Received: 21 August 2015
IOTC-2015-WPEB11-31

Proceedings of the

Regional Symposium on
Sea Turtle Conservation in Asia

24-25 March 2015, Karachi, Pakistan

Organized by: IUCN Pakistan

These Proceedings are made possible with support from the American people, delivered through U.S. Agency for International Development (USAID)

Contents

Paper 4: TURTLE MORTALITY IN FISHING OPERATIONS IN PAKISTAN

By: Muhammad Moazzam and Rab Nawaz
WWF-Pakistan, 46-K, P.E.C.H.S. Block 6, Karachi 75400, Pakistan

Abstract

There are a number of threats being faced by a dwindling population of marine turtles in Pakistan, of which entanglement in various fishing gears is considered to be the most serious threat. In order to enumerate the extent of mortality and to devise a strategy to reduce interaction of turtles with fishing operations, a study was initiated in October 2012. Monitoring of fishing operations was done in coastal and offshore areas of Pakistan which revealed that in the pelagic gillnet operations in the offshore water maximum numbers of turtles get enmeshed resulting in mortality in some cases. It is heartening that the majority of such turtles survived enmeshment. Mortality was observed only in 3 % cases which is mainly because of the poor heaving process and improper handling onboard fishing vessels. A study on seasonal variation of entanglement in the offshore gillnets fisheries revealed a bimodal pattern. A major peak of entanglement was noticed during October-December with the maximum in November. Another smaller peak of entanglement was observed during February and April. It was also observed that in the offshore waters, Olive Ridley turtles (Lepidochelys olivacea) enmeshment were of more common occurrence (85 %) than green turtles (Chelonia mydas). An analysis of the size frequency data of the enmeshed turtles indicates that almost all green turtles were observed to be juveniles having the carapace length ranging between 11 cm and 31 cm whereas almost all Olive Ridley turtles were observed to have carapace length longer than 36 cm. A study on the spatial distribution indicates that turtle enmeshment is more common in the offshore waters as compared to coastal areas.

Turtle enmeshment was also observed in neritic water gillnetting. A large number of turtles are enmeshed in monofilament net along Sindh and Balochistan coast; however, in almost all cases turtles were observed to be alive which is mainly because of shorter duration of the operation and light weightiness of the gear. Turtles were observed to hinder some fishing operations including encircling of breeding schools of catfish and large croakers by gillnet; therefore, fishermen either remove the turtles or kill them in such operations. The maximum number of turtles killed in one such operation was noticed to be 5. It may be pointed out that encircling of breeding school of fishes area is an event of very rare occurrence and usually repeated after a few years.

Turtles are usually not trapped in seine net operation because these nets are laid down only if no turtle is observed in the area. Even if a turtle is entrapped in the seine net it is released immediately because it hinders the operation of the net. No mortality was observed in the seining operations. In shrimp and fish trawling turtles are seldom caught but because of short duration of the operation, such turtles are released without any harm to them. Therefore, no or insignificant mortality occurs in shrimp trawl fishery of Pakistan. Similarly no turtle mortality was observed in other fishing operations including longlining and estuarine set bag net operations along Pakistan coast.

A programme for creating awareness among fishermen for the reducing interaction of turtles and fishing operations was initiated in October 2012. Fishermen were trained to release enmeshed turtles safely to reduce their mortality. The programme, in the beginning, faced some resistance from the fishermen, however, now almost all fishermen especially those engaged in pelagic gillnet fisheries release the turtles safely without wasting time and injuring the enmeshed turtles. It is estimated that in the pelagic gillnet fisheries about 25,000 to 30,000 turtles are safely released annually.

Introduction

The populations of a number of marine animals and plants that are found along the coast of Pakistan are being threatened by anthropogenic factors. It is now being recognized that fishing operations in coastal and offshore waters pose major threat to marine biodiversity. Turtles are considered to be iconic marine animals but these are not spared as these were known to regular interaction with the fishing gears being used in Pakistan. It is presumed that a large number turtles are being killed in shrimp trawl fishing in coastal waters of Sindh. Trawling is not being practiced along Balochistan coast, however, trawlers based in Sindh heavily poach in water of Balochistan. In order to comply with the import requirement of the United States Government, a programme for installation of Turtle Excluder Devices (TED) was implemented in Pakistan since 2000 for which provisions have been made in the fisheries legislations at provincial and federal levels. Despite passage of more than 15 years, TED regulations could not be effectively implemented in Pakistan, because fishermen are still not convinced that trawling for shrimp results in entanglement and mortality of marine turtles. No other regulation in Pakistan takes into consideration protection of marine turtles in fishing operations. Present paper deals with the assessment of mortality of turtles in various fishing gears being used in Pakistan. Additional it will also encompasses the programme that is being implemented to ensure safe released of enmeshed turtles in the fishing gears.

