.* Paper SC/50/SM1 presented to the IWC Scientific Committee, April 1998 (unpublished). 15pp.

ROSS, G.J.B., 2006. *Review of the conservation status of Australia's smaller whales and dolphins*. Page(s) 124. [Online]. Report to the Australian Department of the Environment and Heritage, Canberra. Available from: http://www.environment.gov.au/coasts/publications/pubs/conservation-smaller-whales-dolphins.pdf.

SALM, R.V., 1991. *Live and beached cetacean observations, Sultanate of Oman: Scientific Results of the IUCN Coastal Zone Management Project* (CZMP4:F14). Report prepared for the Ministry of Commerce and Industry, Sultanate of Oman. (Unpublished). 26 pp.

VAN WAEREBEEK, K., FELIX, F., HAASE, B., PALACOIS, D.M., MORA PINTO, D.M. AND MUNOZ HINCAPIE, M., 1998. Inshore records of the striped dolphin, *Stenella coeruleoalba*, from the Pacific coast of South America. *Rep. Int. Whal. Comm*., **48**:525-532.

VAN WAEREBEEK, K., VAN BRESSEM, M.F., ALFARO-SHIGUETO, J., SANINO, G. P., MONTES, D. AND ONTON, K., 1999. A preliminary analysis of recent captures of small cetaceans in Peru and Chile. In: *IWC Scientific Committee document SC/51/ SM17.* Grenada, p. 12.

WAMUKOYA, G.M., MIRANGI, J.M. AND OTTICHILLO, W.K., 1996. Report on the marine aerial survey of the marine mammals, sea turtles, sharks and rays. *KWS Tech. Ser. Rep.*, **1**: 1-22.

(Received 4 May 2013, revised 10 June 2013)

ANNEXURE-IV

Received: 4 November, 2012
IOTC–2012–WPNT02–13

SECOND SESSION OF THE WORKING PARTY ON NERITIC TUNA (WPNT02)
19-21 November, 2012
Penang, Malaysia

STATUS OF FISHERIES OF NERITIC TUNA IN PAKISTAN

Muhammad Moazzam
WWF-Pakistan
Karachi-Pakistan

November 4, 2012

Introduction:

Tuna fishing is one of the oldest economic activity along the coast of Pakistan. There used to be large fisheries for salted-dried products that was exported mainly to Sri Lanka. Among the dry seafood, tuna species used to fetch highest prices, therefore, fishermen prefer to involve in catching of various tuna species along the coast of Pakistan. Main centers for tuna fisheries were Karachi, Gaddani, Ormara, Pasni, Sur, Gwader, Phushukan, Ganz and Jiwani. All these population centers are located along the open coastline, therefore, have easy access to neritic waters. Since long the only gear used for catching of tuna is gillnet. Fishermen used to carry salt which was used for preservation on board fishing vessels. There used to be many curing yards at each of these landing centers which we-salted fish from the fishing boats are further processed before export to Sri Lanka.

The processing trend started to change since early part of last decade when tuna was traded with fuel with Iran both at high seas and along the Iran-Pakistan border. Construction of coastal along the Balochistan coast (Mekran Coastal Road) has opened a new avenue and fish from even the distant places like Karachi could be easily transported to Iran with a few hours. This brought changes in fish handling on board fishing vessels and now all the catch is landed in chilled form.

There are two type of tuna gillnet fisheries in Pakistan i.e. neritic tuna fisheries and offshore tuna fisheries. Present paper reviews the neritic tuna fisheries of Pakistan.

Fishing Boats

Pakistani tuna fleet consists entirely of locally made wooden boats (Fig. 1). A census of the fishing boats carried out in December 2011 reveals that most of the boats involved in neritic tuna fishing range between 10 to 15 m (Fig. 2). Almost all tuna fishing boats operating from Karachi have a transom at the stern whereas tuna boats of Balochistan are mostly double keeled. Tuna boats including both operating from Karachi or from Balochistan coast have inboard engine with 50 hp to 500 hp (Fig.3). Almost all of these boats have a hydraulically operated net hauler whereas on some smaller boats nets are hauled manually. Previously no navigational and communication gadgets were used on these boats but now most tuna boats carry fish finders, GPS, GPS plotters and satellite phones. Some boats also have VHF and short-wave radios for communication purposes.

Most of the tuna boats targeting neritic tuna have fish hold consisting of 8 compartments each having capacity to hold about 1 ton of fish. Ice is carried on fishing trips and prime catch is placed with ice. Because of smaller size, fishing boats of Balochistan have fewer fish holds.

(a) (b)

Fig. 1. Tuna fishing boats (a) Smaller Tuna Gillnetter ('hora'/'rachin') (b) Large Tuna Gillnetter

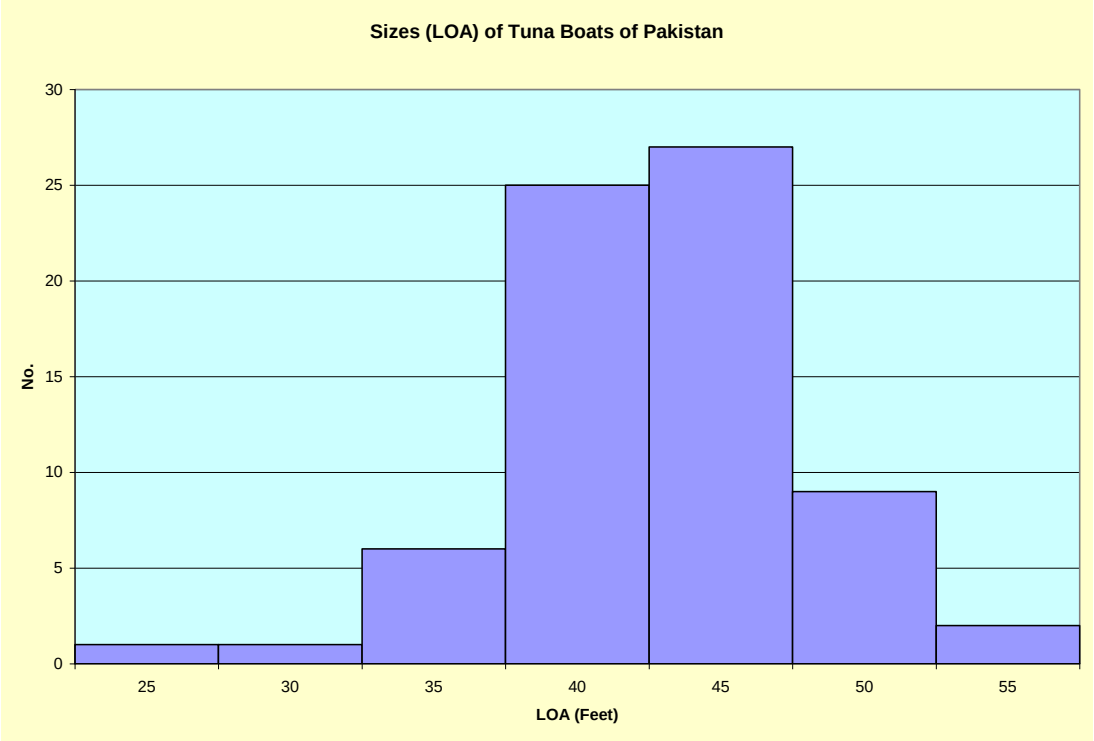


Fig. 2. Length (LOA) of local tuna boats

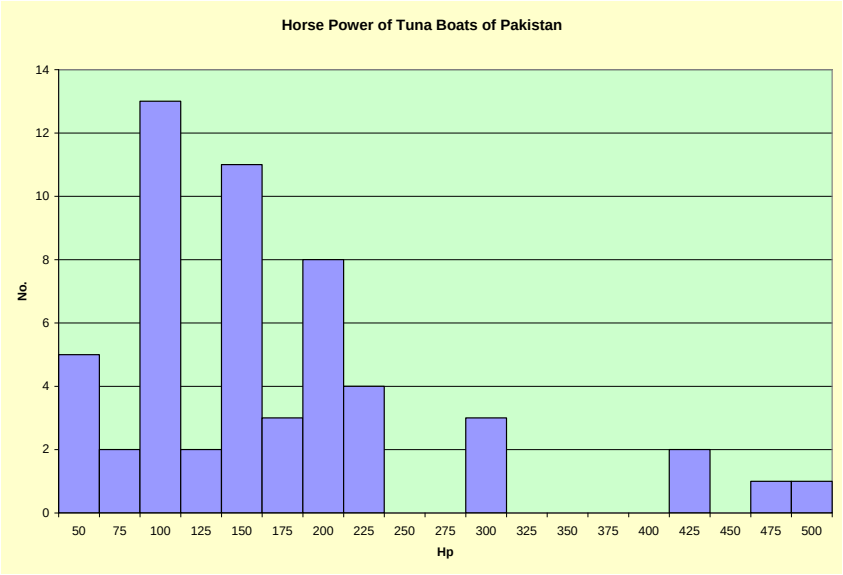
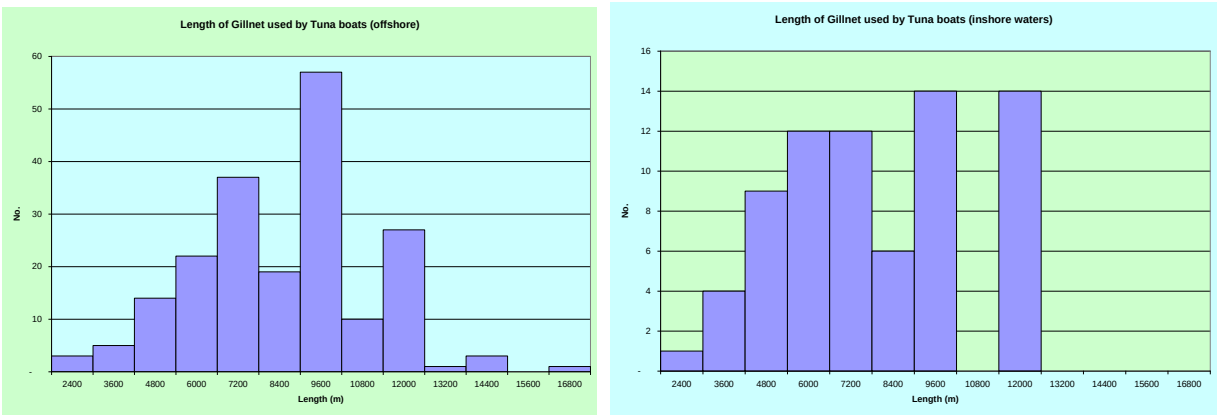


Fig. 3. Engine power (hp) of local tuna boats.

Fishing Gears

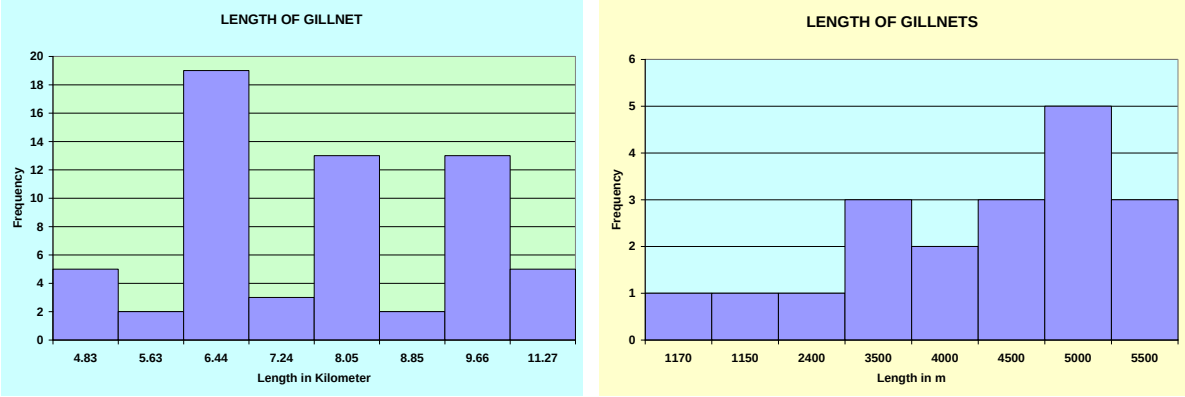
Surface gillnetting using polyamide nets are used for catching tuna in Pakistan. It has stretched mesh size ranging between 13 cm to 17 cm (average 15 cm) with a hanging ratio of 0.5. The length of the net varies from 5 to 10 km. in comparison, those operating in offshore waters may have gillnets which range between 10 and 25 km. A survey of fishing gear carried out in 2005 revealed that nets used in neretic waters had a length ranging between 2.4 and 12.0 km whereas in the those boats operating in the offshore waters had gillnets with length ranging from 2.4 16.8 km (Fig. 4).



