



STATUS OF MARINE TURTLES IN SOME SELECTED ASIAN COUNTRIES: A REVIEW

*Uzma Manzoor, Amtyaz Safi, M. Usman Ali Hashmi, Nasim Samreen, Ponum Nisar,
Tanveer Jabeen and Erum Manzoor
Department of Zoology, Faculty of Science, University of Karachi, Karachi-75270

ABSTRACT

Globally, population of marine turtles has been affecting due to an array of some natural and anthropogenic threats. Seven marine turtle species viz. Hawksbill, Olive ridley, Kemp's ridley, Loggerhead, Leatherback, Flatback and Green turtle have been distributed throughout the world. Six species spend life in Indian Ocean South East Asian region except Kemp's ridley, found in Gulf of Mexico. Nesting of Olive ridley is largely reported in mainland of Indian coastal areas, while Hawksbill in Iran; Islands of Persian Gulf and Oman coast. Pakistan coast provides nesting sites to Green turtle, however Hawksbill and Olive ridley have not been reported since 2003 and 2004 respectively. Loggerhead and Leatherback were reported by fishermen in rookeries but further study is required to identify these species in Pakistan. Currently, Olive ridley nesting is not reported in Karachi coast. Bycatch and gill netting are common threats to marine turtles. Disturbance due to tourism is another issue needs to be addressed. Habitat alteration, harvesting of eggs, pollution, development and anthropogenic activities cause non-nesting behaviour in some marine turtle species previously reported for nesting. Climate change impact on nesting is not drastic but sex ratio is affected. National and international laws have been playing significant role for the conservation of marine turtle species. Research studies about marine turtle has relatively been advanced in Thailand, India, Malaysia and Sultanate of Oman among Asian countries, meanwhile regular monitoring program to provide accurate population trends throughout nesting points but has not been conducted in many countries. IUCN and WWF have also been playing important role in conservation of marine turtles in our region.

Keywords: Coast, marine turtle, nesting, distribution, status.

INTRODUCTION

Population of marine turtles is affecting due to high significance in terms of traditional and economical perspective. ASEAN countries have been engaged to address the conservation issues related to marine turtles along with marine biodiversity (Poloczansk *et al.*, 2016; Worm and Lotze, 2016). Neritic and sandy beaches are the main sites of marine turtles for foraging and nesting (Boltan, 2003), mostly distributed in tropical, sub-tropical and temperate regions (Wallace *et al.*, 2010).

Among seven globally distributed species of marine turtles only Kemp's ridley found in Mexican gulf and six species viz. Hawksbill, Flatback, Olive ridley, Leatherback, Loggerhead and Green turtle distributed in Indian Ocean South East Asian (IOSEA) region which provide suitable nesting site except Flatback, nesting at Australian continental shelf.

All marine turtles found worldwide, listed in Appendix-I

*Corresponding author e-mail: uxmanzoor10@gmail.com

of CITES Convention on International Trade of Endangered Species of Wild Fauna and Flora (Global distribution of Marine Turtles @WWF). This paper is mainly focused on a review of available published literature on marine turtles of some selected regional countries about number of turtle species, nesting status, conservation activities and threats.

DISCUSSION

In Indian Ocean, population of marine turtles have been declined in recent years. Changing temperature is one of the threats to nature and has long lasting impact (Pecl *et al.*, 2017; Lenton *et al.*, 2019) specially on biodiversity (Newson *et al.*, 2009; Walther, 2010). Since 1980s rise in temperature has been observed, Arctic found warmer for last 2000 years (Climate change, 2023), ultimately causing change in marine and coastal ecosystems. Marine fauna like sea grasses, sea weeds and corals have been focussed to study particularly for climate change affect (Poloczansk *et al.*, 2016; Worm and Lotze, 2016; Hughes *et al.*, 2018; Chefaoui *et al.*, 2018; Crespo *et al.*, 2019; Erauskin-Extramiana *et al.*, 2019; Martins *et al.*, 2019;

Albouy *et al.*, 2020). Climate change affect has also been faced by marine turtle however not drastic.

During Pandemic COVID 2019, Middle East and South Asian countries viz. Bangladesh, Bahrain, Djibouti, Egypt, Iran, India, Kuwait, Maldives, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Sudan, United Arab Emirates (UAE) and Yemen have contributed in study of marine turtle species. Regional Management Units (RMUs) have played significant role in evaluating distribution, threats and conservation status of marine turtle species (Sea Turtles in the Middle East and South Asia Region: (MTSG Annual Regional Report 2019. Report of the IUCN-SSC Marine Turtle Specialist Group, 2019).

Research studies about marine turtle has been relatively advanced in Thailand, India, Malaysia and Sultanate of Oman, while several other countries have not done regular monitoring program to provide accurate population trends throughout all nesting points of main nesting areas. All four marine turtle species of Malaysia have been declining due to anthropogenic and developmental activities, however Malaysian people considered marine turtles as part of their natural heritage; protected under the Fisheries Act of 1985 and Terengganu Turtle Enactment of 1951 (Rahman *et al.*, 2018; Tolen and Rusli, 2021).

Bangladesh

Marine turtle species including Green turtle, Hawksbill, Olive ridley, Leatherback and Loggerhead have been reported in Bangladesh (Groombridge *et al.*, 1989; Rashid and Islam, 2005). Among these Olive ridley, Hawksbill, Leatherback and Green turtles found in coastal waters, however nesting of only two species Green turtle and Olive ridley observed. St. Martin's Island is the most important nesting site for Green turtle while Olive ridley found along the entire coastal line. Hawksbill has not been recorded since 1998, previously reported from St. Martin's Island. A dead Leatherback found at St. Martin's Island in 1997, however live specimen have not been reported since 2005 (Marinelife Alliance, 2015, 2019). The main nesting season of marine turtle is winter (October to March/April).

Turtle eggs illegal harvesting, alteration of sand dunes, and bycatch in offshore fisheries found main threats to marine turtles. Plastic waste pollution is another threat; several marine turtles caught in plastic wastes; rescued from beach (Fig. 1). Bangladesh has signed several international agreements and conventions related to protection of marine environment which directly or

indirectly affect marine turtles conservation (Hossain *et al.*, 2013).