Material and Methods

A survey of the fishing gears being used in the coastal and offshore waters of Pakistan was made and information was obtained from fishermen about frequency and quantification of entanglement of marine turtle species. Detailed information about tuna gillnet fisheries was obtained by deployment of four observers on board gillnet vessels operating in offshore waters starting from October, 2012. Spatial and temporal data about entanglement and mortality of turtles was also collected from coastal and offshore waters of Pakistan. In addition, information about the safe release of turtles from gillnet fishing vessels was also obtained.

Results and Discussions

Species

Five species of marine turtles are reported from Pakistan (Boulenger, 1890; Khan, 2004; Minton, 1966), however, authentic records of three species have recently been made from the area. Loggerhead turtle (*Caretta caretta*) was reported by IUCN (2010) and Khan (2010) from Mekran coast whereas first live specimen of leatherback turtle (*Dermochelys coriacea*) was reported from Gwader in 2013 (WWF-Pakistan, 2013). Hawksbay turtle (*Eretmochelys imbricata*) was reported from Pakistan in 2014 (WWF-Pakistan, 2014). Nesting of green turtle (*Chelonia mydas*) and olive Ridley turtle (*Lepidochelys olivacea*) was reported from various parts along Pakistan coast (Khan et al., 2010; Waqas et al., 2011). Green turtles (*Chelonia mydas*) nest on a number of beaches along the coast of Pakistan throughout the year, the peak nesting season is between September and October (Khanum *et al.*, 2014). Olive Ridley turtle nesting at in Hawkes Bay and Sandspit was previously recorded between the months of March and October with a marked peak between July and September (Asrar, 1999), however, for the past 12 years no nesting of this species was recorded from Pakistan (Hasnain, Personal communication).

Fishing Operations

Fishery is an important activity along the coast of Pakistan. A number of fishing gears are being used for catching fish in coastal and offshore waters of Pakistan. Analysis of the data of commercial fishing operation revealed that gillnet is the most commonly used gear in Pakistan

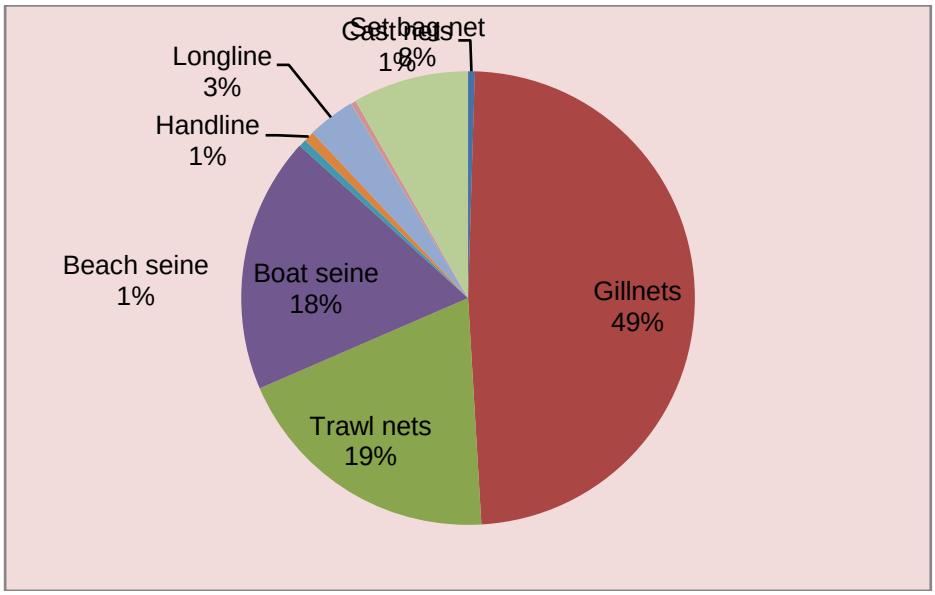

Fig. 1. Fishing methods (as percentage contribution in landings) being used in Pakistan

(Fig. 1) and about 49 % of the fishing fleet is engaged in this fishery which is not only practiced in shallow coastal waters in creeks and lagoons but there is a substantially large fishing fleet that operates in offshore waters and use pelagic gillnets.