(a) (b)

Fig.4. Length of net used by (a) offshore boats (b) neritic tuna boats

In a recent study carried out in December 2011, it was noticed that the length of gillnet varies between 4.83 km and 11.27 km (Fig. 5). The breath of the net was reported to be 14 m. It was informed by the fishermen that there are a number of larger fishing boats being operated from Karachi and Gwadar which may have a length of 20 km or even more.



(a) (b)

Fig.5. Length of tuna gillnet in boats based in (a) Karachi (b) Balochistan (data collected in December 2011)

Mesh size of the net is predominantly 15 mm (stretched), A study carried out in December 2011 revealed that the mesh sizes may vary between 8.0 mm and 18.0 mm (Fig. 6). Both stone and lead weights are used as sinkers whereas various types of floats are used in the head rope.

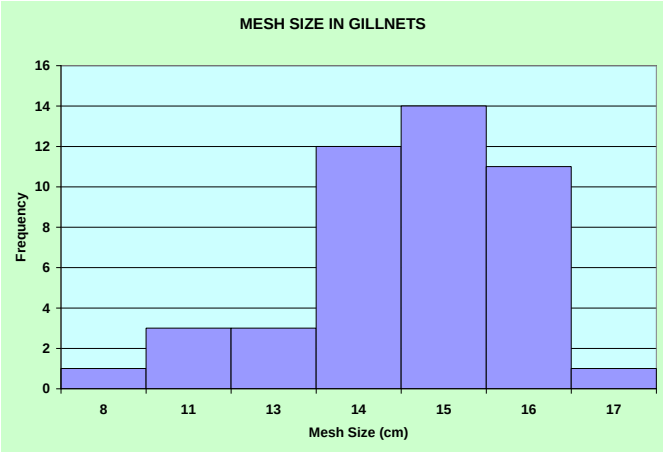
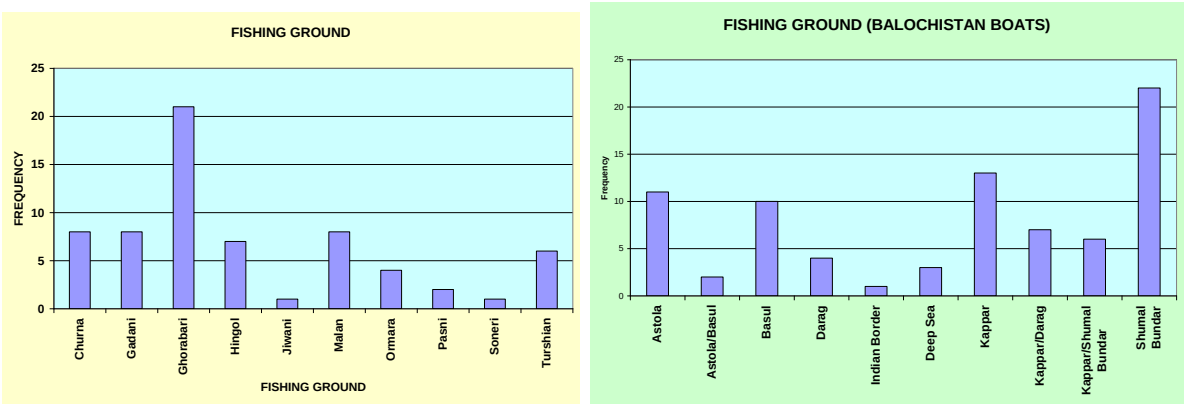


Fig.6. Mesh size of tuna gillnet (data collected in December 2011)

Fishing Grounds

Fishing boats engaged in tuna fisheries are mainly based in Karachi and Gwadar. There are fewer tuna fishing boats which are based in Pasni, Sur and Pushukan. Only a few tuna boats are operating from Pasni because of closure of the Fish Harbour due to excessive siltation. These boats now offload their catch at a creek near Ras Juddi. There used to be substantially a large tuna fleet which was in Ormara and Jiwani but because of the diversion of this fishing fleet to Indian mackerel, tuna gillnet operation from these towns has practically stopped.

The fishing boats engaged in neritic tuna fishing operates within a radius of 40 to 50 km from their base stations, however, boats based in Karachi have wider area of operation; some of the operating as far as 500 km from the base station. The information gathered during a study in December 2011, revealed that there are 10 major fishing ground along Pakistan coast. Of these, off Ghorabari seems to be most preferred location for boats based in Karachi whereas off Churna Island, off Gaddani and off Malan are also important fishing ground (Fig.7a). For the boats based in Balochistan off Shumal Bundar seems to be preferred location (Fig. 7b).

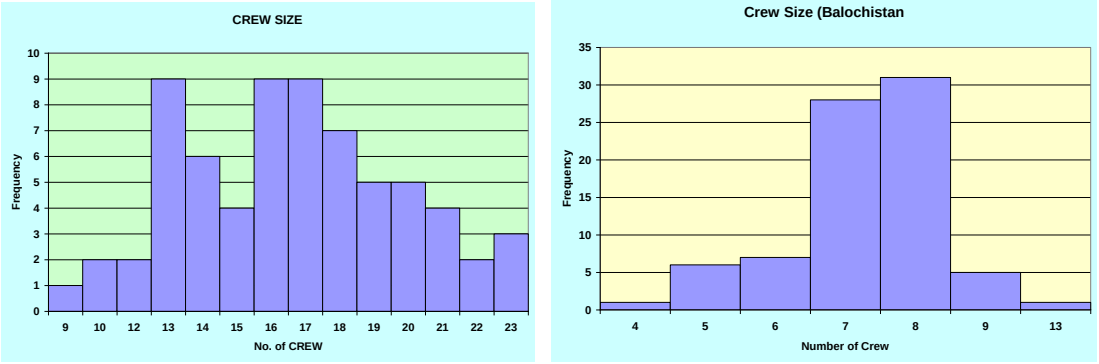


(a) (b)

Fig.7. Major fishing grounds for tuna for boats based in (a) Karachi (b) Balochistan

Fishing Operations

Neritic tuna fishing boats undertake voyage of about 30 to 20 days. In comparison those operating in waters offshore waters undertake fishing voyage of about 60 to 90 days. Crew size varies from 9 to 13 depending on the size of the fishing vessel (Fig. 8). In case of smaller fishing boats (‘horas’ and ‘rachins’) upto 15 fishermen are employed whereas in larger fishing boats especially those operating in offshore waters the crew size varies between 16 to 23. Prior to installation of hydraulic winches, the nets used to heaved manually due to which larger crew used to be engaged for such boats.



(a) (b)

Fig.8. Crew size on tuna gillnet vessels (a) Karachi (b) Balochistan (data collected in December 2011)

In almost all cases nets are laid in the afternoon and retrieved in early morning. Fish is removed from the net after entire net is retrieved. However, in case of high catch density net is retrieved and simultaneous a few crew members are assigned to remove the fish from the net. After every operation nets are inspected and mended before recasting.

Fishing Seasons

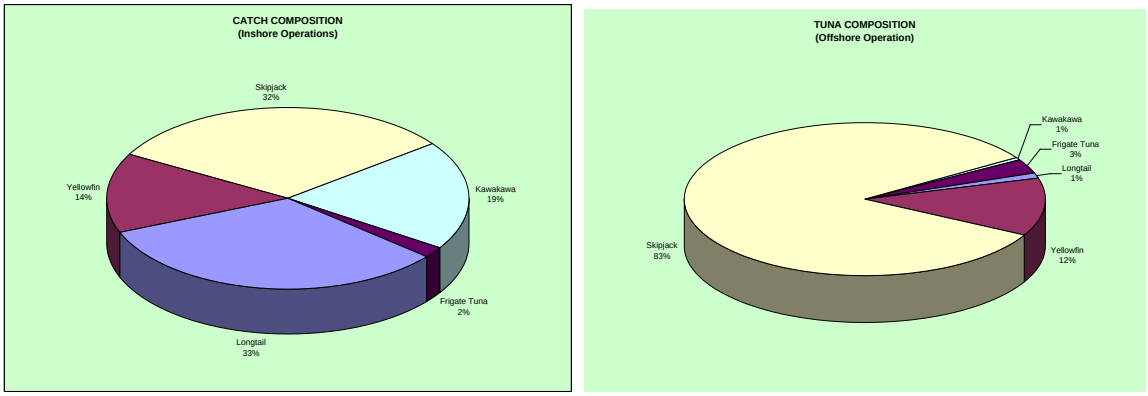
Neritic tuna is harvested throughout the year, however, because of rough seas during southwest monsoon (June to September) tuna fishing activities decreases. There is strong seasonality in catch quantity and catch composition. Summer is the peak season for tuna whereas December and January are months of poor catch.

Catch Composition

Out of eight species known from Pakistan, only five species i.e. yellowfin, longtail, skipjack, kawakawa and frigate tunas are represented in the commercial catches. Stripped bonito sometimes also appear in small quantities. Analysis of data of landings (1982-2000) indicates that the catch composition of fishing boats targeting neritic tuna along Pakistan differs substantially from those operating in offshore waters of Pakistan. Those operating in inshore waters have longtail (33 %) and skipjack (32 %) to be dominating whereas kawakawa (19%), yellowfin (14 %) and frigate tuna (2 %) are also caught (Fig. 9a). In contrast, in offshore operations skipjack alone contribute 83 % followed by yellowfin (12 %) whereas contribution of all other species is about 5 % (Fig. 9b) Seasonal variation in this overall composition was, however, noticed.

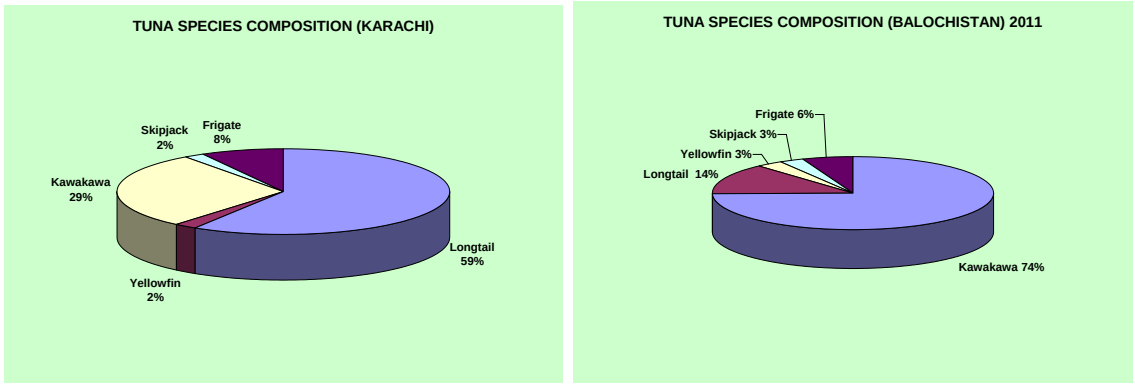
During a study carried out in December 2011, it was observed that longtail tuna is most dominating in the catch (about 59 %) followed by kawakawa (29 %), frigate tuna (8) and

yellowfin and skipjack contributing 2 % as reported from boats operating from Karachi (Fig. 10a). In case of Balochistan kawakawa seems to be dominating species (Fig. 10b). Since most of the longtail and yellowfin are procured from tuna boats operating from Balochistan, therefore, kawakawa appears to be most dominating in the landings made at Gwader (Fig. 11a), Pasni (11b) and Sur Bundar (Fig. 12).



