

**Template for Submission of Scientific Information
to Describe Areas Meeting Scientific Criteria for
Ecologically or Biologically Significant Marine Areas**

Title/Name of the area: Sandspit/Hawks Bay and the adjoining areas including the backwaters

Presented by: Umair Shahid, WWF-Pakistan, North Indian Ocean Coordinator,
ushahid@wwf.org.pk

Abstract (*in less than 150 words*)

Sandspit and Hawks Bay beaches and the adjoining areas including the backwaters (adjoining areas herein referred to as 'backwaters') provide excellent habitats for a thriving ecosystem. The adjacent areas comprise of a dense mangrove forest which provides a highly productive environment conducive for sustaining the diversity in the area. The area is a complex of coastal wetlands and contains shallow tidal lagoons, intertidal mudflats, saltpans, estuaries, saline pond, mangrove swamps and sandy beach that provides excellent habitat for sea turtle nesting. The backwaters provide habitat for vertebrate and invertebrate species, both pelagic and benthic communities form association and is considered an important spawning ground. Unique populations of hydrozoans, copepods, amphipods are also found here. With the presence of abundant forage fish, crabs, shrimps, fishes, and migratory birds, the backwaters and the coastal waters of Sandspit/Hawks bay area offer important feeding area for a number of cetaceans including humpback dolphins, common dolphins and finless porpoise.

Introduction

(To include: feature type(s) presented, geographic description, depth range, oceanography, general information data reported, availability of models)

Together the Sandspit and Hawks Bay beaches and the adjoining areas including the backwaters (adjoining areas herein referred to as ‘backwaters’) provide excellent habitats for a thriving ecosystem. Sandspit lies about 18 Km south-west of Karachi city. It is one of the prime recreational sites for the citizens of Karachi. The area is a complex of coastal wetlands and contains shallow tidal lagoons, intertidal mudflats, saltpans, estuaries, saline pond, mangrove swamps and sandy beach. The western part is open sandy beach extending for about 10 Km. The Lyari river feeds the backwaters from the eastern side and sea water enters from the south as well as from Karachi harbor. A GIS based land cover classification identified the extent of different classes in Sandspit, as Water, 182; Sparse Mangroves, 93; Dense Mangroves, 307; Tidal Mud Flats, 77; Terrestrial Vegetation, 15 and Dry Land, 106 (Source: *GIS Laboratory, WWF – Pakistan*) (WWF-Pakistan, 2004). The area has significant ecological and biodiversity value. The adjacent areas comprise of a dense mangrove forest which provides a highly productive environment conducive for sustaining the diversity in the area. The area is rich in upwelling and nutrient cycling. Mangrove forest provides good feeding, sheltering and breeding ground for many species of birds. The mangrove forest at Sandspit is equally important as it provides a representative wetland ecosystem close to the city. There is only one species of mangrove in the backwaters at Sandspit viz. *Avicennia marina*. About 10 km stretch of the beach facing the Arabian Sea is sandy. The beach is about 100 to 200 meters wide. Sandspit beach is one of the important sites for marine turtle nesting (WWF-Pakistan, 2004). Since including the coastal states exclusive economic zones is up-to the working groups and the coastal state itself to include in the geographical scope of the North-West Indian Ocean and Adjacent Gulf areas, this proposal comprises of the area that is rich in natural resources and supports indigenous communities and is located in the coastal area within 12 nm.

The area is characterized by sand bars that are deposited over the summer seasons with adjoining area including an island known as Manora which forms a peninsula. This is one of the most significant features including beach relics. The climate is arid subtropical with temperatures remaining 30 degree Celsius to 40 degree Celsius in summer and 10 degree to 20 degree Celsius in winter. The saline ponds in the backwater and mudflats are in particular important for economic activities where the local fishing villages collect salt from drying pans. Moreover, they are also important for roosting, feeding and staging of water birds. The pond and the mudflat is frequented by large number of water birds in winter (J. Durrani et al). The area has special significance with regard to the biodiversity. The area inhabits important diversity of vertebrate and invertebrate species, it is assumed that they are attracted by the food from small crustacea, mollusk including oysters, mussels, gastropods, amphipods and copepods (Syed, Najam Khurshid, 2004). Moreover, 114 species of birds, belonging to 14 orders and 38 families were recorded from the area, among which majority were migratory, and 66 winter visitors including vulnerable species (J. Durrani et al, 2004). Ticehurst (1923 – 1924) has given a brief account on the coastal birds of Sindh, based on his work during 1917 – 1920. Ali and Ripley (1968-1974) have given the distribution and status of birds of the Indian subcontinent, but the particular information on the birds of Sandspit-Hawkesbay is lacking. Roberts et al (1988) have worked out the seasonal abundance and occurrence of resident and migratory birds on Karachi coast in general. Hirschfeld *et al.* (1988) have given a brief account of the avifauna of Karachi coast. Khanam and Ahmed (1988) listed the waterbirds of Karachi coast based on their brief four months survey.