Shrimp trawling is an exotic fishing method introduced in Pakistan in 1950's and now engage about 19 % of the fleet. These trawlers now also use high opening fish trawl nets. Boat seine (locally known as "katra") is also an exotic gear which in use since 1970's and it contributes about 18 % in total landings of Pakistan. Set bag net (locally known as "bhulla") which is also an important fishing gear which is used in creek system of the River Indus is also an exotic gear introduced in Pakistan is early 1980's. It contributes about 8 % in total landings. Longlining (locally known as "sangal") is being employed for catching demersal fish species in coastal waters and contributing about 3 % in total landings. Other gears such as cast nets and handlines contribute about 1 % in landings whereas some gears such as trolling, beach seines and traps are also being used but their contribution is insignificant (less than 1 %) in total commercial landings.

Interaction of turtle with fishing gears in Pakistan

Turtle being inhabitant of shallow and offshore waters have close interaction with fishing gears being used in their habitat. In most cases, it was observed that turtles get entangled in the fishing gears but do not die and heaved onboard while fishing gear is retrieved. Since turtles are not consumed in Pakistan and killing them is considered to be bad omen, therefore, in most cases turtles are disentangled from the nets and released alive. A review is given here about interaction of common fishing gear being used in Pakistan and its interaction with turtles.

Seining: Boat seining was introduced in Pakistan in 1970's to meet the demand of fish meal for the poultry industry. Sardinellas and anchovies used to be main target species in the beginning but later on other small pelagic such as scads and Indian mackerels were also targeted. Initially seining operations used to be carried out in coastal waters of Sindh and in the creeks areas of the River Indus, but later on the boats based in Sindh started poaching in waters of Balochistan. Presently about 2,200 seine fishing boats are based in Sindh whereas about 100 boats are based in Balochistan at Damb (Sonmiani). The net being used in seining in Pakistan is of small size (Fig.2), therefore, incidences of entrapment of turtles in these nets are rare. Fishermen usually avoid the area where they spot turtles because turtles usually hinder the operation of seine nets. However, in case any turtle in entrapped in the seining operation, it is usually released before heaving the net. Even if hauled onboard, it is immediately discarded because of limited space on seining boats.

Beach seining is a traditional fishing gear (Fig. 3) being used in creek system of the River Indus and open coast in Clifton, Karachi. Since turtles are not found in the Indus Creek system, therefore, beach seining does not pose any threat to marine turtles. Although turtles may be seldom spotted in the

Clifton area but since the beach seining operation is confined to shallow areas on the beach, therefore, turtles were never observed to be entangled in these nets. Need not to point out that because of spongy nature of the Clifton beach it is not used by turtles for nesting.

Fig. 2. Seining net being used in Sonmiani area.

Fig. 3. Beach seine being used in Creek area

Set Bag Net: Estuarine set bag net (ESBN) was introduced by illegal immigrant Bangladeshi fishermen in early 1980's in the creek system of the River Indus. It is estimated that there are about 6,000 to 8,000 ESBN (locally known as Bhulla) installed in the creek system. There are various sizes of ESBN being used in creek areas (Fig. 4) mainly for catching fish and shellfish species migrating with tides in the creek system. Since turtles are not found in the creek areas, therefore, no mortality of turtles is expected from ESBN. There is no marine set bag net (MSBN) is being used in Pakistan.

Fig. 4. Estuarine set bag net installed in small creek.

Longline and handline: Line gears are used extensively for catching bottom dwelling fish species in the coastal waters of Pakistan. Handline area used from shores as well as boats for recreational and commercial purposes respectively. Commercial handline shark fisheries using live-bait was based in Ormara, Gwader and Jiwani but for the past one decade this fishery has stopped because of decreased stocks of large sharks. Handlines are still used for commercial harvesting of groupers, seabreams, barramundi and eels.

Longline (locally known as “sangal”) is being used for catching eels, sharks, groupers and other demersal fishes in shallow coastal areas and around rocky and reef areas (Fig. 5). Very rarely a turtles may get entangled in handline or longlines. In almost all cases, fishermen snap the line to allow the turtle to escape. No mortality was ever reported from this gear. Pelagic longlining is not being used local fishermen. There used to be a large tuna longlining fleet based in Pakistan between 1991 and 2009. Taiwanese tuna longliners were licensed to operate in the Exclusive Economic Zone of Pakistan. Government observers used to be posted on all these vessels and only on two occasions entanglement of turtles (green turtles) in the hooks was reported. On both occasions the turtles were safely were released after removal of the hooks.

Fig. 5. Longline is used in Pakistan for catching demersal fishes.