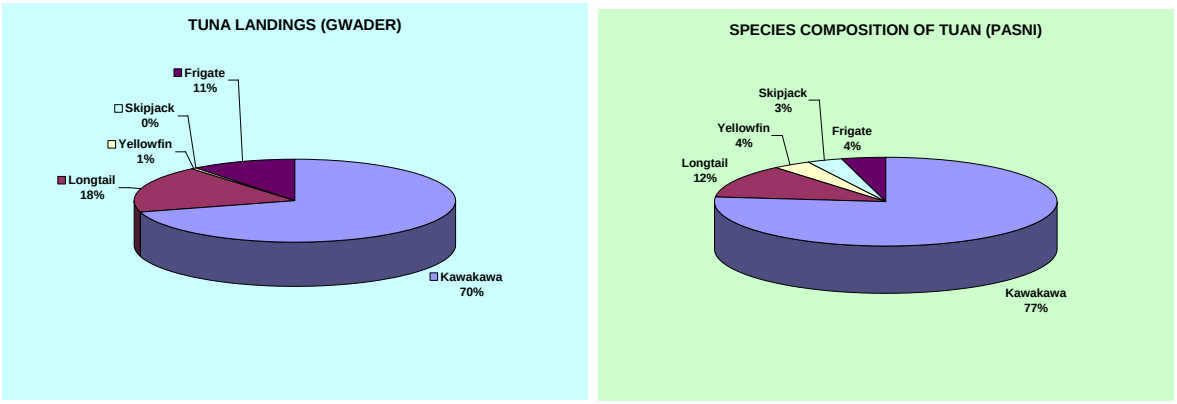
(a) (b)

Fig. 9. Pie diagram showing catch composition of boats operating in (a) inshore and (b) offshore waters of Pakistan



(a) (b)

Fig. 10. Pie diagram showing tuna catch composition in (a) Karachi (b) Balochistan coast (December, 2011)



(a) (b)

Fig. 11. Pie diagram showing tuna catch composition observed during Rapid Assessment Survey in (a) Gwader (b) Pasni (December, 2011)

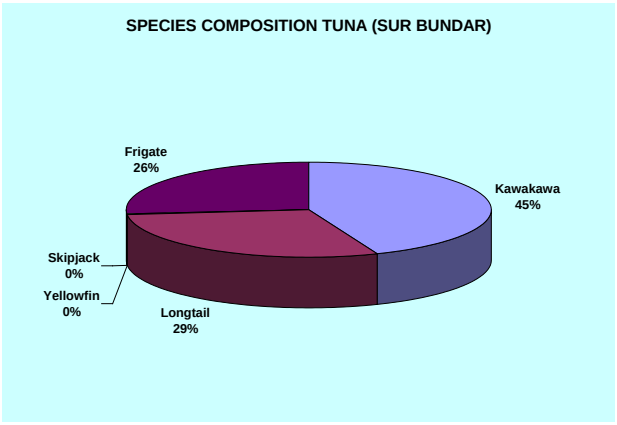
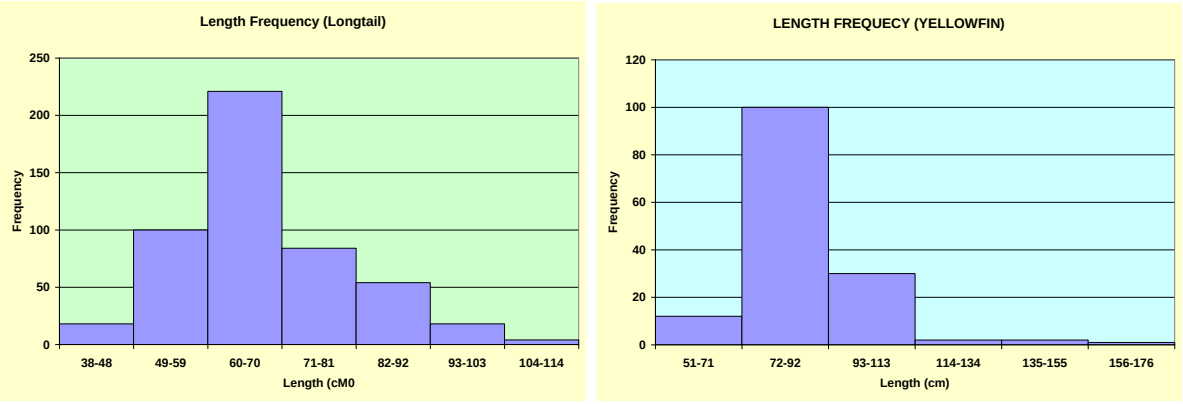


Fig. 12. Pie diagram showing tuna catch composition in Sur Bandar area (December, 2011)

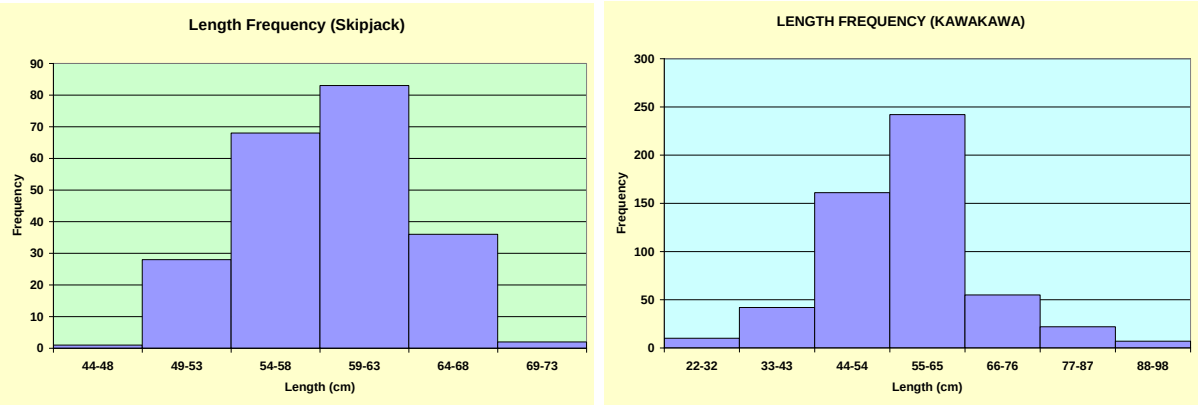
Size Frequency

Lengths of fishes including tuna may be represented by size frequency distributions which in turn approximate the size structure of the populations. Understanding the size structure of fish populations is important as size is considered fundamental for determining growth, reproduction, and recruitment with changes in size an early indicator of disturbance. It also provide snapshots of the combination of fish species present and the sizes of individuals at particular locations and times. Thus groups of such distributions can suggest processes occurring across spatial (area-wise) and temporal (time or seasonal) gradients. Size frequency of major tuna species was collected in a study carried out in December 2011 (Fig. 13 to Fig.16).



(a) (b)

Fig. 13. Histogram showing size frequency of (a) Longtail and (b) yellowfin tuna



(a) (b)

Fig. 14. Histogram showing size frequency of (a) Skipjack and (b) Kawakawa

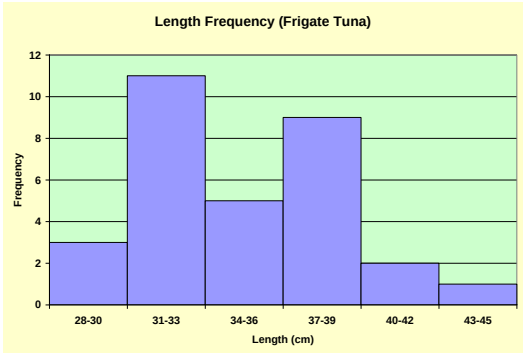


Fig. 15. Histogram showing size frequency of Frigate Tuna

Major Issues related to Neritic Tuna Fisheries of Pakistan

- Tuna fisheries is economically viable fisheries in Pakistan, therefore, a large number of fishing boats which were targeting other fishes such as shrimp have modified and operating in neritic waters. This has increased pressure on the stocks of neritic tuna in Pakistan. There is, therefore, a need to development a management plan for tuna fisheries so that uncontrolled entry into tuna fisheries especially in neritic tuna fisheries may be controlled.
- Neritic tuna gillnet fisheries is marred with high bycatch especially of sharks, turtles and cetaceans. The study carried out in December 2011 revealed that turtle entanglement was found to be high in neritic tuna operations as compared to offshore operations whereas cetaceans engulfment was found to be comparatively less in neritic tuna operations than offshore tuna gillnetting.
- Post harvest losses on board tuna fishing boats is high because of poor handling practices, therefore, there is a need to develop a programme for improvement of fish handling so that high quality tuna is produced which may be exported to better markets than present disposal channels.
- Gillnet operations are non compliant to UNGA Regulation because in most cases the length of gillnet was observed to be longer than 2.5 km. There is a need to immediate corrective measures.
- The data of landings and other biological information is not systematically and regularly collected, therefore, there is a need to develop a system of statistical data collection systems at all major landing centers.

ANNEXURE-V

Report
PAK
2013

Received: 28 August 2013
IOTC-2013-WPEB09-28

AN ASSESSMENT OF CETACEAN MORTALITY IN THE GILLNET FISHERY OF THE NORTHERN ARABIAN SEA

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September, 2013

AN ASSESSMENT OF CETACEAN MORTALITY IN THE GILLNET FISHERY OF THE NORTHERN ARABIAN SEA

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Introduction

Gillnet is the main fishing gear being used for catching tuna and other large pelagic in the Northern Arabian Sea. A large gillnet fleet is based in India, Pakistan, Iran, Oman and Somalia (IOTC, 2013). Gillnet being an indiscriminate fishing gear enmeshes not only target species but also a large number of non-target species (Tregenza and Collett, 1998; Tregenza *et al.*, 1997) Entanglement of some threatened and protected animals including dolphins and whales in gillnets is consider to be a point of concern for fisheries scientists and managers. Gillnet being used in Pakistan, Iran and some countries have length more than 2.5 km, therefore, non-compliant to United Nations General Assembly (UNGA) Resolution 46/215 and IOTC Resolution 12/12 which prohibit the use of large-scale driftnets on the high seas. These large scale gillnetting is more harmful to non target species especially cetaceans.

In comparison to other countries of the area, tuna fishing in Pakistan and Iran is based on large scale gillnets, therefore, as expected cetacean's interaction with gillnet is comparatively very high in these two countries. It is estimated that more than 7,000 gillnetters are operating in these two countries. Some of the vessels in both the countries have double registration both in Iran and Pakistan.In Pakistan, about 500 vessels are dedicatedly engaged in catching tuna (Moazzam, 2012) whereas in Iran about 6,500 are involved in this fishery (Naderi, 2012)

Tuna landings

Tuna landing in the northern Arabian Sea countries (including western Indian coast, Pakistan, Iran, Oman and Yemen) amounting to more than 0.3 million m. tons annually (Fig. 1). The data is obtained through FAO database FishStatJ (Sibeni and Calderini, 2012). The gear wise data is not analyzed however, the tuna fisheries in these countries is largely dependent on gillnets. Country-wise data indicates that Iran is the leading tuna producing countries followed by India, Oman, Yemen and Pakistan (Fig. 2).

Tuna is an important component of the pelagic ecosystem in the offshore waters which is also a favorite habitat of cetacean. A well-diversified cetacean fauna is known from the Arabian Sea (Baldwin *et al.*, 1998; Jefferson *et al.*, 1993; Kumarran, 2012; Moazzam and Niaz, 1988; Moazzam and Niazi, 2013). Presence of whales and

dolphins in the pelagic ecosystem make them prone to interaction with the fishing gears being deployed for catching tuna including their enmeshment in the nets.

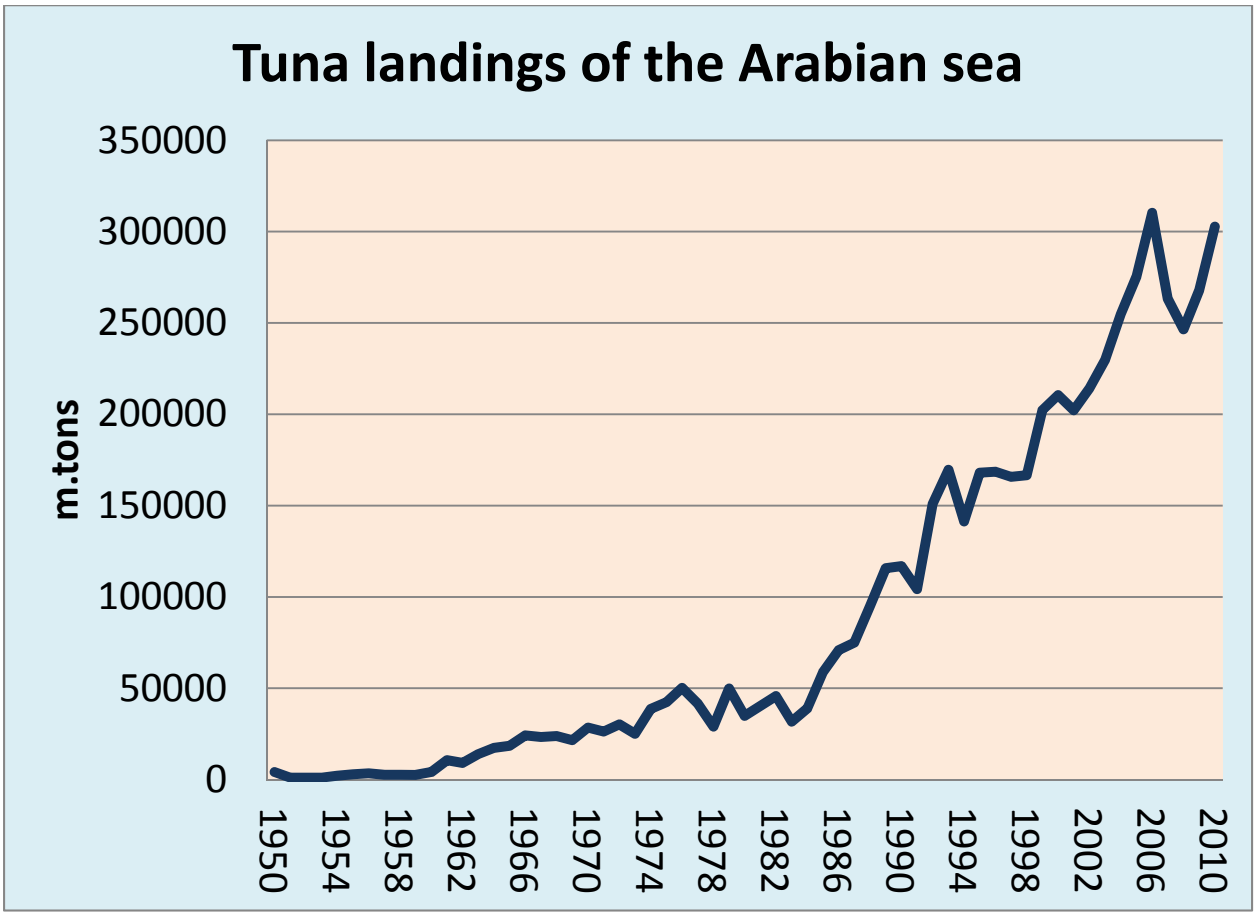

Fig. 1. Tuna landings of the northern Arabian Sea

Cetacean Interaction with Gillnet Gears

Mortality on account of entrapment in gillnet fishing gears is considered to be largest single threat to cetaceans globally (Baldwin, 1993; Read *et al.,* 2006). There is no detailed study dealing with the mortality of cetaceans in the Arabian Sea, however, instances of such mortality was reported by Baldwin (2003), Kumarran (2012) and Moazzam (2012) from Oman, India and Pakistan respectively. Cetacean including baleen whales, toothed whales, dolphins and porpoises are equally threatened. Extent of the bycatch of cetacean in gillnet the northern Arabian Sea is not well known in most countries but beached cetacean carrying part of the gears and marks of enmeshment provide some evidences about the seriousness of the issue.