The backwaters provide habitat for vertebrate and invertebrate species, both pelagic and benthic communities form association and is considered an important spawning ground. Unique populations of hydrozoans, copepods, amphipods are also found here. Bordering on the northern Arabian Sea, Pakistan has a sizeable maritime zone, influenced by atmospheric force of reversing monsoons. These result in the strong seasonal variability in its oceanographic conditions and thus the Arabian Sea appears be an ideal place to understand link between climatic oscillations and community structure of zooplankton and biodiversity (Q. Kazmi, 2004). Forty sand samples for meiofauna were collected at low and high intertidal areas of two stations 7.5 Km apart i.e. from Sandspit near Kakka village (24°50'24"N,

66°54'24"E). *Acarctia amboinensis* is said to be the most dominant copepod in shelf and slope regions of Pakistan (Haq *et al*, 1973), a conclusion supported by processing of the NASEER samples. During 1998 – 2000 surveys on sandy and backwater mangrove areas were conducted and copepod densities in the mangrove area were lower in pre-monsoon and southwest monsoon seasons and were higher with more harpacticoids found in northeast monsoon seasons (Qureshi and Sultana, 2000). During the survey of free-living marine nematodes in the coastal area of Karachi, Pakistan, two new species of the family Cyatholaimidae were encountered from intertidal zone of the Sandspit beach (Nasira K, Kamran, M.K, Shahina, F, 2007). A new species of the genus *Diodontolaimus*, belonging to the family Leptolaimidae, collected from muddy sediments of Sandspit beach, is also described (Nasira, Shahina and Kamran, 2004)

Moreover, eleven species of Cnidaria collected from Pakistani coastal all of which are new records for Pakistan have been described (N. Moazzam and M. Moazzam). Two colonies growing as epiphyte on brown algae, *Sargassum swartzii*, collected from Sandspit Karachi in January 1987. *Grandidierella trispinosa* sp. nov., the first species of the genus *Grandidierella* Coutiere, 1904 from Pakistan, is described from specimens collected at Sandspit backwater, west of Karachi (H. Bano, and Q.B. Kazmi, 2008). This benthic species is found in the Arabian Sea near Sandspit, Karachi coast, Pakistan, especially on sandy substrates, and no tube was observed in the present material. Sandspit back water is known as a nursery ground of various species and is connected to the Arabian through the Manora Channel. The intertidal area of Sandspit back waters is mostly muddy with some sandy patches (Sultana & Mustaqeem, 2003).

Specimens of a Cubozoan jelly fish *Chiropsalmus buitendijki* belonging to the order Chiropsodida and Chiropsodidae family have been reported and another species a large scyphozoan jellyfish *Catostylus mosaicus* which belongs to the order Rhizostomeae and family Catostylidae were recorded as new records from the area (Q. Tahera, and Q.B. Kazmi, 2006).

With the presence of abundant forage fish, crabs, shrimps and fishes the backwaters and the coastal waters of Sandspit/Hawks bay area offer high productivity. During the regular monthly sampling of *Macrophthalmus (Ventilus) dentipes* Lucas from mangrove area and Sandspit including backwaters showed relatively greater size (Qureshi and Saher, 2011). The supply of food in a mangrove floor for deposit feeder crabs depends on the productivity status of the area which comprise of decomposition rate of leaf litter, tidal action and the sediments characteristic (Twilley et al, 1995, Moura et al 1998). Similarly, there are a number of important feeding areas spread across the sandy beach on the shallow continental shelf leading into the backwaters comprising of many forage fish ending as diet for a number of cetaceans including humpback dolphins, common dolphins and finless porpoise (Collins et al, 2005). The backwaters also support important life cycle processes, in a study out of a total of 38 zooplankton samples, 33 positive hauls yielded 2,979 fish eggs, 28 positive hauls inside the mangrove waters had 2,351 fish eggs, and 5 positive hauls outside the mangrove area gave 628 eggs. 14 per cent of the total fish eggs belonged to *Cynoglossus* sp. The highest number of *Cynoglossus* sp. eggs, 406, representing 17.2 volume of the total fish eggs, were collected from backwaters, only 12 *Cynoglossus* sp eggs, 1.91 volume of the total fish eggs were collected from outside the mangrove waters. The highest monthly occurrence was in May (Khatoon and Hussain, 1998). Other fish records also include *Sardinella sindensis*, *Pomadasys stridens*, *Alepes kleinii*, *A. melanoptera* and *Liza carinata* (Z. Khatoon, R Papernoz and S.M. Hussain 2013).