Trawling: Shrimp trawling is considered to be mainstay of fishery of Pakistan. According to the census of fishing vessels carried out by Marine Fisheries Department in 2010, there are about 2,500 trawlers being employed for catching shrimp in coastal waters. The number of operational trawlers, at present, may be comparatively less as a number of the trawlers have been modified into gillnetters during past 3 years. Recent monitoring of the fishing vessels reveals that there are more than 1,250 trawlers that operate from Karachi Fish Harbour (Wasim, Personal communications). There are additionally a number of fishing trawlers that are based in Ibrahim Hayderi and Rehri.

Shrimp fishery was introduced in 1950's by modifying a doubled keeled local fishing boat. The gears being used since then is a low opening stern trawl net using two otter boards (Fig.6), operated to a maximum depth of 40 m (Zalinge *et al*., 1996). Since 2003, all trawlers also carry another high opening trawl net which is used for catching fish in comparatively deeper waters (50 to 150 m). Shrimp used to be the main target and trawlers used to be operated all along the coast of Pakistan but since 1999, shrimp stocks started to dwindle. Now for 2 months i.e. August and September trawling is done in shallow coastal waters mainly targeting shrimp whereas for remaining part of the year fish trawling is being done in comparatively deeper waters targeting fish species. Trawling done in Pakistan is marred with very high bycatch mainly of juveniles of commercially important species and bottom dwelling invertebrates.

Fig. 6. Shrimp trawl net being towed for catching shrimp and other demersal species.

Turtles sometimes get entangled in trawling gears but because of short operational duration (about ½ to 1 hours), almost all the entangled turtles was observed to be alive and after heaving the net these

are thrown overboard immediately. Surveys carried out by Marine Fisheries Department in coastal area of Sindh and Balochistan during in 2010 and 2014 revealed no mortality of marine turtles in shrimp trawl nets. Observation collected from research fishing cruises onboard local shrimp trawlers, as part of FAO/MFD Fisheries Resources Appraisal Project also revealed no entrapment or mortality of marine turtles in trawling gear (Table-I). On various research cruises being undertaken in the past 30 years by Marine Fisheries Department, various types of trawl nets were used. On these research cruises (operating in deeper waters and with much bigger nets) turtle entanglement was observed on 7 occasions (6 green and 2 olive Ridley turtle) but all turtles was safely released (Fig7).

Fig. 7. Green turtle being lifted for release on board research vessel R/V Tehkik.

Table-I. Shrimp trawl net operation undertaken by Marine Fisheries Department under Fisheries Resource Appraisal Project (FRAP) during 2010 and 2014

Year	Dates	No. of Days	Area of Operation	Number of Turtle Entanglement/mortality
2010	31 May to 15 June	16	Coastal and shelf area of Sindh and Sonmiani	Nil
	17 August to 6 September	20	Coastal and shelf area of Sindh and Sonmiani	Nil
2013	5 October to 7 October	03	Coastal and shelf area of Sindh	Nil
	7 October to 17 October	11	Coastal and shelf area of Sindh and Balochistan	Nil
2014	12 April to 14 April	03	Coastal and shelf area of Sindh	Nil
	14 April to 20 April	07	Coastal and shelf area of Sindh and Sonmiani	Nil
	23 April to 30 April	08	Coastal and shelf area of Sindh	Nil
	6 May to 13 May	08	Coastal and shelf area of Sindh	Nil
Total (Fishing Days)		76		Nil

In 2000, under the leadership of first author, US requirements of installing Turtle Excluder Device (TED) in Pakistani shrimp trawl nets was complied. A high power mission of Department of Commerce and NOAA verified operation of TED in fishing grounds as well as in the landing centres. Provisions have been made in the federal and provisional fisheries legislations making it mandatory to install TED in the shrimp trawl net. Since then US authorities annually verify compliance to TED regulation, however, fishermen are not convinced about it use therefore, in most cases avoid installing TED in their nets.

Gillnets: Various types of gillnets being used in Pakistan for catching fish and shellfish in coastal and offshore waters of Pakistan. Presently major part of the fleet is being engaged in catching Indian

mackerel and sardinellas along the coastal waters using monofilament nets (Fig. 8). Bottom set gillnet is used in shallow waters for catching shrimps, crabs and other shellfish species as well as demersal fish species.

Gillnet fleet consisting of about 1,200 fishing boats is engaged in catching pelagic and demerso-peagic fishes in neritic and offshore waters. Of these about 700 are exclusively involved in catching tuna in offshore waters. Some of these boats also operated in the Area Beyond National Jurisdiction (ABNJ) and in the EEZ of Somalia and some other countries. Gillnets area considered to enmesh a variety of bycatch including marine turtles.