According to Baldwin (2003) most susceptible species of the cetacean to enmeshment in fishing gears in Oman are coastal whales and dolphin including Bryde's whale, humpback whale, long-beaked common dolphin, Indo-Pacific humpback dolphin, bottlenose dolphin and finless porpoises. In his book, Baldwin (2003) provided photographs of many species of cetaceans which were enmeshed in gillnet fishing gears.

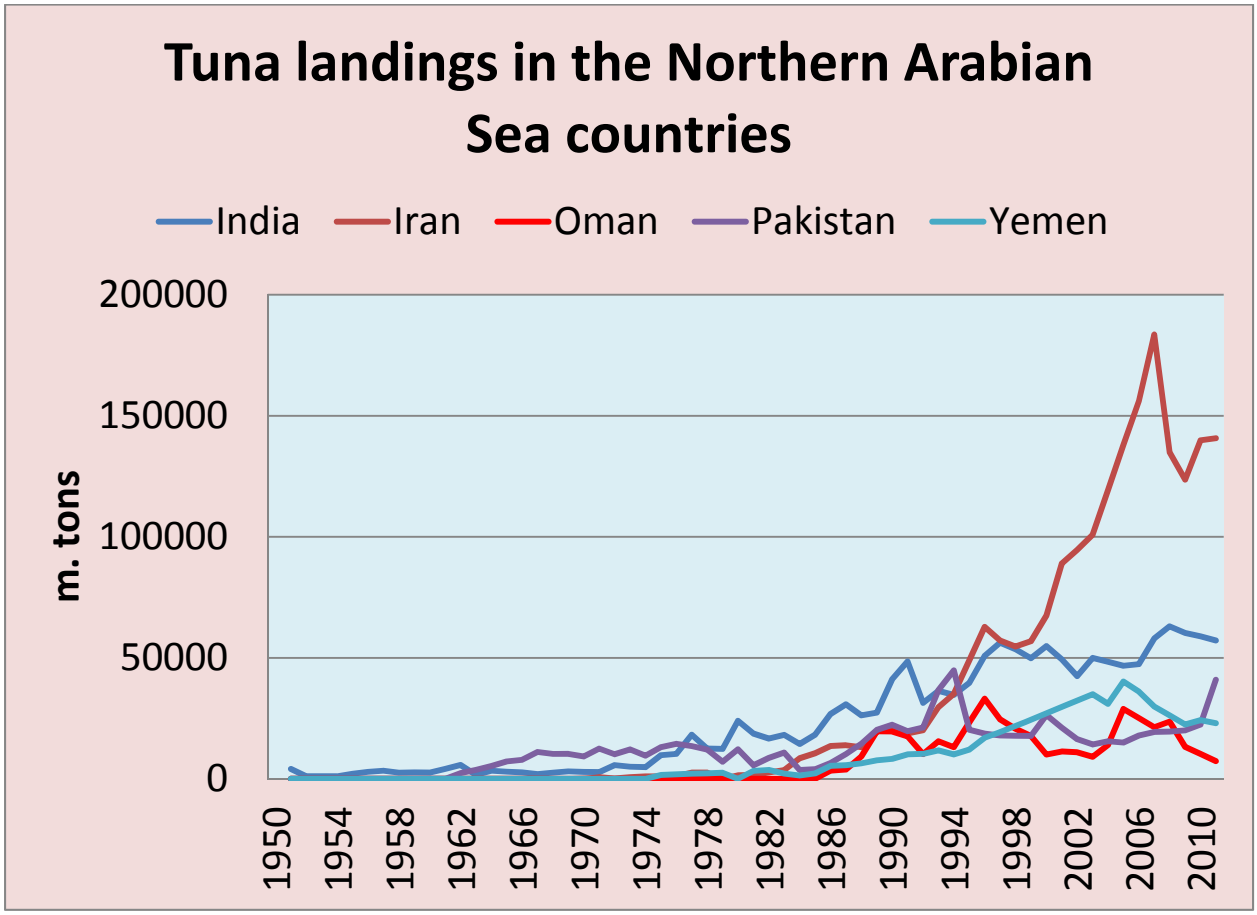

Fig. 2. Tuna landings of the northern Arabian Sea countries

Collins *et al.* (2002) observed that in some parts of Oman such as the Gulf of Masirah, where use of drift and gill nets is prevalent, mortality of dolphin on account of fisheries interaction were high. In some such instances evidence for mortality associated with fisheries was compelling. Thirty-one dolphins showed direct evidence of entanglement in nets and ropes. These included specimens that were either still entangled in gear when encountered or bore lesions consistent with entanglement. They observed that in eight specimens flukes and fins were clearly severed, which is the best method to facilitate the separation of entangled cetacean carcasses from fishing gear.

Almost no information about the mortality in fishing gears in Iran is available, however, entrapment in gillnet is the major threat to cetacean population along Iranian coastline

(Valinassab, Personal communication). Interaction with fishery is considered as a major threat to cetaceans in India also where 19 species (75% of the national total) have been recorded as accidently entrapped in different fishing gears especially in gillnets (Kumarran, 2012). From Arabian sea coast of India very few studies have been reported to address gillnet interaction with cetacean. However, Kumarran (2012), Jayaparkash *et al.* (1995), Mohan (1985) Pillai and Chandrangathan (1990), Silas *et al.* (1984) and Yousuf *et al*. (2088) have studied impact of fisheries on cetaceans in India. According to Kumarran (2012) 50.2 % of all records of cetacean mortality from India are from fishery interaction.

Along the Pakistan coast, dolphins seem to be more frequent in getting entangled in tuna gillnets (Moazzam, 2012; Niazi and Moazzam, 1990). Indo-pacific humpback dolphin are more frequently entangled in gillnets placed in coastal waters of Pakistan where rarely a few black finless porpoises are also reported. Spinner dolphin, pantropical spotted dolphin and bottlenose dolphins seems to entangle in tuna gillnets deployed in offshore waters. According to fishermen, most of dolphins entangled in gillnet die immediately, thus discarded (Fig. 3).

Fig. 3. Carcass of enmeshed spinner dolphin (*Stenella longirostris*) on board tuna gillnet boat along Pakistan coast

It was previously estimated that 25- 35 dolphins are killed every month in gillnet fishing operations along Pakistan coast (Moazzam, 2012). Baleen whales especially humpback

are reported to get entangled in tuna gillnets but such events are of rare occurrence. According to the information recently collected 1 to 2 whales are entangled every year and in most cases fishermen try to release the entangled whales, however, sometime entangled whale die. During the surveys of dead whales beached along the coast of Pakistan since 2008, three specimens were observed to have net entanglement. Two of these were humpback whale and third was a Bryde's whale.

WWF-Pakistan has started an study on the quantify cetacean mortality in gillnet fisheries of Pakistan which is funded by Indo-Pacific Cetacean Research and Conservation Foundation, Government of Australia since October, 2013. Preliminary analysis of the data reveals that incidences of mortality in tuna gillnet operation is much higher than previously estimated. On average 1-4 dolphins get enmeshed in each fishing trip (Fig. 4).

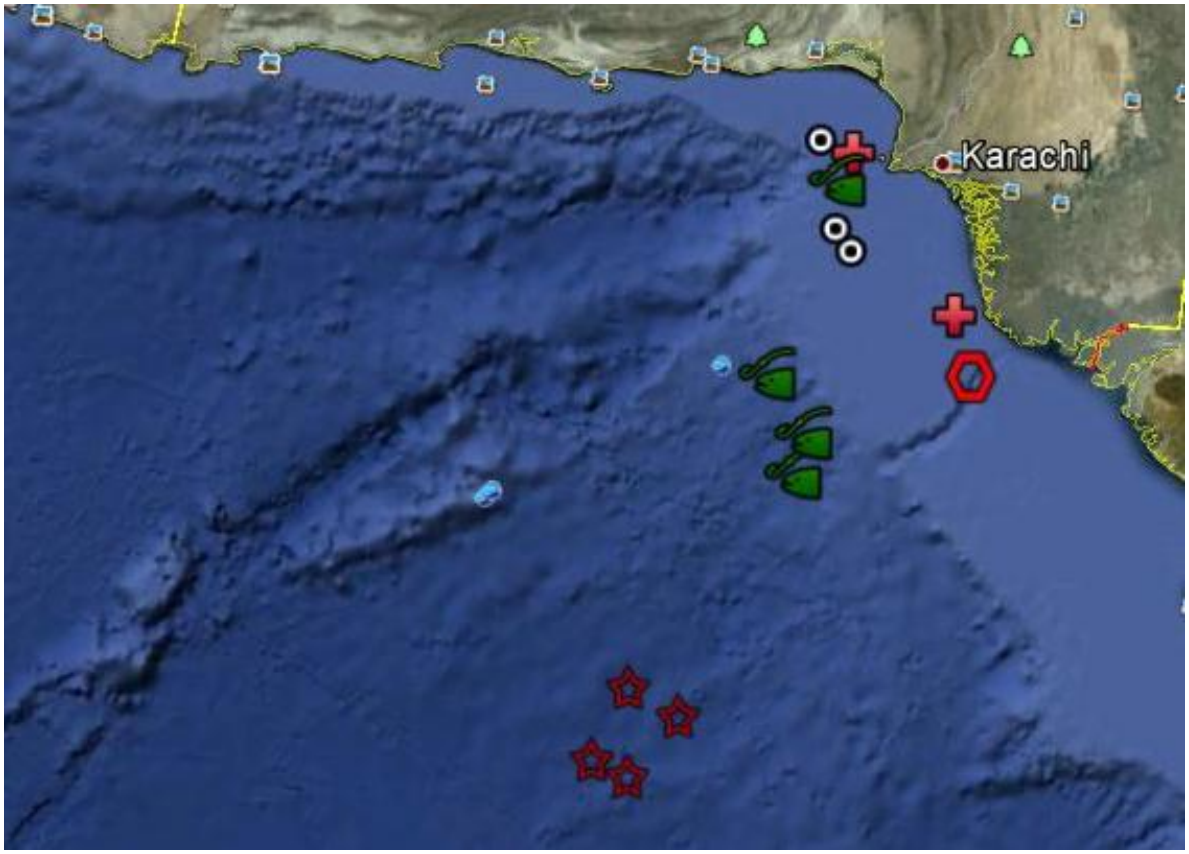

Fig. 4. Location of dolphin mortalities along Pakistan coast during gillnet operation (data of four gillnetters) in March (2013)

The study further revealed that mortality of a number of dolphin species including Indo-Pacific humpback dolphin (*Sousa chinensis*), bottlenose dolphin (*Tursiops aduncus/ truncatus*), spinner dolphin (*Stenella longirostris*), Pan-tropical spotted dolphin (*Stenella attenuata*), long beaked common dolphin (*Delphinus capensis tropicalis*), and Risso's

dolphin (*Grampus griseus*), striped dolphin (*Stenella coeruleoalba*) and rough tooth dolphin (*Steno bredanensis*). No baleen whale was observed during the study, however, a few cases of their entrapment in gillnet were previously observed (Fig. 5).