Fig. 1. Local community carry a marine turtle to release into Sea in Cox's Bazar, Bangladesh. (source: www.ndtv.com/world-news/bangladesh (Accessed on Jan 3, 2023).

Bahrain

Five species of marine turtle viz. Green turtle, Hawksbill, Loggerhead, Leatherback and Olive ridley have been recorded in coastal areas of Bahrain. Green and Hawksbill turtles observed frequently, while Loggerhead, Leatherback and Olive ridley identified infrequently. Nesting has not been reported or documented (Miller and Abdulqader, 2009).

Bahrain Sea Turtle Rescue Team (BSRT) and Environment Friends Society (EFS) have been working for conservation of marine turtles in Bahrain. April 2019, both organizations had received 10 hatchling, two juvenile Hawksbills, and two adult Green turtles in coastal areas. BSRT and EFS usually busy in the months of December-April in turtle rescues, treatment and rehabilitation by releasing in marine water (Khawla Al-Muhammadi *et al.*, 2021).

Iran

An extensive coastline of Iran is connected with North-West Indian Ocean by Persian Gulf and Sea of Oman. Hawksbill is the most abundant nesting species; mainly aggregated in numerous Islands of Persian Gulf including Nakhiloo, Ommolkaram, Sheedvar, Hendourabi, Hengam, Queshm, and Kish. Green turtle is the most abundant species across Persian Gulf and Omani waters, with sporadic nesting in Oman, Sistan and Balochistan provinces, also observed in different islands of Persian Gulf including Sheedvar, Hendourabi and Khargoo (Mobaraki, 2004, 2006; Mostafavi, 2010).

Table 1. Distribution and threats of marine turtle species in Pakistan.

S.No.	Common name	Scientific name	Family	Distribution	Nesting Sites	Threats	Remarks
1.	Hawksbill turtle	<i>Eretmochelys imbricata</i>	Cheloniidae	Along coastline of Sindh and Balochistan	Cape Monze (2003), Astola Island (2006), nesting not reported recently.	Tuna fish operation (gill netting), ghost gears, oil spillage,	Research is required to identify causes of loss of nesting.
2.	Olive ridley turtle	<i>Lepidochelys olivacea</i>	Cheloniidae	Northern Arabian Sea, off shore waters of Pakistan	Sandspit, Hawkesbay (Sindh), Ormara, Astola Island (Balochistan), nesting disappeared since 2004	Shrimp trawl fishing, entanglement in tuna gill netting, oil spillage	Nesting disappeared, research is needed to highlight causes.
3.	Leatherback turtle	<i>Dermochelys coriacea</i>	Cheloniidae	Coastal and off shore waters of Gwadar and Jiwani (Balochistan), Karachi Great Khori Bank Indus Canyon (Sindh)	Nesting is not reported	Gill netting	Feeding and nesting habitats need to be evaluated.
4.	Loggerhead turtle	<i>Caretta caretta</i>	Cheloniidae	Widely distributed in coastline of Sindh and Balochistan (particularly closed to Masirah Is., Oman)	Nesting is not documented	dogs, crabs, sea gulls	Feeding and nesting needs to be investigated.
5.	Green turtle	<i>Chelonia mydas</i>	Cheloniidae	Coastal and off shore waters of Sindh and Balochistan	Sandspit, Hawkesbay, Kapaysee, Cape Monze (Sindh), Ormara, Astola Island, Pasni, Gawadar, Jiwani (Balochistan)	Pollution, compaction of sand, oil spillage, predation, by catch, habitat degradation, construction, debris	Eggs and hatchlings need protection.

Table 2 shows trends and distribution of five species of marine turtles found in different regions of Indian Ocean South East Asian region (IOSEA).

Table 2. Distribution, threats and conservation of marine turtle species in IOSEA.

S.No.	Common name	WIO	NEIO	NWIO	SWIO	Abundance	Threats	Conservation
1.	Hawksbill turtle		Sri Lanka, Bangladesh and India	Bahrain, Djibouti, Egypt, India, Iran, Kuwait, Maldives, Oman, Qatar, Saudi Arabia, Sudan, United Arab Emirates, Yemen		Nesting in Eritrea	Exploitation of eggs, depredation of nesting sites in Andaman and Nicobar Islands, India.	Govt. legislation in India and Sri Lanka is enforced
2.	Olive ridley turtle	Bahrain, India, Maldives, Oman, Pakistan, Yemen	Sri Lanka, Bangladesh, India				Bycatch, exploitation of eggs by predators	National legislation in India and Sri Lanka is enforced
3.	Leatherback turtle		Sri Lanka, Bangladesh and India		Bahrain, Djibouti, Kuwait, Pakistan, Sudan, Yemen,		Degradation of nesting site by local population	legislation in India and Sri Lanka is enforced
4.	Loggerhead turtle		Sri Lanka	Oman and Yemen		Masirah Island, Oman, lesser in Socotra Island, Yemen	Predators, lighting in adjacent nesting sites, by catch	Govt. legislation is enforced
5.	Green turtle		Bangladesh and India	Bahrain, Djibouti, Egypt, India, Iran, Kuwait, Maldives, Oman, Pakistan, Qatar, Saudi Arabia, Sri Lanka, Sudan, United Arab Emirates, Yemen		Yemen and Oman	Pollution, developmental activities at coastal sites, lighting, bycatch, predation of eggs and hatchlings	Govt. legislation is enforced

WIO= West Indian Ocean, NEIO= North East Indian Ocean, NWIO= North West Indian Ocean, SWIO=South West Indian Ocean.