Fig. 7. Monofilament net being used for catching Indian mackerel and sardinellas

Since a large number of turtles were reported to get entangled in the tuna gillnets, therefore, Since October 2012 a programme of monitoring of tuna gillnet vessel was started. Initially data was collected from tuna fishing boats by posting observers onboard. Tuna gillnet vessels (Fig. 8) uses multifilament braided nets extending to a length more than 7 km. The collected data indicates that two species of marine turtles are commonly found entangled in the gillnets (Fig. 9). Of these, Olive Ridley turtles were observed to be more common followed by green turtle. On a few occasions hawksbill turtles were also observed to be entangled.

Fig. 8. Tuna gillnetter showing store gillnet onboard.

Analysis of the data further revealed that turtle enmeshment is not restricted to any particular area along the coastline or offshore waters but it is widely distributed in the area (Fig. 10). However, the enmeshment of turtle is more frequent in offshore waters as compared to inshore and neritic waters. Study on seasonal variation of entanglement in the offshore gillnets fisheries revealed a bimodal pattern (Fig. 11). Turtles were observed to be enmeshed throughout the year with maximum enmeshment in the month of November whereas minimum was observed to be during May. Another smaller peak of entanglement was observed during February and May with a peak in April. No data was recorded for June and July being the close season for tuna fisheries. Initially the mortality of turtles in the gillnet was estimated to be about 3 %, however, because of improved handling on board and their early release, the mortality rate has substantially decreased.

It was also observed that in the offshore waters Olive Ridley turtles (Lepidochelys olivacea) enmeshment were of more common occurrence (85 %) than green turtles (Chelonia mydas). Seasonal pattern of the two species follows same pattern except that no green turtle enmeshment was noticed during the month of January. Analysis of size frequency data of the enmeshed turtles indicates that almost all green turtles were observed to be juveniles having the carapace length ranging between 11 cm to 31 cm whereas almost all Olive Ridley turtles were observed to have carapace length longer than 36 cm. (Fig. 12). The largest Olive Ridley turtle was observed to have a carapace length of about 71 cm.

Fig. 9. Olive Ridley enmeshment in tuna gillnets

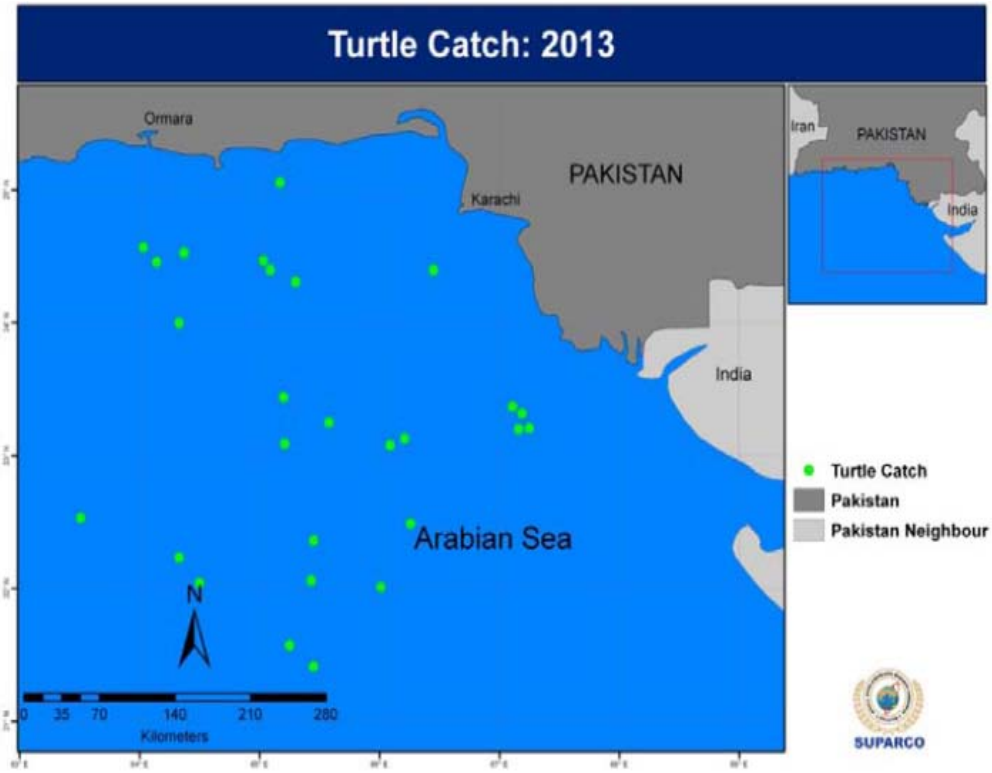

Fig. 10. Spatial distribution of tuna enmeshment in gillnets along the coast of Pakistan