Fig. 5. Bryde's whale enmeshed in tuna gillnet at Gwader, Balochistan

In addition, on some occasions some smaller toothed whales including dwarf sperm whale were observed to have enmeshed in tuna gillnet operation on more than two occasions (Fig. 6).

Fig. 6. Dwarf sperm whale (*Kogia sima*) mortality in gillnet operation along Pakistan coast.

Pakistan, WWF has initiated an awareness programme among the fishermen communities to release entrapped whales and other protected species, if found alive in the gillnet or other fishing gears. The communities are getting more aware about the

importance of these animals and some fishermen now strive to release such entrapped animals (Fig. 7).

Fig. 7. Arabian humpback whale enmeshed in the gillnet, towed to the beach and successfully released at Gunz, Balochistan

Conclusion

There are no two opinions that information about cetacean morality in the fishing gears especially tuna gillnet operation from northern Arabian Sea is limited and there is a need to collect such data from the area. Information about such mortality is especially missing about Iran which has the largest gillnet fleet in the area. There is also need for northern Arabian Sea nations to comply with United Nations General Assembly (UNGA) Resolution 46/215 and IOTC Resolution 12/12 which prohibit the use of large-scale driftnets on the high seas. This will help in reducing the incidences of the mortality of cetaceans in tuna gillnet fishing.

References:

Baldwin, R., 2003. Whales and dolphins of Arabia. Ministry of Information, Sultanate of Oman, Muscat

Baldwin, R., Van Waerebeek, K. and Gallagher, M. (1998). A review of small cetaceans from waters off the Arabian Peninsula. Scientific Committee document SC/50/SM6, International Whaling Commission, Muscat, Oman.

Collins,T., Minton,G., Baldwin,R., Van Waerebeek, K., Davies, A.H. and Cockroft, V. 2002. A preliminary assessment of the frequency, distribution and causes of mortality of beach cast cetaceans in the Sultanate of Oman, January 1999 to February 2002. Paper SC/54/O4, Scientific Committee of IWC, Shimonoseki, Japan, 26 April-10 May 2002.1-13.

IOTC 2013, Website http://www.iotc.org/English/data/databases.php#dl visited on August 24, 2013.

Jayaprakash, A. A., Nammalwar, P., Krishna Pillai, S., and Elayath, M. N. K., 1995. Incidental bycatch of dolphins at Fisheries Harbour, Cochin, with a note on their conservation and management in India. J. mar. boil. Assoc. India 37: 126-133.

Jefferson, T.A., S. Leatherwood, and M.A. Webber, 1993. FAO species identification guide. Marine mammals of the world. Rome, FAO. 1993.

Kumarran, R. P., 2012. Cetaceans and cetacean research in India. J. Cetacean Res. Manage.12: 159–172.

Moazzam, M., 2012.Status report on bycatch of tuna gillnet operations in Pakistan. IOTC–2012–WPEB08–13.

Moazzam, M., and Niaz, M. S., 2013. Whales and dolphins of Pakistan. WWF-Poster
Moazzam, M., and Niaz-Rizvi, S. H., 1988. Whales in Waters of Pakistan (Northern Arabian Sea). Presented in International Whaling Commission, Seychelles. 19p.

Mohan, R. S. I., 1985. Observations on the bycatch of dolphins *Stenella longirostris, Tursiops aduncus, Sousa chinensis* and *Dephinus delphis tropicalis* in gillnets off Calicut coast, india. Pp. 78-83. (In: Silas, E, G., ed.). proceedings of the Symposium on Endangered Marine Animals and Marine Parks. Cochin, India 12-16 January, 1985. Marine Biological association of India, Cochin.

Naderi, R. A., 2012. Fishery in Iran with particular reference to neritic tunas.IOTC–2012–WPNT02–11 Rev_1

Niazi, M. S., and Moazzam, M., 1990. Fisheries and cetacean mortality along the coast of Pakistan. Symposium on the Mortality of the Cetaceans in Passive Fishing Nets and Traps. October 20-21, 1990. International Whaling Commission La Jolla California (Abstract).

Pillai, C. S. G., and Chandrangathan, S. B., 1990. On the drift net entangled dolphins landed at Sakthikulanara. Mar. Fish. Infor. Serv. T. & E. Ser. 104: 16-17.

Read, A.J., P. Drinker, and S. Northridge. 2006. Bycatch of marine mammals in U.S. and global fisheries. Conserv. Biol. 20:163-169.

Sibeni, F., and Calderini, F., 2012. FishStatJ, a tool for fishery statistics analysis. Release: 2.0.0 (http://www.fao.org/fishery/statistics/software/fishstatj/en)

Silas. E. G., Pillai, P. P., Jayaprakash, A. A., and Pillai, M. A., 1984. Focus of small scale fisheries. Driftnet net fisheries off Cochin. Mar. Fish. Infor. Serv. T. & E. Serr. 55.

Tregenza, N.J.C. and Collett, A. 1998. Common dolphin (*Delphinus delphis*) by-catch in pelagic trawl and other fisheries in the northeast Atlantic. *Report of the International Whaling Commission,* 48:453-459.

Tregenza, N.J.C., Berrow, S.D., Hammond, P.S. and Leaper, R. 1997. Harbour porpoise (*Phocaena phocaena* L.) by-catch in set gillnets in the Celtic Sea. ICES *Journal of Marine Science.* 54:896-904.

Yousuf, K. S. S. M., Anoop, A. K., Anoop, B., Afsal, V. V., Vivekanandan, E., Kumarran, R. P., Rajagopalan, M., Krishnakumar, P. K. and Jayasankar, P., 2008. Observations on incidental catch of cetaceans in three landing centres along the Indian coast. J. Mar. Biol. Ass. UK. [Biodiversity Records. Published online].

ANNEXURE-VI

Received: 28 August 2013
IOTC-2013-WPEB09-29

PROPOSAL FOR SPECIES IDENTIFICATION GUIDE FOR CETACEANS (WHALE AND DOLPHINS) OCCURRING IN THE INDIAN OCEAN

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INTRODUCTION

To guide observers, samplers, as well as fishers in order to increase the recording and reporting of data on tuna and bycatch species, IOTC has published a series of Species Identification Guides. These guides were published as per the recommendations of the Working Party on Ecosystems and Bycatch and the Scientific Committee, IOTC has developed Identification guides for marine turtles, billfishes, seabirds, and sharks and rays that maybe incidentally caught or otherwise interact with IOTC fisheries targeting tuna and tuna-like species in the Indian Ocean. Species Identification Guide for tuna and tuna like species is being developed and will be published soon. There is no immediate plan to publish a guideline for cetaceans which are considered to important conflict with the tuna fisheries.

RATIONALE FOR SPECIES IDENTIFICATION GUIDE FOR CETACEANS

The conflicts between marine cetaceans and tuna fisheries are primarily of operational types. The operational conflicts involve physical encounters between cetaceans and tuna fishing gear, broadly defined. They arise, for example, when cetaceans damage fishing gear and when they damage fish caught in the gear (depredation) or cause the fish to escape, resulting ultimately in economic losses to commercial tuna fisheries. They also arise when cetaceans are taken incidentally in commercial fisheries (bycatch) resulting in their injury or death or become entangled in discarded fishing gear.

It is estimated that Over 300,000 whales, dolphins, and porpoises are killed each as a result of by-catch. The World Conservation Union (IUCN) recognizes bycatch as one of the greatest threats to the survival of cetacean populations. Fishing gear can injure and kill large cetaceans as well - even the powerful sperm whales may become entangled in nets and drown, or starve to death if gear becomes wrapped around or embedded in its mouth. Mortality of cetacean is not confined to dolphins belonging to suborder Odontoceti but also large whale belonging to suborder Mysticeti are also killed in tuna fishing.

In order to guide stakeholders including observers, samplers, as well as fishers to improve the recording and reporting of cetacean bycatch, WWF offer to prepare and print Species Identification Guide for dolphins and whales occurring in the Indian

Ocean. This Species Identification Guide will include species of whale and dolphin occurring in the Indian Ocean listed in Table-I.

Table-I. list of the species to be included in the proposed Species Identification Guide for cetaceans of Indian Ocean

S. No.	Species	Common Name	Remarks
SUBORDER MYSTICETI - Baleen Whales			
1.	*Eubalaena australis*	Southern right whale	
2.	*Caperea marginata*	Pygmy right whale	Insufficiently known from Indian Ocean
3.	*Balaenoptera musculus*	Blue whale	
4.	*Balaenoptera physalus*	Fin whale	
5.	*Balaenoptera borealis*	Sei whale	
6.	*Balaenoptera edeni*	Bryde's whale	
7.	*Balaenoptera acutorostrata*	Minke whale	
8.	*Megaptera novaeangliae*	Humpback whale	Including Arabian humpback whale
SUBORDER ODONTOCETI - Toothed Whales			
9.	*Physeter macrocephalus*	Sperm whale	
10.	*Kogia breviceps*	Pygmy sperm whale	
11.	*Kogia sima*	Dwarf sperm whale	
12.	*Berardius arnuxii*	Arnoux's beaked whale	Insufficiently known from Indian Ocean
13.	*Ziphius cavirostris*	Cuvier's beaked whale	
14.	*Hyperoodon planifrons*	Southern bottlenose whale	
15	*Tasmacetus shepherdi*	Shepherd's beaked whale	Insufficiently known from Indian Ocean
16.	*Mesoplodon densirostris*	Blainville's beaked whale	
17.	*Mesoplodon grayi*	Gray's beaked whale	
18.	*Mesoplodon ginkgodens*	Ginkgo-toothed beaked whale	Insufficiently known from Indian Ocean
19.	*Mesoplodon hectori*	Hector's beaked whale	Insufficiently known from Indian Ocean
20.	*Mesoplodon mirus*	True's beaked whale	Insufficiently known from Indian Ocean
21.	*Mesoplodon layardii*	Strap-toothed whale	
22.	*Mesoplodon bowdoini*	Andrews' beaked whale	

23.	*Orcaella brevirostris*	Irrawaddy dolphin	
24.	*Orcinus orca*	Killer whale	
25.	*Globicephala melas*	Long-finned pilot whale	
26.	*Globicephala macrorhynchus*	Short-finned pilot whale	
27.	*Pseudorca crassidens*	False killer whale	
28.	*Feresa attenuata*	Pygmy killer whale	
29.	*Peponocephala electra*	Melon-headed whale	
30.	*Sousa chinensis*	Indo-Pacific hump-backed dolphin	
31.	*Steno bredanensis*	Rough-toothed dolphin	
32.	*Lagenorhynchus obscurus*	Dusky dolphin	
33.	*Lugenorhynchus cruciger*	Hourglass dolphin	
34.	*Grampus griseus*	Risso's dolphin	
35.	*Tursiops truncatus*	Bottlenose dolphin	
36.	*Tursiops aduncus*	Indo-Pacific Bottlenose Dolphin	
37.	*Stenella attenuata*	Pantropical spotted dolphin	
38.	*Stenella longirostris*	Spinner dolphin	
39.	*Stenella coeruleoalba*	Striped dolphin	
40.	*Delphinus delphis*	Common dolphin	
41.	*Lagenodelphis hosei*	Fraser's dolphin	
42.	*Lissodelphis peronii*	Southern right whale dolphin	Insufficiently known
43.	*Cephalorhynchus commersonii*	Commerson's dolphin	
44.	*Australophocaena dioptrica*	Spectacled porpoise	insufficiently known from Indian Ocean
45.	*Neophocaena phocaenoides*	Finless porpoise	

PROPOSED FORMAT

The proposed Species Identification Guide for Cetacean found in Indian Ocean will be prepared on the pattern which was used for shark and ray, seabird and billfish for in Indian Ocean pelagic fisheries. Sample pages of the Identification Guide for Cetaceans are annexed. Most of the diagrams used in the Identification Guide are specifically drawn for the purpose whereas some of them are obtained from FAO Species Identification Guide-Marine Mammals of the World (Jefferson *et al.*, 1993). The maps are also derived from Jefferson *et al.* (1993). It is proposed that relevant portion pertaining to marine mammals given "Fishermen, protectors of the endangered marine species" which is published by Office of Protection and Improvement of Marine Resources, Iranian Fishery Organization and presented in WPEB07 as "Reduction of Marine mammals, Sea birds and turtles bycatch in Tuna fishing" (**IOTC-2011-WPEB07-22)** (http://www.iotc.org/files/proceedings/2011/wpeb/ IOTC-2011-WPEB07-22.pdf) which will provide guidance for safe release of entangled cetaceans from fishing gears.