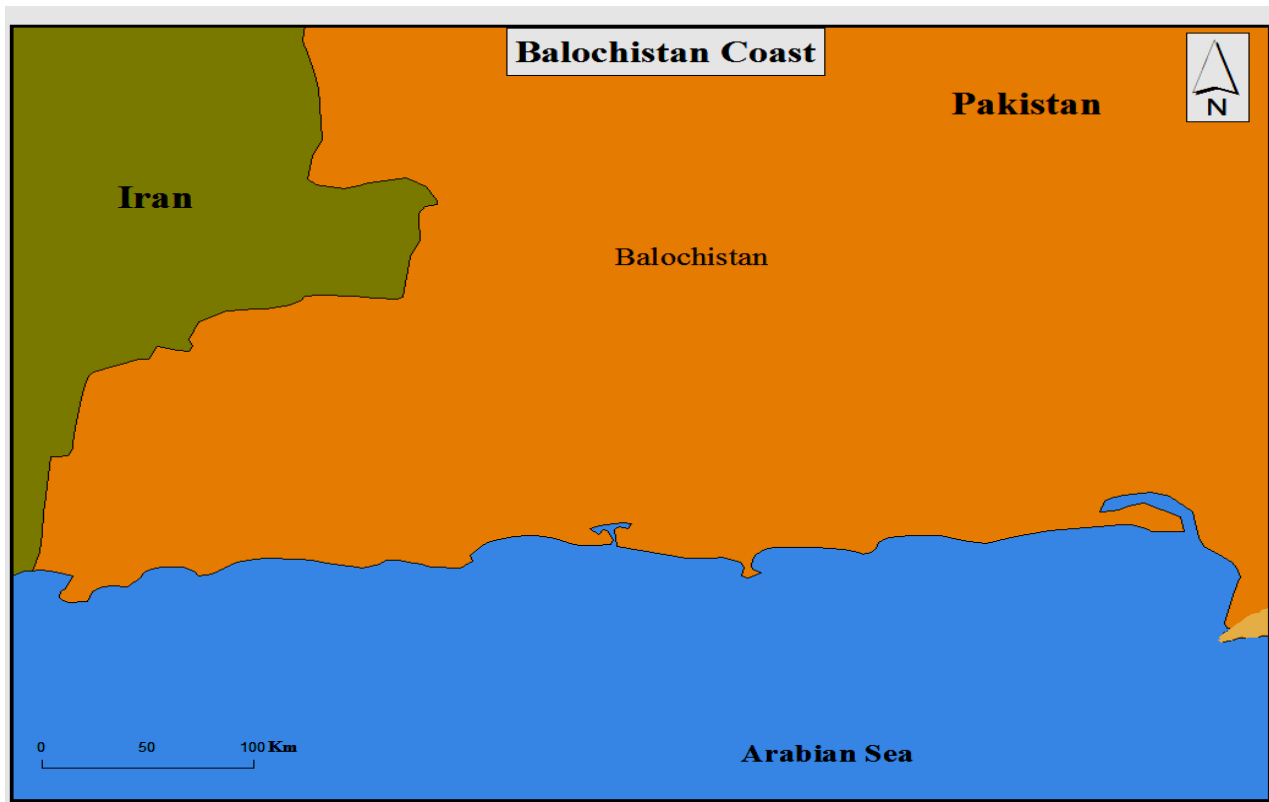


Fig. 2. Coastline of Balochistan province in Pakistan.

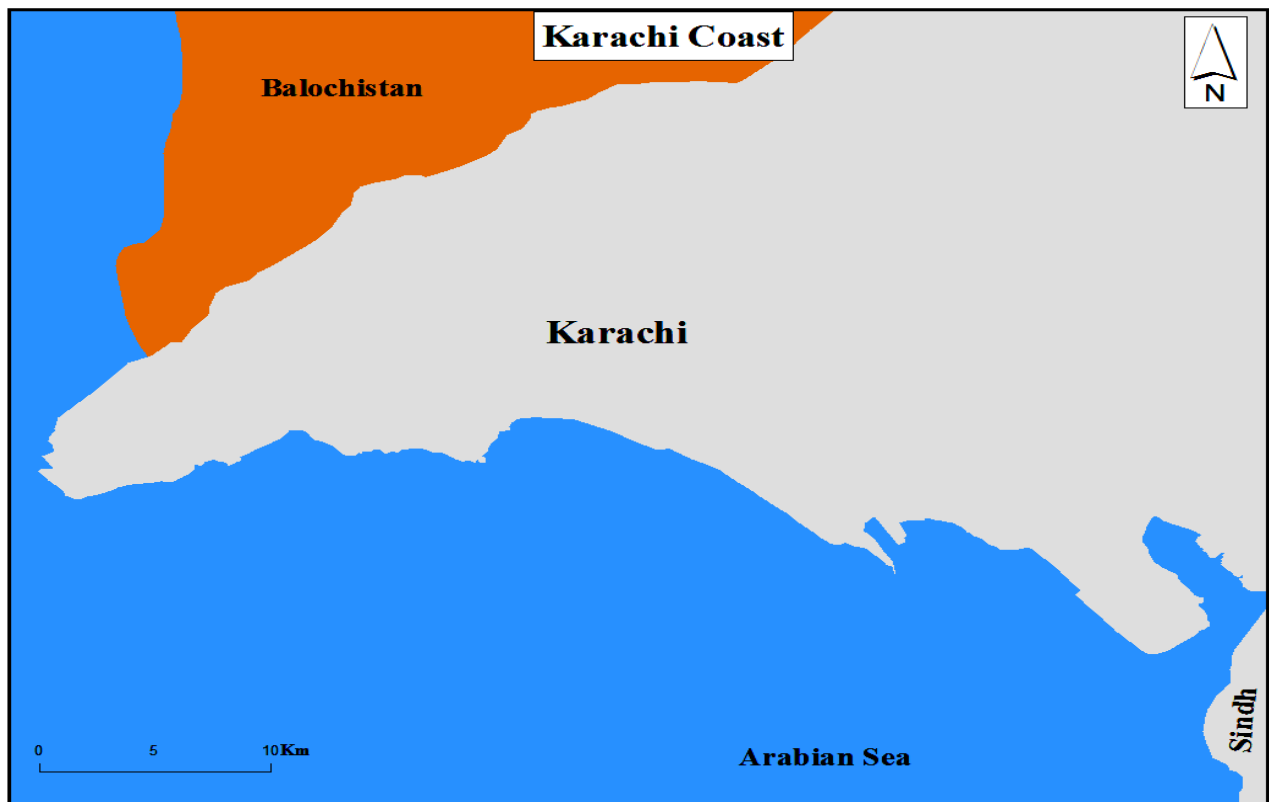


Fig. 3. Karachi coastline of Sindh province in Pakistan.