Two species of marine turtles nest in Pakistan—the olive ridley turtle and the green turtle (Minton 1966, Salm 1976). These turtles are known to nest at Hawksbay–Sandspit, a 20-km beach on the Karachi coast in Sindh (Minton 1966, Ghalib and Zaidi 1976). Kabraji and Firdous (1984) estimated that 6,000 green turtles, and about 200 olive ridley turtles, nest in Hawksbay–Sandspit per year. Green turtles have been afforded legislative protection under a number of treaties and laws (e.g. Navid 1982, Humphrey and Salm 1996, Fleming 2001, Fretey 2001). Among the more globally relevant designations are those of ‘endangered’ by the World Conservation Union (IUCN; Baillie and Groombridge 1996, Hilton-Taylor 2000).

The area also hosts other reptile species and in a study it has been revealed that total 27 reptilian species including 9 lizard species (common tree lizard, spotted barn gecko, yellow bellied common house gecko, Persian house gecko, blotched house gecko, Mediterranean house gecko, blue tail sand lizard, spotted lacerta, and Bengal monitor) have been recorded from the area from 2001 – 2009. 15 snake species (beaked sea snake, Persian sea snake, broad band sea snake, reef sea snake, yellow sea snake, pygmy sea snake, spotted small headed sea snake, pelagic sea snake, spotted viperine sea snake and blotched diadem snake) along with 3 species such as Cliff racer, saw scaled viper and black cobra are recorded from the area (Khan et al 2010)

Location

(Indicate the geographic location of the area/feature. This should include a location map. It should state if the area is within or outside national jurisdiction, or straddling both.)

The area between Cape Mounze and Korangi is characterized by wide surf zones, cliff beaches, sea arch, sea notch and river silt. The prominent geomorphological features of Karachi coast comprise shallow lagoons, sea cliff, sea stacks and terraces, wave cut platform, sea caves and notches. The vegetation in this area is mainly comprised of mangrove forests; however, many salt shrubs and bushes also persist along the coastline which provides an excellent habitat for migratory and resident birds.

Sandspit/Hawkesbay is situated on the southern limits of Karachi, 15 km south-west of Karachi city. The western part of Sandspit/Hawkesbay is open sandy beach extending for about 10 km. The major turtle nesting area on this beach is about 5.5 km long. The name of Sandspit Beach is derived from the numerous turtle nesting pits. The beach is composed of fine and coarse particles of sand. The eastern part is all sand whereas the western part (Hawkesbay) has some rocky areas. The area experiences an arid sub-tropical climate with temperature remaining high throughout the year. The average annual rainfall is 125 mm, and the mean annual temperature is 32°C. (Map is annexed)

Feature description of the proposed area

(This should include information about the characteristics of the feature to be proposed, e.g. in terms of physical description (water column feature, benthic feature, or both), biological communities, role in ecosystem function, and then refer to the data/information that is available to support the proposal and whether models are available in the absence of data. This needs to be supported where possible with maps, models, reference to analysis, or the level of research in the area)

The Sandspit/Hawksbay and adjoining areas i.e. the backwaters play an important role in defining the ecology of the area. The water temperature of Sandspit ranged from 21 to 30°C with an average of 26.1°C, from 20.0 to 33°C. The pH values ranged from 7.15 to 7.98 with an average of 7.84 at Sandspit (Barkati and Rehman, 2005). In a study by Nuzhat Ibrahim (1992) it is revealed that Sandspit area has coarse sand particles with exchange of sand being spit by the sea at regular interval changing the course and enabling it to be more productive. This productive sand beach helps Green turtle nesting and hatching take which place all through the year, with peak nesting in November, this is just before winter – when high tides, rain and low temperatures are common – and a great number of eggs perish in the conditions. Thus, it is the eggs laid in August, September and October which stand the greatest chance of survival as they incubate in ideal conditions of temperature and humidity; these eggs hatch in September, October and November (Kabiraji and Firdous, 1984). Moreover, tagging of turtles has also been employed to study the pattern of growth, migratory route, nesting and feeding grounds, breeding frequency, homing instinct, with use of tagging turtles was introduced by Professor A. Carr in mid-1950's (Bustard, 1972). From 1982 – 1997 tagging of two species of marine turtles (green and olive ridley) was employed for the first time in Pakistan on the Sandspit area (Firdous et al).