References

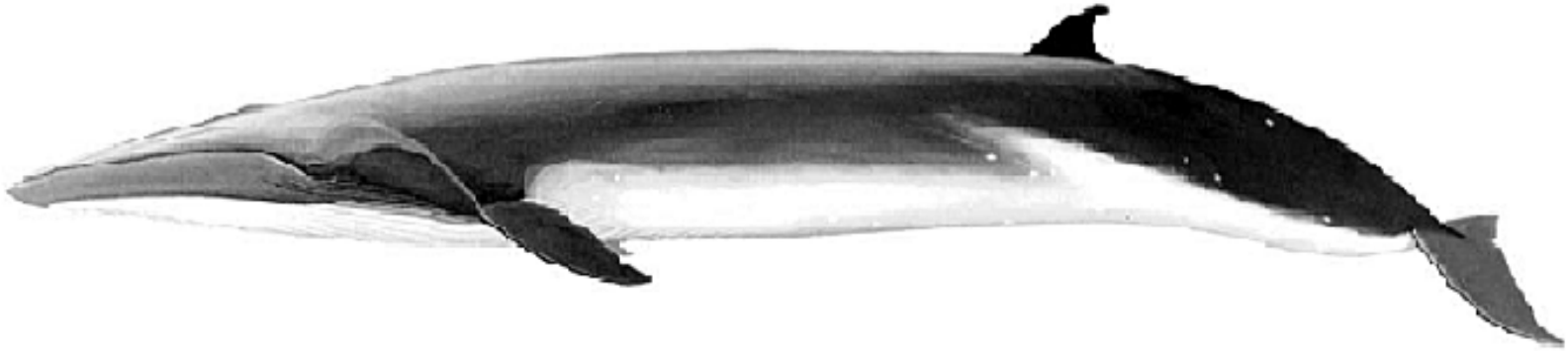
Jefferson, T.A., Leatherwood, S. and Webber, M.A. 1993. FAO species identification guide. Marine mammals of the world. Rome, FAO. 1993.320. p. 587.

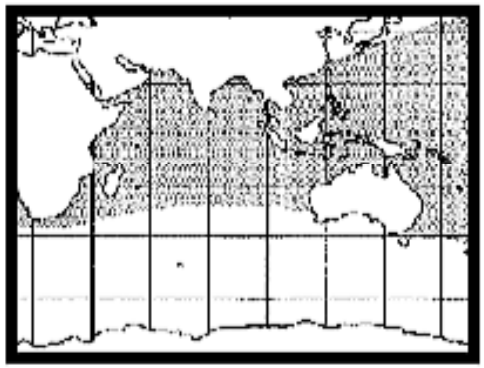
Bryde,s Whale

***Balaenoptera edeni* Anderson, 1878**

Size: About 15.5 meter long.

Distribution: Found in both offshore and coastal waters, generally creature of tropical and sub-tropical zones.





Three prominent ridges present on rostrum.
The dorsal fin is tall and falcate, generally rises abruptly out of the back.
Dark grey dorsally and lighter ventrally.

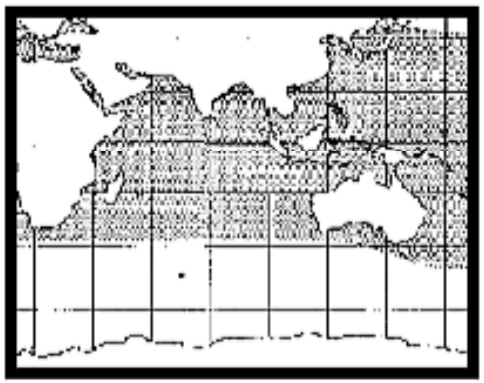
BALEEN WHALE

Common Dolphin

Delphinus delphis **Linnaeus, 1758**

Size: About 2.6 meter long.

Distribution: Oceanic water from tropical to warm temperate zones of world oceans.



Moderately slender body with a medium to long beak and a tall, slightly falcate dorsal fin. Strikingly marked with a dark brownish grey back, white belly and tan to ochre anterior flank patch.

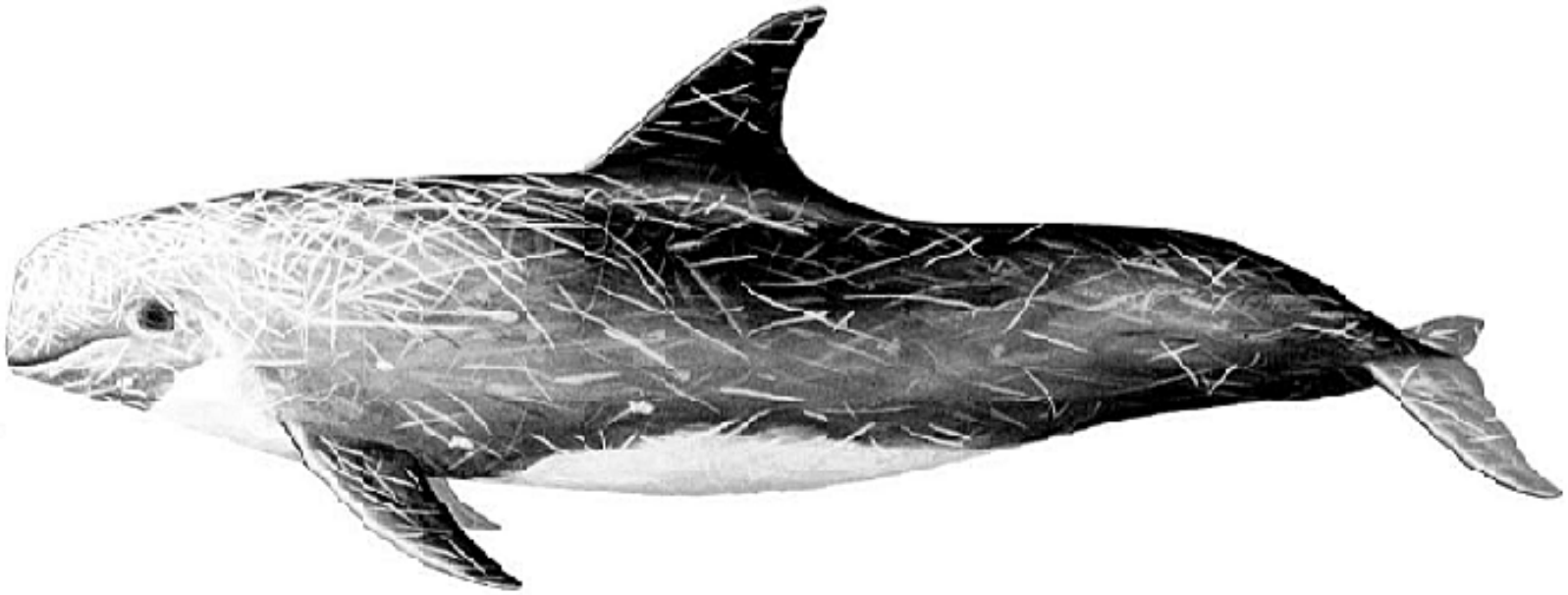
BEAKED DOLPHIN

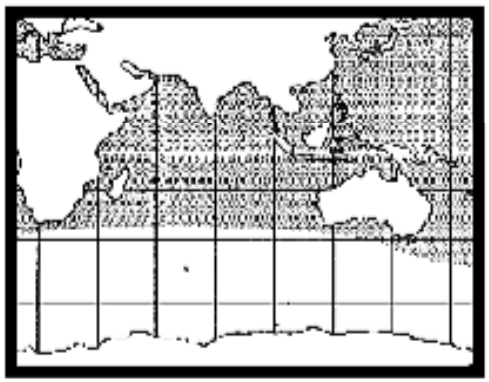
Risso,s Dolphin

Grampus griseus Cuvier, 1812

Size: About 3.8 meter long.

Distribution: Oceanic and continental slope water from the tropics through the temperate regions.





Robust blunt headed animal without distinct beak.
Flippers are long, pointed and recurved.
Dorsal fin tall, falcate and the most distinctive feature is a vertical crease on the front of the melon.

BEAKED DOLPHIN

ANNEXURE-VII

MFF Regional Fisheries Symposium, Kochi, India, 28th-30th October 2013

BY-CATCH OF TUNA GILLNET FISHERIES OF PAKISTAN: A SERIOUS THREAT TO NON-TARGET, ENDANGERED AND THREATENED SPECIES

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ABSTRACT

Tuna gillnet fishery of Pakistan employs more than 500 fishing boats that operate in offshore waters. Gillnet being a nonselective fishing gear, catches large quantities of by-catch fish species including billfishes, pelagic sharks, dolphinfish, oceanic pomfrets as well as marine turtles and cetaceans which are considered to be protected species. High bycatch seriously of these non-target animals affects their population in the area. The paper provides information on bycatch of species and also suggests measures that can be adopted as alternate fishing methods to minimize mortality of endangered and threatened cetaceans and turtles.

INTRODUCTION

Gillnet is the main fishing gear being used for catching tuna and other large pelagic fishes in many countries of the world including in Pakistan (IOTC, 2013). These nets are considered to be an indiscriminate fishing gear which enmeshes not only target species (tuna) but also a large number of non-target animals (Gillet, 2011; Lewison *et al.*, 2004; Tregenza and Collett, 1998; Tregenza *et al.*, 1997). The non-target species (bycatch) includes some species which are considered protected or threatened such as cetacean and turtles, therefore, there is a general concern among conservationists about use of these indiscriminate nets (Lewison *et al.*, 2004).

Tuna fishing in Pakistan is based on large scale gillnets used on board about 500 vessels which are dedicatedly engaged in catching large pelagic species (Moazzam, 2012). There is a general concern that gillnets being used in these fishing operation pose a serious threats to non-target endangered and protected species occurring in the area. However, information about the species composition and mortality of these important species is not documented. In the present paper an attempt is made to present data on bycatch of tuna gillnetting operations and to suggest measures that can be adopted as alternate fishing methods to minimize mortality of endangered and threatened species.

MATERIALS AND METHOD

For making a review of the fishing practices, landings and disposal of the catch, information has been obtained from published literature, statistical data and government archives. In addition monitoring of bycatch through landings data at major fish landing center at Karachi as well as by posting a few observers onboard tuna gillnetters was initiated in 2012. The paper presents quantitative data of tuna landings, by-catch composition including frequency and seasonality of

enmeshment, areas of fishing and some biological information about by-catch species. Data were collected from landing centre intermittently since September 2011 and through observer programme from October, 2012 till September, 2013. No tuna gillnet operation was carried out during July and August, 2013

RESULTS

Historically tuna gillnetting is an important fisheries of Pakistan. Fishing vessels from Pakistan used to operate not only in the coastal and offshore areas of Pakistan but some of these used to operate in high seas including in the waters of Somalia which is considered to be a very rich fishing ground for tuna and tuna like species. Tuna and other bycatch fish species are not consumed in Pakistan but the catch used to be exported in salted dried form to Sri Lanka since centuries, however, since last 10 years, it is transported to neighboring countries in chilled form and only small quantities is exported in salted dried form to Sri Lanka.

Fishing Boats

Pakistani tuna fleet consists entirely of locally made wooden boats. A recent study (Moazzam, 2012) carried out in two maritime provinces i.e. Sindh and Balochistan revealed that most of the boats operating from Karachi (Sindh) range between 15 to 25 m (Fig. 1) whereas those operating from Balochistan range between 10 to 15 m (Fig. 2). There are about 65 large boats (ranging between 20 to 30 m LOA) which have on board freezing facilities which operates in comparatively deeper waters and engaged in fishing trips of more than two months.

Tuna fishing vessels are equipped with a hydraulic net hauling device as well as navigation equipments such as GPS and fish finders. Fish is stored in insulated 6-8 compartments each having a capacity of about 1 to 1.5 tons. In most tuna fishing vessels, the catch is stored in crushed block ice. Most fishing vessels do not have communication equipment whereas a few larger vessels may have VHF and shortwave radios.

Fishing Gears

Surface gillnetting using polyamide nets (Fig. 3) are used for catching tuna in Pakistan. It has stretched mesh size ranging between 13 cm to 17 cm (average 15 cm) with a hanging ratio of 0.5 (Fig. 3 inset). The length of gillnet varies between 4.83 km and 11.27 km. The breath of the net was reported to be 14 m. There are a few larger fishing boats being operated from Karachi and Gwadar may have a gillnet of about 20 km length. There are variation in the length and specification of net. In case of targeting small tuna in neritic waters nets with smaller mesh are used. In almost all cases, tuna gillnet is laid down in the evening and retrieved in the early morning.

Fishing Grounds

Fishing boats engaged in tuna fisheries are mainly based in Karachi and Gwadar. A few tuna fishing are based in other coastal towns Pasni, Sur and Pushukan (Balochistan). There used to be substantially a large tuna fleet which operated from Ormara and Jiwani in Balochistan but

because of the diversion to Indian mackerel fishing, tuna gillnet operation from these towns has practically stopped.