Iraq, Israel and Jordan

Nesting of any marine turtle species has not been reported in coastlines of Iraq, Israel and Jordan which are only 58km in Iraq, 12 km in Israel and 27km in Jordan. Records of stranded or in water turtles have been available, but verification is needed. Loggerhead, Olive ridley, Hawksbill and Green turtles are included in checklists of herpeto fauna for Iraq (Al-Barazengy *et al.*, 2015). A stranded Leatherback turtle found in Basrah province of Iraq. Hawksbill turtles have been observed in Jordan (Phillott, 2020).

India

Olive ridley, Green turtle, Leatherback and Hawksbill species have been found in coastal areas of India. Nesting of Olive ridley observed all across the West coast as well as on the Islands of Lakshadweep (Shanker and Choudhury, 2006) while Green turtle is reported in Andaman and Nicobar Islands of North East Indian Ocean (Andrews *et al.*, 2006) and Lakshadweep Island of North West Indian Ocean and Gujarat coast (Tripathy *et al.*, 2002; Sunderraj *et al.*, 2006; Kumar and Choudhury, 2009). Nesting of Leatherback and Hawksbill turtles found in Andaman and Nicobar Islands (Andrews *et al.*, 2006; Swaminathan *et al.*, 2017).

Kuwait

Two species of marine turtles including Green turtle and Hawksbill have been observed in Kuwait. Qaru and Umm Al-Maradim are the nesting sites of both Hawksbill and Green turtle while Ras Al Zour is also nesting area of Hawksbill turtle (Rees *et al.*, 2013; Al-Mohanna *et al.*, 2014).

Oman

Nesting of four species *viz.* Loggerhead, Hawksbill, Green turtle and Olive ridley have been reported in the coastal areas of Oman particularly Masirah Island (Ross and Barwani, 1982; Ross, 1985) with a great number of Loggerhead and Green turtle while Daymaniat and Masirah Islands have been reported as nesting and feeding habitats of Hawksbill turtle (Baldwin and Al Kiyumi, 1999; Rees and Baker, 2006; Pilcher *et al.*, 2014). There has been a Marine Turtle Conservation Project (MTCP) undertaken on Masirah Is. between 2004 and 2008 to evaluate population assessment of marine turtle species (Rees *et al.*, 2018). In Muscat and Daymaniat Island Olive ridley nesting have been recorded, while Leatherback reported in Omani waters only but no sign of nesting found. Ras Al Jinz beach is popular nesting site for Green turtle. In 2008 government established Ras Al Jinz Turtle Center for conservation of marine turtle and promotion of Ecotourism (Ministry of Tourism, 2023).

Pakistan

Among globally occurring species of marine turtles, five species *viz.* Green turtle, Hawksbill, Olive ridley,

Leatherback and Loggerhead have been documented in Pakistan except Flatback and Kemp's ridley (Asrar, 1999; Ghalib and Zaidi, 1976; Groombridge, 1982, 1987a, 1987b, 1989; Firdous, 1986, 1988; Kabraji and Firdous, 1984; Groombridge *et al.*, 1988; Khan and Ghalib, 2006). The coastal area of Pakistan comprising of larger (800 km) Balochistan coast and smaller (250 km) Sindh coast with highly significant Karachi coast (Fig. 2 and 3).

Nesting of Green turtle (Fig. 4) and Olive ridley (Fig. 5) in Pakistan occurs at Hawkesbay and Sandspit along Karachi coast Sindh and Ormara and Jiwani (Daran) along Balochistan coast.



Fig. 4. Green turtle (*Chelonia mydas*) caught in Pakistan coast.



Fig. 5. Olive Ridley (*Lepidochelys olivacea*).

Recently, no concrete evidence has been found for vanishing of Hawksbill and Olive ridley nesting from Pakistan. No pollution hindrance in large scale and commercial exploitation of eggs and hatchlings have been observed of these species in Pakistan.

Green turtle shows stable population in Sindh and Balochistan coast. Daran (Jiwani) is relatively a remote

area, supported large number of nesting of Green turtle (Uzma *et al.*, 2022; Moazzam *et al.*, 2021). Table 1. shows distribution and threats of different marine turtle species in Pakistan.

Threats

Several threats are being faced by marine turtle species such as predators including ghost crabs, crows, sea gulls and dogs of hatchlings or eggs. Compaction of coastal sand slows down nesting (Crain *et al.*, 1995; Brinn, 2008), vulnerable in oil spilled areas (Camacho *et al.*, 2013) if survived, abnormalities seen (Wallace *et al.*, 2020). Debris of crumbling huts, garbage and solid wastes create obstruction for nesting species.

Camping, bonfire and other recreational activities, movement of vehicles on nesting beaches affect nesting of turtles. Flooding of nests due to high tides and beach erosion also faced by marine turtles. Lightening in coastal sites is another distraction for hatchlings to move towards sea meanwhile die of dehydration.

Large scale construction and coastal development activities alters nesting habitats (Manzoor *et al.*, 2019). Harassment of nesting species and hatchlings by tourists or visitors also cause disturbance in nesting. Andaman and Nicobar Islands have been affected for nesting in 2004 due to natural disaster Tsunami in Indian Ocean.

Shrimp trawl entanglement has not been observed since 2010-2014 in Pakistani waters. A figure of 24,600 Olive ridley caught in tuna gillnetting. Nine Hawksbill have been entangled between March 2013 and December 2018. Among 28,800 entangled species ~4,200 were Green turtles. 17 Leatherback have been caught in tuna gillnetting since 2012-2017 in Pakistani waters, out of these, four were stranded on coast, one found dead at Miani Hor, Sonmiani while remaining entangled in fishing except one which died in net (Moazzam and Nawaz, 2014, 2015, 2017, 2019).