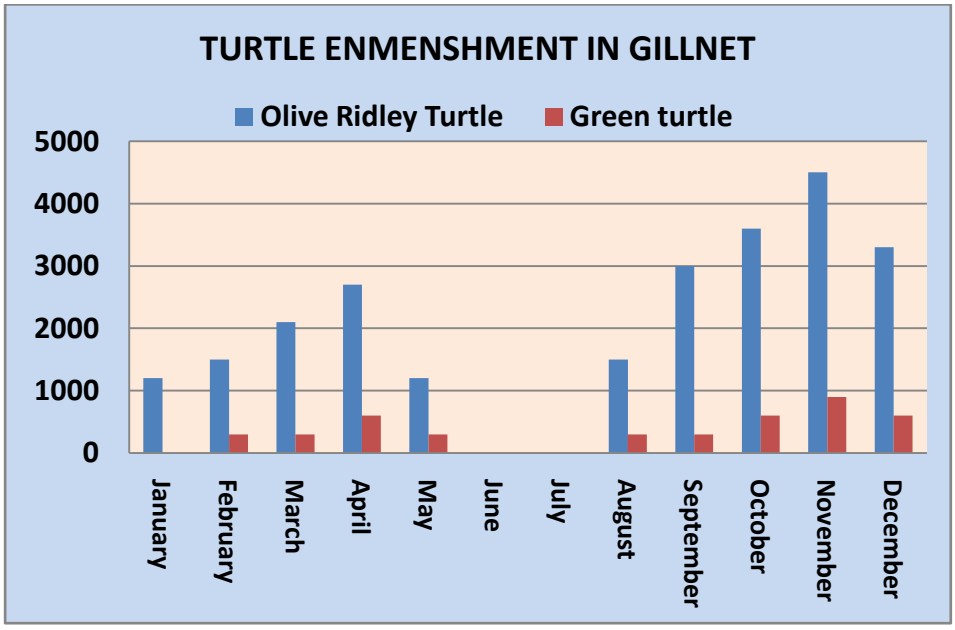

Fig. 11. Seasonal enmeshment of green and olive Ridley turtles in tuna gillnets

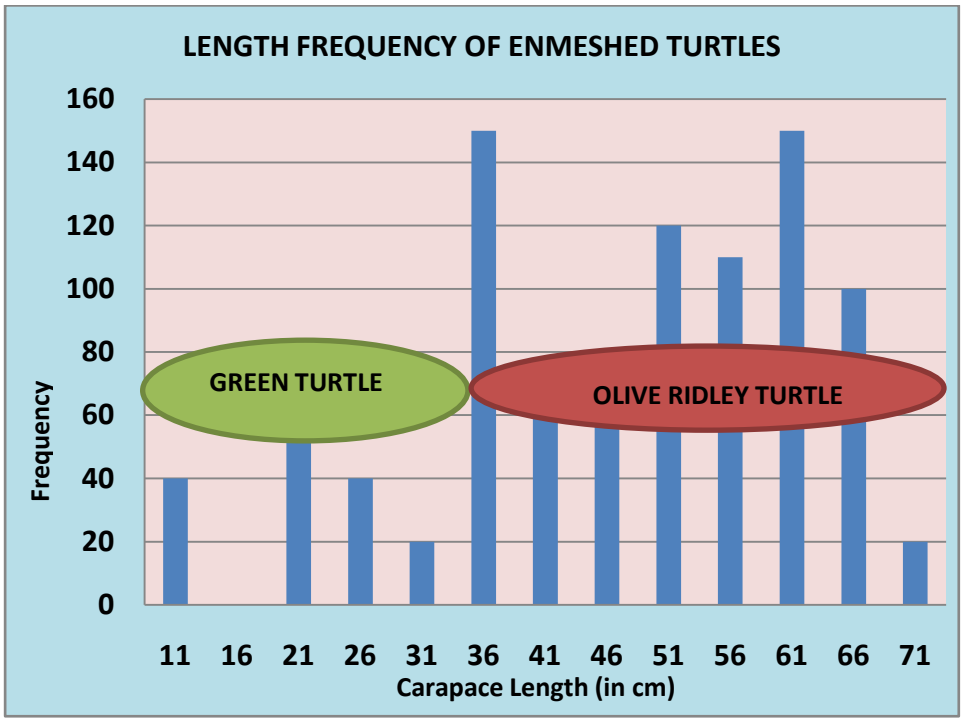

Fig. 12. Size frequency of enmeshed turtles in the tuna gillnets

Turtle enmeshment was also observed in neritic water gillnetting. Various types of gillnets are being used in the neritic waters for catching demersal and pelagic fishes. A large number of turtles are enmeshed in monofilament net along Sindh and Balochistan coast, however, in almost all cases turtles was observed to be alive which is mainly because of shorter duration of the operation and light weightiness of the gear. Since monofilament net is fragile net, therefore, some turtles may escape from the net with a part of net still entangling the turtle which pose serious risk to their survival. Extent of mortality of turtles in bottom gillnet being used for demersal fish is not estimated, however, fishermen engaged in such highly seasonal fisheries informed that instance of turtle enmeshment is much lower than those observed in pelagic gillnetting, however, this is not independently verified.

There is a substantially large fishery for catching shrimp and crabs using bottom set gillnets in very shallow waters. This net, locally known as “Thukri” is usually a gillnet of shorter length (about 1 to 1.5 km) and although data for about 300 operations have been recorded but no entanglement of turtles was ever reported. This net is mainly used for catching shrimp and portunid crabs along the sandy and sandy cum muddy shore.

Encircling gillnet are being used for catching breeding schools of large croakers and sea catfishes in the bays and shallow coastal waters on some rare occasions. This operation is known as “Pinn” in Sindhi and “Aranga” in Balochi. Upon locating such schools, net is laid down around such schools. Encircled fish is heaved using cast net, other gillnets and handlines. Turtles, if entrapped in such encircled nets, will lift the net resulting in the escape of the fish school. Fishermen, therefore, try to remove the turtles from such nets but in most cases kill them by hitting them with clubs and sticks. Maximum number of turtles killed in one such operation was noticed to be 5 in Ormara, Balochistan in 1983. About 30 years back such entrapment of breeding school use to occur annually at least one or two places along the coast of Pakistan but now this event of very rare occurrence and usually recur after a few years.