Kabiraji and Firdous (1984) carried out opportunistic studies of the food and feeding habits of marine turtles. Dead turtles found washed up on the shore were dissected and the stomach contents examined to determine diet. Seaweed growing along the rocky parts of the shoreline

and washed up on the sandy beaches was collected and identified. Gut contents included phytoplankton (*Dinophysis miles*, *Dinophysis* spp., *Centroceros* spp.), helminths (only developmental stages of some species), molluscan shells (broken), crabs (broken pieces), and red algae (found in the mouth). Potential turtle food found along the rocky coves and beaches of Hawksbay and Sandspit were *Caulerpa* spp. (green algae), *Sargassum* spp. (brown algae), *Gracilaria* spp. and *Gelidium* spp. (red algae), crustaceans, sponges, jellyfish and molluscs. Divers have reported seeing green turtles grazing on seaweed off rocks. Such reports coupled with the evidence of gut contents strongly suggest that suitable feeding grounds exist along the coast. A hatchery was developed to protect eggs and hatchlings and in recent years has released upto 30,000 hatchlings each season. Hatching success in the hatchery averages about 40 per cent and is quite variable (Firdous 1988).

WWF-Pakistan has also worked on marine turtle conservation and it has been proposed in many forums for improved management for turtle nesting area.

WWF-Pakistan established Wetland Center also provides protection and monitoring of flagship species including the sightings of dolphins and whales in the area, however, humpback dolphins can be easily sighted during winters by standing on the sandspit area beach (images annexed). There is little information available on the numbers of dolphins visiting the area, however (Collins et al, 2005) has identified dead specimens in the area.

Monitoring of both inland, pelagic and track surveys confirm many avian species (J. Durrani et al) and during regular bird watching trips have recorded more than 30 species (unpublished data, WWF-Pakistan).

Discolouration of sands and other marine substrata caused by benthic diatoms have been reported by Aleem (1950) Eaton and Moss (1966), Riznyk (1973), ReyesVasques (1975), Sullivan (1980), Maple (1983), Navarro (1983) and Wah and Wee (1988). However, this is for the first time that such a phenomenon is being reported from a mangrove habitat of Karachi. It was caused by a pennate diatom *Navicula cancellata* Donkin. The diatoms were collected from Sandspit, near Karachi (Lat.24°45'N, Long. 66°58'E) on three different

occasions, that is, 22.1.91, 9.2.91 and 10.3.91. The area represents backwaters of Karachi harbour and is populated with dense growth of mangroves (F. Chagtai, and S.M. Saifullah, 1992).

Feature condition and future outlook of the proposed area

(Description of the current condition of the area – is this static, declining, improving, what are the particular vulnerabilities? Any planned research/programmes/investigations?)

Long terms study (1981 to 1997) of the distribution of nesting incidences of these turtles show a decreasing trends in the number of egg laying females recorded at Sandspit for both *C. mydas* and *L. olivacea*; this can be attributed anthropogenic impacts like pollution and degradation of habitat. Moreover, there is considerable evidence of marine turtle by catch in tuna gillnet fisheries (WWF-Pakistan, 2012). Moreover, the focus of the research relies heavily on success from awareness raising activities and involvement of community or developing a participatory approach to manage sea turtle habitats for nesting. The long-term effects of pollution on the nesting populations have also been determined by WWF-Pakistan and reported in many studies undertaken on the coast of Pakistan. Similarly, the Sindh Wildlife Department, WWF-Pakistan, IUCN-Pakistan and many other organizations have conducted tagging and satellite tracking studies, assisted in the implementation of turtle excluder devices (TEDs) on shrimp trawlers, and generated a GIS report on green turtle nesting habitats¹ At present WWF-Pakistan is responsible for spearheading sea turtle conservation efforts in the region.

¹ Status and new nesting sites of sea turtles in Pakistan, M. Zaheer Khan, Syed Ali Ghalib, and Babur Hussain accessed from (<http://www.chelonianjournals.org/doi/abs/10.2744/CCB-0767.1>) on 9 February 2015 at 1200 hours
Conservation of Green turtle (*Chelonia mydas*) at Daran Beach, Jiwani Baluchistan, WWF-Pakistan (downloaded from ([http://www.zsp.com.pk/85-90%20\(14\)%20PJZ-167-09.pdf](http://www.zsp.com.pk/85-90%20(14)%20PJZ-167-09.pdf)) on 9 February 2015 at 1205 hours.
GIS Mapping of Karachi coast and GIS based analysis of marine turtle habitat: Sandspit/Hawksbay Eco-system 2009 (Shehri-Citizens for a Better Environment) report downloaded from www.shehri.org on 17 November 2014.