Recommendations

- Use of Turtle Excluder Device (TED) for the safety of marine turtle species from entanglement.
- Research is needed to find out causes of recent declining population or non-nesting behaviour of some species of marine turtles in areas where previously recorded.
- Small and simple construction should be done in coastal sites to minimize disturbance in nesting.
- Exploitation of eggs must be stopped with strict implementation of national and international laws.
- Training workshops on marine turtle management should be regularly organized to update fishermen.

- Recreational activities should be arranged with great care.
- Symbols, sign boards and directions must be displayed in coastal areas for guidance of general public and tourists.
- Regular awareness programmes should be arranged in different educational institutions for safety of marine turtles and fishing activities.
- Academic and research work on marine turtle conservation should regularly be shared with government, relevant NGO's and academia.
- A comprehensive network between regional countries must be developed for the exchange of research results, experiences, seminars and training workshops.

REFERENCES

- Al-Barazengy, AN., Salman, AO. and Hameed, FTA. 2015. Updated list of amphibians and reptiles in Iraq 2014. Bull. Iraq. Nat. Hist. 13:29-40.
- Albouy, C., Delattre, V., Donati, G., Frölicher, TL. *et al.* 2020. Global Vulnerability of Marine Mammals to Global Warming. Sci. Rep. 10:548.
- Al-Mohanna, SY., Al-Zaidan, AY. and George, P. 2014. Green turtles (*Chelonia mydas*) of the north-western Arabian Gulf, Kuwait: The need for conservation. Aquatic Conservation: Marine and Freshwater Ecosystems. 24:166-178.
- Andrews, HV., Tripathy, A., Aghue., Glen, John, S. and Naveen, K. 2006. The status of sea turtle populations in the Andaman and Nicobar Islands. In: Towards an integrated and collaborative sea turtle conservation program in India: a UNEP/CMSIOSEA.
- Anwar, F. 2005. Habitat management plan for the Proposed Turtle Beach Protected Area: A Framework for Action. Unpublished Report (https://www.shehri.org./united_nations-development_programme.html). [accessed on Dec 22, 2022]
- Anwar, F. 2013. Assessing the habitat suitability for species habitation Case study: Sandspit/ Hawkesbay Coastal ecosystem as a Turtle Habitat. Unpublished Report 17p. (http://www.sustainableinitiatives.org.pk/Journal_%20FA.pdf). [accessed on Dec 22, 2022].
- Asrar, F. 1999. Decline of Marine Turtle Nesting population in Pakistan. Marine Turtle Newsletter. 83:13-14. (<http://www.seaturtle.org./mtn/archives/mtn83/mtn83p13.shtml>) [accessed on Dec 22, 2022].

- Baldwin, RM., Al Kiyumi, A. and Bin, A. 1999. The Ecology and Conservation Status of the Sea Turtles of Oman. In: The Natural History of Oman. A Festschrift for Michael Gallagher. Eds. Fisher, M., Ghazanfar, SA. and Spalton, A. Leiden. The Netherlands: Backhuys Publishers. 89-98.
- Boltan, AB. 2003. Variation in sea turtle life history patterns: neritic vs. oceanic developmental stages. In: The Biology of Sea Turtles. Eds. Lutz, PL., Musick, JA. and Wyneken, J. CRC Press, Boca Raton, FL. 2:163-197.
- Boulenger, GA. 1890. Fauna of British India, including Ceylon and Burma: Reptile and Batrachia, London.
- Brinn, LA. 2008. Assessment of differences in physical properties of sand associated with beach nourishment and effects on Loggerhead sea turtle (*Caretta caretta*) nesting in northwest Florida. MS. Thesis. University of Florida, USA.
- Camacho, M.P., Calabuig, O., Luzardo, LD., Boada, M., Zumbado and J. Orós. 2013. Crude oil as a stranding cause among Loggerhead sea turtles (*Caretta caretta*) in the Canary Islands, Spain (1998-2011). Journal of Wildlife Diseases. 49:637-640.
- Chan, EH. 2006. Marine turtles in Malaysia: on the verge of extinction? Aquatic Ecosystem Health & Management. 9:175-184.
- Chefaoui, RM., Duarte, CM. and Serrão, EA. 2018. Dramatic loss of sea grass habitat under projected climate change in the Mediterranean Sea. Glob. Change Biol. 24: 4919-4928.
- Climate Change. 2023. <https://climate.nasa.gov> [accessed on Dec 22, 2022].
- Crain, DA., Bolten, AB. and Bjorndal, KA. 1995. Effects of beach nourishment on sea turtles: Review and research initiatives. Restoration Ecology. 3:95-104.
- Crespo, GO., Dunn, DC., Gianni, M., Gjerde, K., Wright, G. and Halpin, PN. 2019. High-seas fish biodiversity is slipping through the governance net. Nat Ecol Evol. 3: 12730-1276.
- Erauskin-Extramiana, M., Arrizabalaga, H., Hobday, A.J., Cabré, A. *et al.* 2019. Large-scale distribution of Tuna species in a warming ocean. Glob. Change Biol. 25:2043-2060.
- Firdous, F. 1986. Marine Turtles. Proceedings of International Conference on Marine Sciences of the Arabian Sea Institute of Marine Sciences. University of Karachi.
- Firdous, F. 1986. Marine turtles. Proceedings of International Conference on Marine Sciences of the Arabian Sea Institute of Marine Sciences. University of Karachi.
- Firdous, F. 1988. Conservation of turtles at Sandspit and Hawkesbay, Karachi In: Proceedings of International Conference on Marine Sciences of the Arabian Sea. Eds. Thomson, MF. and Tirmizi, NM. American Institute of Biological Sciences, Washington, DC, USA. 217-222.
- Firdous, F. 1989. Male Leatherback turtle strands in Karachi. Marine turtle Newsletter. 47:14-15.
- Firdous, F. 2000. Sea Turtle conservation and education in Karachi, Pakistan. In: Sea Turtles of Indo Pacific: Research, Management and Conservation. Eds. Pilcher, N. and IG. ASEAN Academic Press: Sarawak. 45-59.
- Firdous, F. 2001. Sea Turtle Conservation and Education in Karachi, Pakistan. ASEAN Review of Biodiversity and Environmental Conservation (ARBEC). 1-10.
- Firdous, F. 2005. Turtles Conservation and Education in Karachi, Pakistan. (Unpublished report). 1-8.
- Firdous, F. 2009. Conservation of Marine Turtles at Sandspit and Hawkesbay, Karachi. Proc. Sem. Trans-boundary coastal and Marine Protected Areas with special priorities for Spawning grounds, Karachi, Zool. Sur. Dept. and Min. of Env. Govt. of Pakistan. 61-66.
- Firdous, F. 2015. Marine Turtle Conservation in Pakistan with special reference to measures taken by Sindh Wildlife Department. In: Anonymous Proceedings of the Regional Symposium on sea Turtle Conservation in Asia 24-25 March, 2015 Karachi, Pakistan. IUCN, Karachi, Pakistan. 94-104.
- Firdous, F., Barkati, S. and Rehman, S. 2010. Studies on nesting and Tagging of two species of turtles of Karachi coast. Pak. Jour. of Oceanography. 6(1):1-14.
- Fuentes, MPB. and Saba, V. 2016. Impacts and effects of ocean warming on marine turtles. In: Explaining ocean warming: causes, scale, effects, and consequences. Eds. Laffoley, D. and Baxter, JM. IUCN, Gland. 289-302.
- Ghalib, SA. and Zaidi, SSH. 1976. Observations on the Survey and Breeding of Marine Turtle on Karachi Coast. Agricultural Pakistan. 27(1):87-96.
- Ghalib, SA., Rahman, H., Iffat, F. and Hasnain, SA. 1981. A Checklist of Reptiles of Pakistan. Rec. Zool. Surv. Pakistan. 8:37-59.