In addition to gillnet, a number of turtles were observed to get entangled in derelict fishing gears in coastal and offshore waters which results in most cases in death of turtles. Sometimes the turtles may even get entangled in the derelict handlines which may also kill them. Instances of such ghost fishing is increasing because of use of monofilament net which are fragile and if entangled in rocks and other submarine structures, the net will remain stuck up with these structure . Such nets keep on entangling other fishes and turtles for very long periods resulting in death of the enmeshed species. Some NGOs and individuals have started removing such ghost nets from underwater reefs and rocky area in the recent past.

Programme for release of turtles in gillnets

Considering high rate of enmeshment in the tuna gillnet fishing, WWF-Pakistan has initiated a programme in October, 2012 to train fishermen to safely release enmeshed turtles. For the purpose an awareness programme for fishermen engaged in gillnet operation was initiated with the aim to reduce interaction of turtles and fishing operations. The programme, in the beginning, faced some resistance from the fishermen, however, now most of the fishermen especially those engaged in pelagic gillnet fisheries release the turtles safely without wasting time and injuring the enmeshed turtles (Fig. 13). It is estimated that in the pelagic gillnet fisheries about 25,000 to 30,000 turtles enmeshed during gillnet operations are released annually.

Fig. 13. Olive Ridley turtle being released on board tuna gillnetter

Conclusion

Marine turtles in Pakistan are observed to have different levels of interactions with various fishing gears. Firdous (1998) have pointed out that the shrimp trawl net is the most important gear resulting in the mortality of marine turtles due to drowning in these nets. She identified incidental mortality in shrimp trawl nets as a significant threat to Pakistan's sea turtle populations. Contrary to this, it was observed that almost no mortality of marine turtle was observed in trawl net operations whereas tuna gillnetting was found to have large numbers of turtles that are enmeshed. A distinct seasonal pattern in turtle enmeshment was reported with maximum enmeshment was reported to occur during post monsoon month (August to December). The study further revealed presence of large population of Olive Ridley turtles in the offshore waters of Pakistan. Since this species is not reported to be nesting in Pakistan, therefore, it is presumed that these may be nesting in other regional countries. It may be

a part of the most important breeding population of Olive Ridley turtles (arribada) in the Indian Ocean along the Bay of Bengal is Odisha.