The fishing boats from towns and cities along Balochistan operates within a radius of 40 to 50 km, however, boats based in Karachi have wider area of operation; some of the operating as far as 400 miles from the base station. Larger fishing boats also operate in high seas i.e. beyond the Exclusive Economic Zone of Pakistan. Previously about 150 to 200 large boats based mainly in Karachi, Gwadar and Jiwani used to catch tuna from area beyond Pakistan territory. The most important destination for these tuna gillnet boats used to be Somali waters. Because of Somali piracy, only a tuna boat from Pakistan are operating in these waters.

Tuna landings and Catch Composition

Tuna is an important fishery of Pakistan contributing annually about 40,000 m. tons (Fig. 3). Tuna landing in the year 2000 was recorded as 22,000 m. tons which steadily increased to a level of 40,900 in the year 2010. A slight decrease was noticed in 2011 when it reached 39,300 m. tons. Eight species of tuna are known from Pakistan, of which only five species i.e. yellowfin (*Thunnus albacores*), longtail (*Thunnus tonggol*), skipjack (*Katsuwonus pelamis*), kawakawa (*Euthynnus affinis*) and frigate (*Auxis thazard thazard*) tunas are caught in commercial quantities. Bigeye tuna (*Thunnus obesus*) is of rare occurrence in Pakistan and known from only a few specimens. Bullet tuna (*Auxis rochei rochei*) and stripped bonitos (*Sarda orientalis*) are also not common in Pakistan.

Analysis of landing data from Karachi Fish Harbour for four years i.e. from 2008 to 2011 indicates that the catch composition of fishing boats operating in the neritic areas along Pakistan differs substantially from those operating in offshore waters of Pakistan. Those operating in neritic waters are longtail (59 %) and kawakawa (29%) as dominating and frigate (8%), yellowfin (2%) and skipjack tuna (2%). In offshore operations, skipjack alone contributes 83%, followed by yellowfin (12%). Contribution of all other species is about 5%. Seasonal variation in overall species composition was, however, noticed both in neritic and offshore waters.

Bycatch Composition

In addition to tuna, a number of other fish species of commercial importance is caught both by vessels operating in neritic and offshore waters. In the neritic waters, the bycatch consists predominantly of talang queenfish (*Scomberoides commersonianus*) followed by kingfish (*Scomberomorus commerson*), barracuda (*Sphyraena spp.*), dolphinfish (*Coryphaena hippurus*), Indo-Pacific sailfish (*Istiophorus platypterus*), thresher shark (*Alopias superciliosus*), silky shark (*Carcharhinus falciformis*), other requiem sharks and mantas. Bycatch of tuna gillnetting in offshore deep waters consists mainly of Indo-Pacific sailfish, marlin (*Makaria indica*), striped marlin (*Tetrapturus audax*), dolphinfish, thresher sharks and mako (*Isurus oxyrinchus*). The data of bycatch of gillnet fishing is no recorded separately therefore, it is apparently not possible to determine any historical change in their catches.

Finfish

Recent studies based on the catches of 4 observers posted on tuna gillnetters revealed that tuna species contributes about 67 % in total catch followed by finfish species (23 %) and sharks and rays (10 %) in total average catch (Fig. 7). Turtles contribute about 0.6 % and cetaceans about 0.4 % of the total catch. The study further revealed that among finfishes, talang queenfish is most dominating species in bycatch in fishing boats (Fig.8) whereas kingfish and dolphinfish contribute each by 12 %. Indo-Pacific sailfish contributes o about 8 % whereas other species contribute about 4 %. It may, however, be pointed out that there is a marked seasonality in the composition of bycatch and data for an average annual catch is presented.

Sharks (Fig. 9)

Observations made by 4 observers posted on tuna gillnetters indicate that sharks are important bycatch of tuna gillnet operations (about 10 %). During the study 25 species of sharks were observed, however, bigeye thresher (*Alopias superciliosus*), shortfin mako (*Isurus oxyrinchus*), silky shark (*Carcharhinus falciformis*), oceanic whitetip shark (*Carcharhinus longimanus*), scalloped hammerhead (*Sphyrna lewini*) and great hammerhead (*Sphyrna mokarran*) are dominating the catch. The most dominating species of sharks is shortfin mako followed by , bigeye thresher and silky shark whereas other species are comparatively rare in opccurrence.

Rays

Rays are comparatively rare in occurrence in the catches of the tuna gillnet. The study revealed that 10 species of rays are frequently found as bycatch. Pelagic stingray (*Pteroplatytrygon violacea*), bluespotted stingray (*Dasyatis kuhlii*), longheaded eagle ray (*Aetobatus flagellum*), Chilean devil ray (*Mobula tarapacana*), spinetail mobula (*Mobula japonica*), pygmy devil ray (*Mobula eregoodootenkee*) and Javanese cownose ray (*Rhinoptera javanica*) are represented in the catches of tuna gillnet. Of these pelagic stingray, spinetail mobula and Chilean devil ray are noticed more frequently than other species.

Whale Shark

Whale sharks (*Rhincodon typus*) are frequently observed in coastal and offshore areas of Pakistan. It was previously reported about 2 to 5 whale sharks entangled in tuna gillnet every year (Moazzam, 2012). However, the data collected by 4 observers indicate that frequency of their enmeshment in the tuna gillnet is at least about 4 times than previously reported. During a period of about 1 year, five whale sharks were enmeshed in four vessels, of which one whale sharked has died whereas other four are successfully released by the fishermen.

Marine Birds

No marine bird was found to be caught in gillnets during the study period. A detailed investigation reported that a single specimen of flesh-footed shearwater (*Puffinus carneipes*) got entangled in the gillnet during heaving process which was captured live by fishermen and released later on.

Turtle (Fig. 10)

Five species of marine turtles i.e. green turtle (*Chelonia mydas*), olive Ridley turtle (*Lepidochelys olivacea*), hawksbill turtle (*Eretmochelys imbricata*), leatherback turtle (*Dermochelys coriacea*) and loggerhead turtle (*Caretta caretta*) are reported from Pakistan. During the study only three species were observed to have enmeshed i.e. olive Ridley turtle. green turtle and hawksbill turtle. On average on each fishing trips 1-2 green turtles and 3 to 8live Ridley turtles are observed to get entangled in the tuna gillnets. Only about 3 to 5 % mortality of turtles was recorded. Most turtles were observed to be alive in the gillnets and in most cases fishermen release the enmesh turtle. It is most interesting that no nesting of olive Ridley turtle was observed in Pakistan during last ten years but a large population of this species flourishes in the offshore waters. Hawksbill turtle was observed to on at least three occasions during the study whereas one report of leatherback turtle was also recorded. Loggerhead turtle so far has not been found in the bycatch.

Dolphins (Fig. 11)

Dolphins seem to be more frequent in getting entangled in tuna gillnets. Spinner dolphin (*Stenella longirostris*), pantropical spotted dolphin (*Stenella attenuata*), striped dolphin (*Stenella coeruleoalba*) and bottlenose dolphins (*Tursiops truncatus* and *T. aduncus*) were observed to get entangled in tuna gillnets. Although it is not possible to accurately estimate the number of dolphins killed every year in tuna gillnet operation (Moazzam, 2012) estimated that 25- 35 dolphins are killed every month in gillnet operation. Present study reveals that about on average each tuna gillnet entraps about 60 dolphins annually and with a tuna fleet of about 500, the mortality of dolphin can be about 3,000 annually. This needs, however, further studies to verify. It is sad that almost all dolphin enmeshed in the tuna gillnet operation die and thus, discarded.

Whales (Fig. 12)

Baleen whales including blue (*Balaenoptera musculus*), sei whales (*Balaenoptera edeni*) and Arabian humpback (*Megaptera novaeangliae*) are reported to get entangled in tuna gillnets but such events are of very rare occurrence. According to the information recently collected 1 to 2 whales are entangled every year and in most cases fishermen try to release the entangled whales, however, sometime entangled whale die. In survey of dead whales beached along the coast of Pakistan since 2008, three whales were observed to have net entanglement. Two of these were humpback whale and third was a sei whale. Toothed whales do occur in Pakistan but only one such whale i.e. dwarf sperm whale *(Kogia sima)* was observed to get entangled in the gillnet and died.

DISCUSSIONS

Tuna gillnetting is an important fisheries for Pakistan which is contributing annually about 40,000 tuna and a large quantity of fishfish and sharks as bycatch. In addition to commercially important species, gillnet operations in coastal and offshore waters a large number of non target

species such as sharks, rays, turtles and cetaceans are enmeshed. This is considered as a serious threat to these non-target species and some mitigation measures needs to be taken. In order to control the mortality of non target species, it is suggested that gillnet fleet may be diverted to other mode of fishing such as longlining which is known for comparatively fewer mortality of non-target species. In addition, there are Indian Ocean Tuna Commission and United Nations General Assembly resolutions which warrant length of gillnet to be limited to 2.5 km. Reduction of the gillnets being used in Pakistan (> 10 km) can also help in reducing the entrapment and mortality of non-target species. Use of techniques such as pingers and light attached to the gillnets can b used which are known deter or reduce entrapment of vulnerable species may also be attempted.

ACKNOWLEDGEMENT

The paper form a part of the study being undertaken with the assistance of Smart Fishing Initiatives (SFI), WWF-Pakistan and Indo-Pacific Cetacean Research and Conservation Fund (Government of Australia) which is greatly acknowledged. Participation in the Regional Fisheries Symposium, Kochi, India is made possible through funds from Mangrove for the Future which is appreciated. Special thanks are due to Mr. Ghulam Qadir Shah, Coordinator, MFF-Pakistan who help made it possible to attend the symposium. Assistance provided by Mr. Khalid Mahmood, Miss Saba Ayub and Mrs. Shazia Iqbal of the WWF-Pakistan's Tuna programme is highly acknowledged.

REFERENCES

IOTC 2013, Website http://www.iotc.org/English/data/databases.php#dl visited on March 16, 2014.

Lewison, R. L.,Crowder, L. B., Read, A. J. and Freeman, S. A. 2004.Understanding impacts of fisheries bycatch on marine megafauna. Trends in Ecology and Evolution.11: 598-604.

Gillett, R., 2011. Bycatch in Small Scale Tuna Fisheries: A Global Study. FAO Fisheries and Aquaculture. Technical PaperNo.560.Rome,FAO.

Moazzam, M., 2012.Status report on bycatch of tuna gillnet operations in Pakistan. IOTC–2012–WPEB08–13.

Tregenza, N.J.C. and Collett, A. 1998. Common dolphin (*Delphinus delphis*) by-catch in pelagic trawl and other fisheries in the northeast Atlantic. Report of the International Whaling Commission, 48:453-459.

Tregenza, N.J.C., Berrow, S.D., Hammond, P.S. and Leaper, R. 1997. Harbour porpoise (*Phocaena phocaena* L.) by-catch in set gillnets in the Celtic Sea. ICES Journal of Marine Science. 54:896-904.

Fig. 1. Larger tuna fishing boat (23 m) at high seas.

Fig. 2. Smaller tuna fishing boat (12.5 m) at Jiwani, Balochistan

Fig. 3. Polyamide gillnet stored on board tuna fishing vessel at Karachi. Inset stretched mesh.