- Government of Balochistan. 2016. Coastal Development and Fisheries Department. Notification No. SO (COORD) FISH/2-1/2013/3148-54 dated 8 September 2016.
- Government of Sindh. 2016. Livestock and Fisheries Department. Notification No.5 (3) SO(FISH)/L&F 16 dated 18 May 2016.
- Groombridge, B. 1982. The IUCN Amphibia-Reptilia Red Data Book, Part I, Testudines, Crocodylia, Rhynchocephalia. IUCN Gland, Switzerland.
- Groombridge, B. 1987^a. A Preliminary marine turtle survey on the Makran Coast, Baluchistan, Pakistan with notes on birds and mammals. Cambridge: IUCN Conservation Monitoring Centre. (Unpublished Report). pp. 25.
- Groombridge, B. 1987^b. Makran Coast: A newly explored habitat for Marine turtle. WWF-Pakistan Newsletter. 6(2):1-5.
- Groombridge, B. 1988. Marine turtles in Balochistan. Report on an aerial survey (with notes on wetland sites and a proposed marine turtle conservation project). Cambridge: World Conservation Monitoring Centre. (Unpublished Report). pp. 25.
- Groombridge, B. and Iuxmoore, RA. 1989. The Green Turtle & Hawksbill (Reptilia: Cheloniidae): World Status, Exploitation & Trade. Secretariat of the Convention on International Trade in Endangered Species of Wild Fauna & Flora, Lausanne, Switzerland. pp. 601.
- Hamann, M., Fuentes, MMPB., Ban, NC. and Mocellin, VJL. 2013. Climate change and marine turtles. The Biology of Sea Turtles. Eds. Wyneken, J., Lohmann, KJ. and Musick, JA. Book 3. CRC Press, Boca Raton, FL. 353-378.
- Hawkes, LA., Broderick, AC., Godfrey, MH. and Godley, BJ. 2009. Climate change and marine turtles. *Endang. Species Res.* 7:137-154.
- Hossain, MA., Mahfuj, MSE., Rashid, SMA., Miah, MI. and Ahsan, MN. 2013. Present status of conservation and management of sea turtle in Cox's Bazar district, Bangladesh. *Mesopot. J. Mar. Sci.* 28(1):45-60.
- Hughes, TP., Kerry, JT. and Simpson, T. 2018. Large scale bleaching of corals on the Great Barrier Reef. *Ecology* 99:501.
- IUCN. 2010. Guidelines for using the IUCN Red List Categories and Criteria, 8.1. <http://intranet.iucn.org/webfiles/doc/SSC/Redlistguidelines.pdf>. [accessed on Dec 22, 2022].
- IUCN. 2011. IUCN Red List of Threatened Species. Version 2011.1. www.iucnredlist.org. [accessed on Dec 22, 2022].
- IUCN. 2012. Guidelines for application of IUCN Red List Criteria at Regional and National Levels. [Internet]. Version 4.0. IUCN, Gland.
- IUCN-SSC Marine Turtle Specialist Group, 2019. MTSG Annual Regional Report.
- Kabraji, AM. and Firdous, F. 1984. Conservation of turtles, Hawkesbay and Sandspit, Pakistan. World Wildlife Fund Project 1451, WWF International and Sindh Wildlife Management Board. pp. 52.
- Khan, MS. 1999. Herpetology of habitat types of Pakistan. *Pakistan J. Zool.* 31:275-289.
- Khan, MZ. and Ghalib, SA. 2006. Marine Ramsar sites in Pakistan with special reference to biodiversity of Astola Island and Jiwani Coastal Wetland. *Journal of Natural History and Wildlife* 5(1):165-168.
- Khan, MZ. and Ghalib, SA. 2006. Status, distribution and conservation of marine turtles in Pakistan. *Journal of Natural History and Wildlife* 5(2):195-201.
- Khan, MZ., Ghalib, SA. and Hussain, B. 2010. Status and new nesting sites of Sea turtles in Pakistan. *Chelonian Conservation and Biology*. 9:119-123.
- Khan, MZ., Hussain, B., Ghalib, SA., Zehra, A. and Mehmood, N. 2010. Distribution and Population status and environmental impacts on reptiles in Manora, Sandspit and Cape Monze areas of Karachi coast. *Canadian Journal of Pure and Applied Science* 4:1053-1071.
- Khawla Al-Muhannadi, Mehsin Alyafei, Tiffany Claire Delpont and Ali Al Suweidi. 2021. Recent Sea turtle Updates from the Arabian Gulf. *Indian Ocean Turtle Newsletter - Issue 32*.
- Kumar, S. and BC. Choudhury. 2009. Ecology of marine turtles in the Lakshadweep islands of India with a focus on the hawksbill turtle (*Eretmochelys imbricata*). Project report submitted to Wildlife Institute of India, Dehradun, India.
- Lenton, TM., Rockström, J., Gaffney, O., Rahmstorf, S., Richardson, K., Steffen, W. and Schellnhuber, HJ. 2019. Climate tipping points too risky to bet against. *Nature*. 575:592-595.