WWF-Pakistan has made plans to trace the migration pattern of Olive Ridley turtle using satellite tracking. In the meanwhile, WWf-Pakistan has established a database of distinctive face scale digitization which may be compared with such records from other areas and regional countries countries. Carter, *et al.*, (2014) and Dunbar et al., (2014) have carried out similar studies on green turtles and hawksbill turtle respectively. It is also planned to make modification in the gillnets to reduce turtle bycatch such as increasing gear visibility (e.g., illumination), reducing net height, eliminating tie-downs, modifying float characteristics, changing set direction and treating nets with safe chemicals.

Acknowledgement

The authors would like to proffer their gratitude to Indo-Pacific Cetacean Research and Conservation Foundation, Australian Marine Mammal Centre, Australian Government for providing funds for the Project ”An assessment of cetacean mortality in the tuna fisheries of Pakistan” through which most of the information about turtle given in the study was generated. A part of this study was also funded by Smart Fishing Initiatives (SFI), WWF which is also acknowledged..

References

Asrar, F. F., 1999.Decline of Marine Turtle Nesting Populations in Pakistan. Marine Turtle Newsletter 83:13-14.

Boulenger, G. A. 1890. Fauna of British India, including Ceylon and Burma. Reptilia and Batrachia. London.

Carter, S. J. B., Bell, I. P., Miller, J. J., and Gash, P. P., 2014. Automated marine turtle photograph identification using artificial neural networks, with application to green turtles. Journal of Experimental Marine Biology and Ecology 452: 105–110.

Dunbar, S. G., Ito, H. E. Bahjri, K. Dehom, S., and Salinas, L., 2014. Recognition of juvenile hawksbills *Eretmochelys imbricata* through face scale digitization andautomated searching. Endangered Species Research 26: 137–146.

Firdous, F., 1998. Marine turtle conservation in Pakistan, Proceedings of the Northern Indian Ocean Sea. Turtle Workshop and Strategic Planning Session Bhubaneshwar, Orissa, India, 13-18 January 1997.

*IUCN, 2010. Nesting of Loggerhead Turtles in Pakistan confirmed by renowned expert Nicolas Pilcher.**http://www.iucn.org/news_homepage/news_by_date/?4742/Nesting-of-Loggerhead-Turtles-in-Pakistan-confirmed-by-renowned-expert-Nicolas-Pilcher***

Khanum, F., Kazmi, S. J. H. and Shaikh, S., 2014. A Spatio-Temporal Assessment of Green Turtle Habitat at Hawkes Bay, Karachi through Geo-Informatics Techniques. Journal of Basic & Applied Sciences, 2014, 10, 377-383.

Khan, A., 2010. Records of loggerhead turtles on the Makran Coast, Pakistan. Indian Ocean Turtle Newsletter No. 12: 13.

Khan, M. S., 2004. Annotated checklist of amphibians and reptiles of Pakistan. Asiatic Herpetological Research 10: 191-201.

Khan, M. Z., Ghalib, S. A., and Hussain, B., 2010. Status and New Nesting Sites of Sea Turtles in Pakistan. Chelonian Conservation and Biology, 9: 119–123

Minton, S. A. 1966. A contribution to the herpetology of West Pakistan. Bulletin of the American Museum of Natural History 134(2):31-184.

Waqas, U., Hasnain, S. A., Ahmed, E., Abbasi, M., & Pandrani, A. 2011. Conservation of Green Turtle (Chelonia mydas) at Daran Beach, Jiwani, Balochistan. Pakistan. J. Zool. 43: 85-90.

WWF-Pakistan, 2013. First evidence of a leatherback turtle along Pakistan's coastline (http://wwf.panda.org/wwf_news/?208408/First-evidence-of-a-leatherback-turtle-along-Pakistans-coastline

WWF-Pakistan, 2014. WWF-Pakistan records authentic occurrence of hawksbill turtle for the first time in Pakistan. (http://www.wwfpak.org/newsroom/160114_hawksbill.php #sthash.TZBCrLkq.dpuf).

Van Zalinge, N. P., Khaliluddin, M. Khan, W., 1994. Pakistan's shrimp fishery. In: Proceedings of National Seminar on Fisheries Policy and Planning (Majid, A., Khan, M. Y., Moazzam M., and Ahmad J. eds.), Marine Fisheries Department, Karachi. Pp. 130-177..

INTERNATIONAL UNION FOR CONSERVATION OF NATURE

Country Office

1 Bath Island
Karachi 75530
Pakistan

Tel +92 (21) 35861540/41/42/43
Fax +92 (21) 35861448
cro.pk@iucn.org

www.iucn.org/pakistan