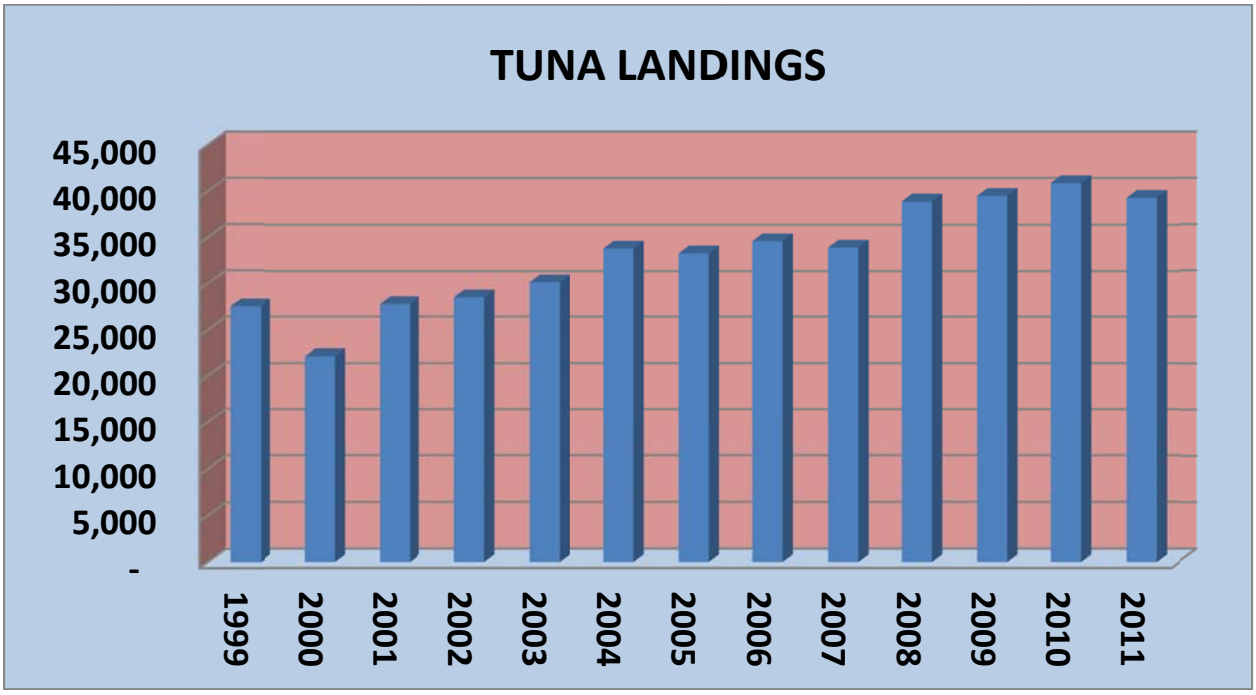


Fig. 4. Tuna landings (in m. tons) in Pakistan

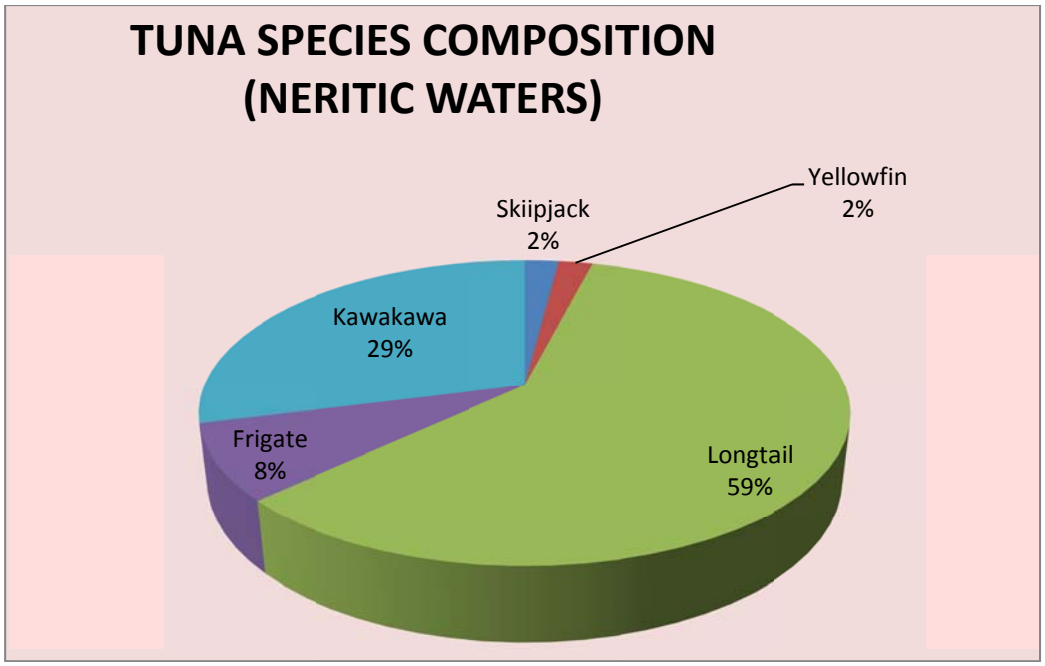


Fig. 5. Species composition in coastal tuna fisheries

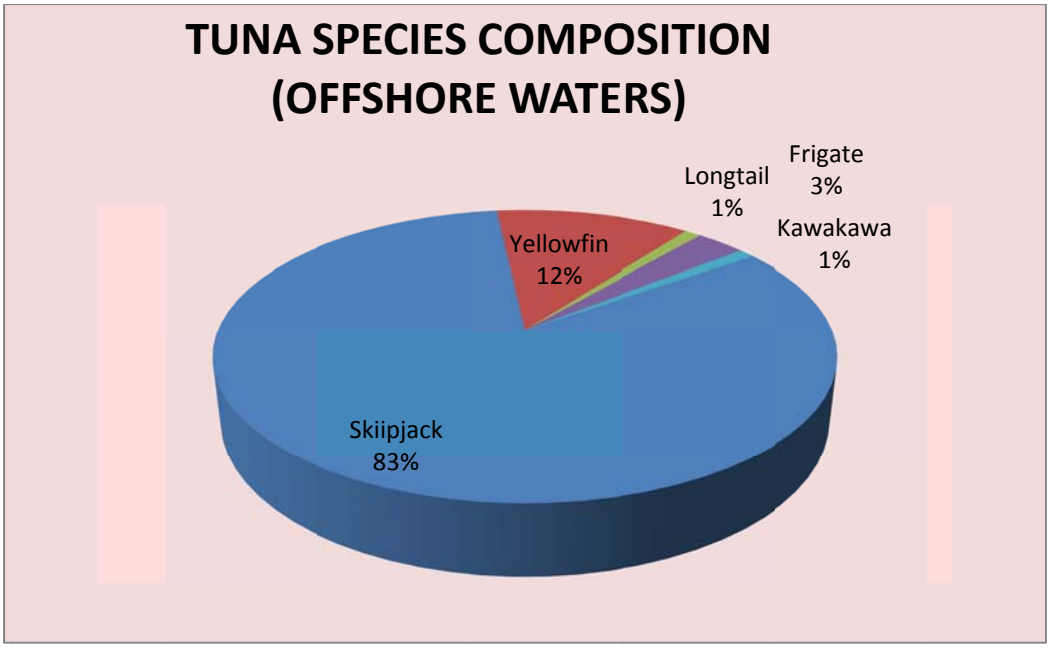


Fig. 6. Species composition in offshore tuna fisheries

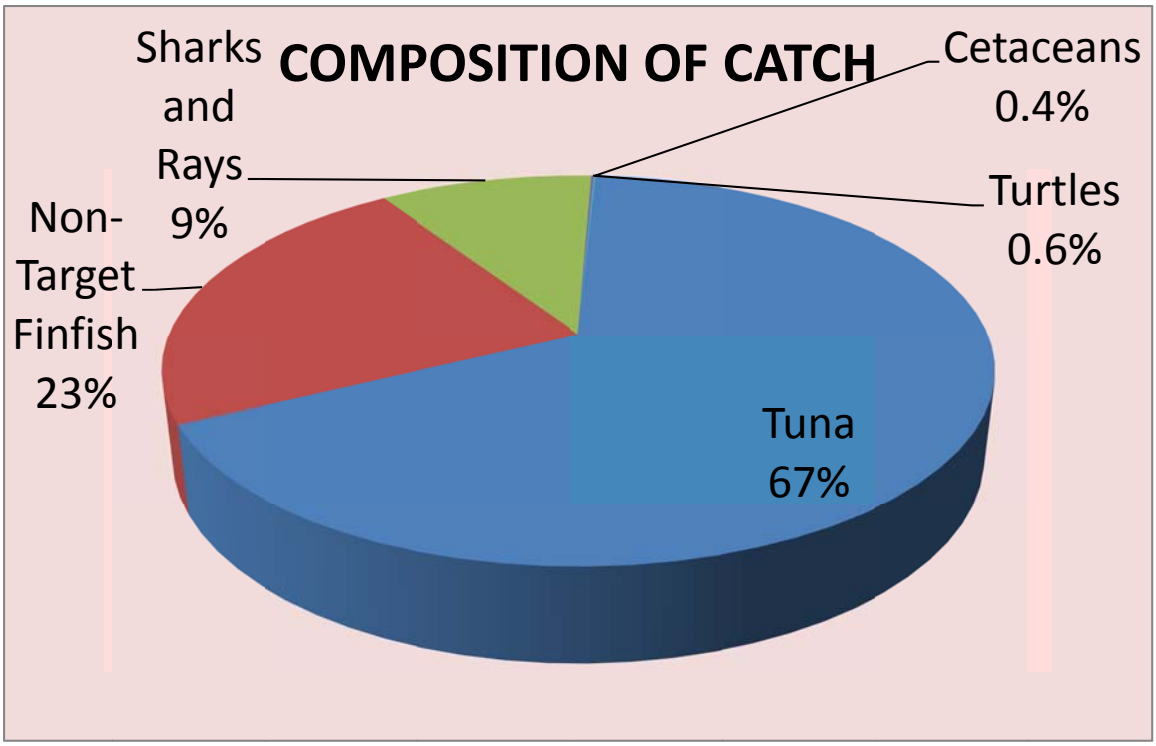


Fig. 7. Bycatch composition of tuna gillnet operation

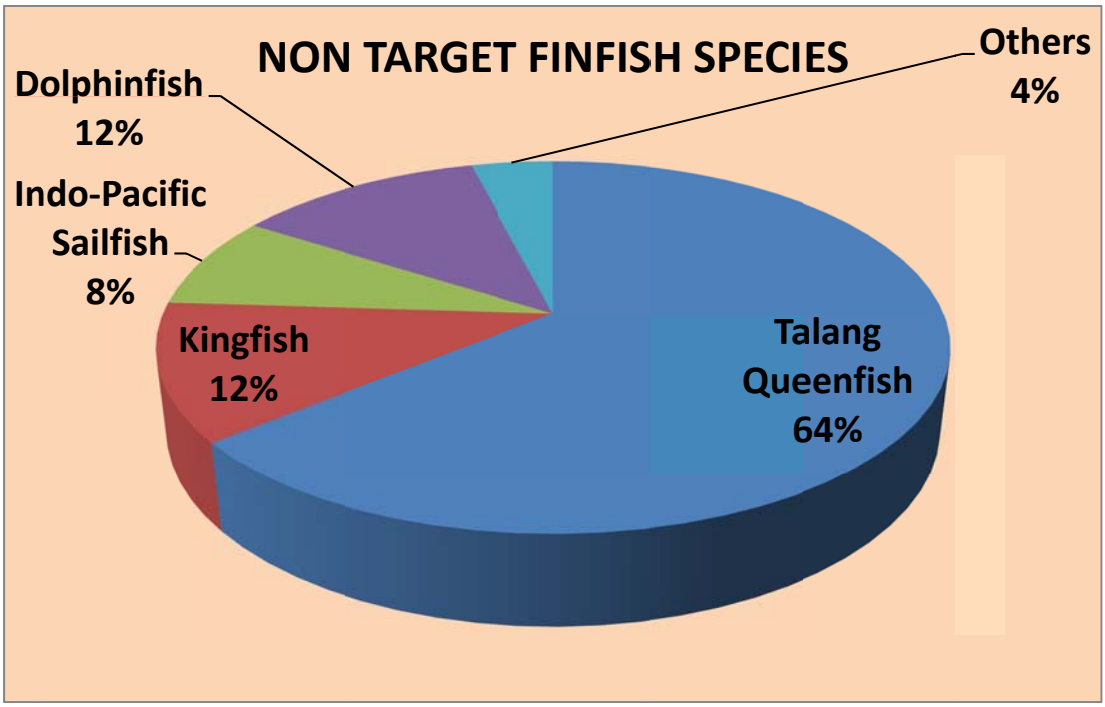


Fig. 8. Finfish bycatch of tuna gillnet operation

Fig. 9. Bigeye thresher shark (*Alopias superciliosus*) entrapped in tuna gillnet

Fig. 10. Olive Ridley turtle (*Lepidochelys olivacea*) entrapped in tuna gillnet

Fig. 11. Striped dolphin (*Stenella coeruleoalba*) entrapped in tuna gillnet

Fig. 12. Sei whales (*Balaenoptera edeni*) entrapped in tuna gillnet and beached at Gwader (Photo: Courtsy Abdul Rahim)

PROJECT PHOTOGRAPHS

PROJECT PHOTOGRAPHS

Typical Tuna Gillnetter

Gillnet being heaved

Tuna retrieved through net-hauler

Tuna catch on board fishing vessel

Dolphin being disentangled from the net

Dead striped dolphin

Dead Risso's dolphin

Data being collected from dead dolphin

Turtle bycatch

Shortfin mako bycatch

Masked booby

Mobulid bycatch

Free swimming dolphins

Whale shark being released

Spinner dolphin showing marks of gillnet

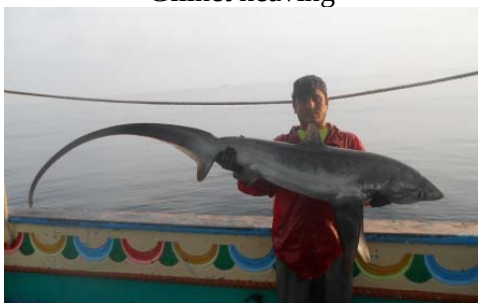
Indo-Pacific bottlenose dolphin

Bryde’s whale

Common bottlenose dolphin

Gillnet heaving

Olive Ridley turtle being released



Thresher shark

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Yellowfin tuna

Green and olive Ridley turtle

Data of shark being collected