- Manzoor, U., Khan, MZ. and Iqbal, MA. 2019. Distribution, status and conservation of reptilian fauna in the coastal areas of Karachi with special reference to marine turtles. *J. Anim. Plant Sci.* 29:1748-1760.
- Marinelife Alliance. 2015. Annual Report: Community based Sea turtle restoration program in Bangladesh, Period 2014-15. Sea Turtle Program-Bangladesh, Marinelife Alliance. pp. 33.
- Marinelife Alliance. 2019. Annual Report: Community based Sea turtle restoration program in Bangladesh, Period 2018-19. Sea Turtle Program-Bangladesh, Marinelife Alliance. pp. 69.
- MFF Pakistan, 2018. Astola Island-First Marine Protected Area in Pakistan. MFF Pakistan. pp. 92.
- MFF Pakistan. 2016. A Handbook on Pakistan's Coastal and Marine Resources.
- Miller, JD. and Abdulqader, EAA. 2009. Marine reptiles of Bahrain. In: Marine Atlas of Bahrain. Eds. Loughland, R. A. and Zainal, AJM. GEOMATEC Bahrain Centre for Studies and Research, Bahrain. pp. 384.
- Ministry of Tourism. 2023. Turtle Watching in Oman. Ministry of Tourism, Sultanate of Oman. www.tourismoman.com.au/news/turtle-watching-in-oman [accessed on Jan 3, 2023].
- Moazzam, M. 2019. Crew based observer program of WWF-Pakistan-A source of data collection on cetacean bycatch. IWC Scientific Committee Meeting- The Subcommittee on (Unintentional) Human Induced Mortality (HIM). SC/68A/HIM/12-International Whaling Commission. pp. 15.
- Moazzam, M. and Khan, MF. 2019. Issues related to adoptions of surface gillnetting to reduce bycatch in Pakistan. IOTC Working Party on Ecosystem and Bycatch. WPEB 15 La Reunion, France September 3-7, 2019. IOTC-2019-WPEB 15-48. 13p (IOTC-2019-WPEB 15-48pdf).
- Moazzam, M. and Nawaz, R. 2014. By-catch of tuna gillnet fisheries of Pakistan: A serious threat to non-target, endangered and threatened species. *J. Mar. Biol. Ass. India*, 56:85-90.
- Moazzam, M. and Nawaz, R. 2015. Turtle mortality in fishing operations in Pakistan. In. Anonymous (ed.) Proceedings of the Regional Symposium on Sea Turtle Conservation in Asia 24-25 March 2015, Karachi, Pakistan. IUCN, Karachi, Pakistan. 52-65.
- Moazzam, M. and Nawaz, R. 2017/2019. Occurrence and distribution of Leatherback turtle (*Dermochelys coriacea*) in the coastal and off shore waters of Pakistan. *Rec. Zool. Surv. Pakistan*. 23:4-8.
- Moazzam, M. and Nawaz, R. 2019. Distribution and abundance of Hawksbill turtle (*Eretmochelys imbricata* Ruppell, 1835) from Pakistan. *International Biology and Biotechnology*. 16:983-990.
- Moazzam, M., Ahmad, S. and Nabi, G. 2021. Fuel Smuggling: An Emerging Threat For Green Turtles at Daran Beach, Pakistan. *The Indian Ocean Turtle Newsletter*. 34:7-10.
- Moazzam, MK. and Nawaz, R. 2016. Bycatch of commercially important species of the tuna gillnet fisheries of Pakistan. IOTC-2016-WPEB12-40. 1-16. (IOTC-2016-WPEB12-40_Pakistan.pdf).
- Mobaraki, A. 2004. Green sea turtle nesting on the Gulf of Oman Coastline of the I.R. Iran. *Marine turtle newsletter*. 104.
- Mobaraki, Asghar. 2006. Sea Turtle Study and situation in Iran, Marine Conservation Forum, WWF, EWS, Abu Dhabi, UAE.
- Mostafavi, Hossein, Kiabi, B., Liagati, H., Abdoli, A. *et al.* 2010. Management plan of Kharkoo wildlife refuge, Shahid Beheshti University/ Department of Environment, Iran. pp. 162.
- Namboothri, N., Swaminathan, A. and Shanker, K. 2015. Olive ridley mass-nesting at Cuthbert Bay wildlife sanctuary, Middl.
- Newson, SE., Mendes, S., Crick, HQP., Dulvy, NK. *et al.* 2009. Indicators of the impact of climate change on migratory species. *Endang Species Res.* 7:101-113.
- Patrício, AR., Hawkes, LA., Monsinjons, JR., Godley, BJ. and Fuentes, MMPB. 2020. Climate change and marine turtles: recent advances and future directions (Review). *Endang. Species Res.* 44:363-395.
- Pecl, GT., Araújo, MB., Bell, JD., Blanchard, J. *et al.* 2017. Biodiversity redistribution under climate change: Impacts on ecosystems and human well-being. *Science*. 355:9214.
- Phillott AD. and Godfrey, MH. 2020. Assessing the evidence of 'infertile' sea turtle eggs. *Endang Species Res.* 41:329-338.
- Phillott, AD. and Rees, AF. (Eds.). 2019. Sea Turtles in the Middle East and South Asia Region: MTSG Annual

- Regional Report 2019. Report of the IUCN-SSC Marine Turtle Specialist Group.
- Pilcher, NJ., Antonopoulou, M., Perry, L., Abdel-Moati, MA., Al Abdessalaam, TZ., Albeldawi, M. and Willson, A. 2014. Identification of important sea turtle areas (ITAs) for Hawksbill turtles in the Arabian region. *Journal of Experimental Marine Biology and Ecology*. 460:89-99. <https://doi.org/10.1016/j.jembe.2014.06.009>.
- Poloczanska, ES., Burrows MT., Brown CJ., García Molinos, J. *et al.* 2016. Responses of marine organisms to climate change across oceans. *Front Mar. Sci.* 3:62.
- Poloczanska, ES., Limpus, CJ. and Hays, GC. 2009. Vulnerability of marine turtles to climate change. *Adv. Mar. Biol.* 56:151-211.
- Rahman, MAA., Rusli, MU., Mohd, NA., Rusli, HM. and Talaat, WIA. 2018. An appraisal of the Malaysian legal framework in conserving the marine endangered species. *Journal of Sustainability Science and Management* 13: 217-224.
- Rashid, SMA. and Islam, MZ. 2005. Status and conservation of marine turtles in Bangladesh. In: *Marine Turtles of the Indian Subcontinent*. Eds. Shanker, K. and Choudhury, BC. Universities Press, Hyderabad, India. 200-216.
- Rees, AF., Al Hafez, Ali, Lloyd, JR., Papathanasopoulou, N. and Godley, BJ. 2013. Green turtles, *Chelonia mydas*, in Kuwait: Nesting and Movements. *Chelonian Conservation and Biology*. 12(1):157-163.
- Rees, AF., and Baker, SL. 2006. Hawksbill and Olive Ridley Nesting on Masirah Island, Sultanate of Oman: an Update. *Marine Turtle Newsletter*. 113:2-5.
- Rees, AF., Kiyumi, A., Al, Papathanasopoulou, N. and Godley, BJ. 2018. The Masirah turtle conservation project: the first turtle tracking on Masirah Island, Oman. *Indian Ocean Turtle Newsletter*. (28):12-15.
- Rees, AF., Papathanasopoulou, N. and Godley, BJ. 2018. Satellite tracking of sea turtles in Kuwait: findings and further research needs. *Indian Ocean Turtle Newsletter* 28:23-26.
- Ross, JP. 1985. Biology of the Green Turtle, *Chelonia mydas*, on an Arabian Feeding Ground. *Society for the Study of Amphibians and Reptiles*. 19(4):459-468.
- Ross, JP. and Barwani, MA. 1982. Review of Sea Turtles in the Arabian Area. *World Conference on Sea Turtle Conservation (1979)*. Washington, DC, USA. 373-383.
- Shanker, K. and Choudhury, BC (Editors). 2006. *Marine turtles of the Indian subcontinent*. Universities Press, Hyderabad. India.
- Sunderraj, SFW., Joshua, J., Brahmabhatt, L., Saravanakumar, A., Muthuraman, B. and Das, SK. 2006. The status of sea turtle populations on the Gujarat coast. In: *Monitoring and znetworking for sea turtle conservation in India: A UNEP CMS Project Report*.
- Swaminathan, A., Namboothri, N. and Shanker, K. 2017. The Indian Ocean is my swimming pool: Leatherback turtles of the Andaman and Nicobar Islands. Poster presentation at the International Sea Turtle Symposium, Las Vegas, USA.
- Swaminathan, A., Thesorow, S., Watha, S., Manoharakrishnan, M., Namboothri, N. and Chandi, M. 2017. Current status and distribution of threatened leatherback turtles and their nesting beaches in the Nicobar group of islands. *Indian Ocean Turtle Newsletter*. 26:12-18.
- Tolen, N. and Rusli, MU. 2021. Slaughtered Green Turtles (*Chelonia mydas*) Stranded on the coast of Terengganu, Malaysia, Highlights The Need For Greater Educational Awareness Within Local Communities. *The Indian Ocean Turtle Newsletter*. 34:10-13.
- Tripathy, B., Choudhury, BC. and Shanker, K. 2002. Marine turtles of Lakshadweep islands, India. *Kachhapa*. 7:3-7.
- UNESCAP. 1996. *Coastal Environmental Management Plan for Pakistan*.
- Uzma, M., Moazzam, M., Zubair, S., Khan, MZ. and Hussain, B. 2022. A Review: Distribution, status and conservation of Marine turtles in coastal areas of Pakistan. *Canadian Journal of Pure and Applied Sciences* 16:5403-5417.
- Wallace, BP., Stacy, BA., Cuevas, E., Holyoake, C., Lara, PH., Marcondes, ACJ., Miller. *et al.* 2020. Oil spills and sea turtles: Documented effects and considerations for response and assessment efforts. *Endangered Species Research*. 41:17-37.
- Walther, GR. 2010. Community and ecosystem responses to recent climate change. *Philos. Trans. R. Soc. B*. 365: 2019-2024.
- WWF Pakistan. 2004. *Dam Right: Rivers at risk*. WWF Dams Initiatives. WWF International: Gland, Switzerland (<http://internet.panda.org/data/downloads/10060/riversatri skfinalfullreport.pdf>).

WWF Pakistan. 2006. Mangrove Ecosystem of Pakistan.
pp. 4.

WWF. 2023. Global distribution of Marine Turtles.
<https://www.worldwildlife.org/species/sea-turtle>.
[accessed on Dec 22, 2022].

Received: Dec 29, 2022; Revised: Jan 24, 2023;
Accepted: Feb 1, 2023

Copyright©2023, Uzma *et al.* This is an open access article distributed under the Creative Commons Attribution Non Commercial License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