Climate change poses a serious threat to sea turtles as their terrestrial reproductive phase is only successful within a limited range of environmental and physical conditions. These conditions are likely to become less optimal as climate change progresses. To date, management and conservation of sea turtles has focused almost entirely on non-climate stressors, due at least in part to practitioners not knowing what strategies to take and the feasibility and risks of potential strategies. To aid the management of sea turtles in a changing environment, research (U. Shahid et al, work in progress) aims to focus on habitat changes and nesting conditions with reference to green turtle populations. It is a common fact that beaches are naturally dynamic and can change considerably over time. Sand is added and taken away all the time and a beach may disappear and return over a few months, depending on the frequency of cyclones or tides that remove large quantities of sand. Loss of beach area may happen when there is not enough sand available to replace sand lost to the sea. Changes in sand availability can happen due to the construction of structures that affect the movement of sediment, such as groynes, sea walls, ports etc or due to sediment input into coastal systems e.g. from changes in land use. As sea level rises, many beaches will naturally shift landwards and reconfigure so they do not lose any area. In other places where the natural movement is prevented by walls, buildings behind the beach, sea level rise will lead to narrower beaches.

There are several pressures on the natural resources of the area and they have been identified in the map annexed in this proposal.

Assessment of the area against CBD EBSA Criteria

(Discuss the area in relation to each of the CBD criteria and relate the best available science. Note that a proposed area for EBSA description may qualify on the basis of one or more of the criteria, and that the polygons of the EBSA need not be defined with exact precision. And modeling may be used to estimate the presence of EBSA attributes. Please note where there are significant information gaps)

CBD EBSA Criteria	Description (Annex I to decision IX/20)	Ranking of criterion relevance (please mark one column with an
--------------------------	---	--

Title

10

(Annex I to decision IX/20)		X)			
		No information	Low	Medium	High
Uniqueness or rarity	Area contains either (i) unique (“the only one of its kind”), rare (occurs only in few locations) or endemic species, populations or communities, and/or (ii) unique, rare or distinct, habitats or ecosystems; and/or (iii) unique or unusual geomorphological or oceanographic features.			X	
<i>Explanation for ranking</i> Together the Sandspit and Hawks Bay beaches and the adjoining areas including the backwaters (adjoining areas herein referred to as ‘backwaters’) provide excellent habitats for a thriving ecosystem. Sandspit beach is one of the important sites for marine turtle nesting (WWF-Pakistan, 2004). Kabraji and Firdous (1984) estimated that 6,000 green turtles, and about 200 olive ridley turtles, nest in Hawksbay–Sandspit per year. A hatchery was developed to protect eggs and hatchlings and in recent years has released upto 30,000 hatchlings each season. Hatching success in the hatchery averages about 40 per cent and is quite variable (Firdous 1988). A new species of the genus <i>Diodontolaimus</i>, belonging to the family Leptolaimidae, collected from muddy sediments of Sandspit beach, is also described (Nasira, Shahina and Kamran, 2004)					

Specimens of a Cubozoan jelly fish <i>Chiropsalmus buitendijki</i> belonging to the order Chirodropida and Chirodropidae family have been reported and another species a large scyphozoan jellyfish <i>Catostylus mosaicus</i> which belongs to the order Rhizostomeae and family Catostylidae were recorded as new records from the area (Q. Tahera, and Q.B. Kazmi, 2006).					
Special importance for life-history stages of species	Areas that are required for a population to survive and thrive.			X	
<i>Explanation for ranking</i> The area has special significance with regard to the biodiversity. The area inhabits important diversity of vertebrate and invertebrate species, it is assumed that they are attracted by the food from small crustacea, mollusk including oysters, mussels, gastropods, amphipods and copepods (Syed, Najam Khurshid, 2004). Moreover, 114 species of birds, belonging to 14 orders and 38 families were recorded from the area, among which majority were migratory, and 66 winter visitors including vulnerable species (J. Durrani et al, 2004).					
Importance for threatened, endangered or declining species and/or habitats	Area containing habitat for the survival and recovery of endangered, threatened, declining species or area with significant assemblages of such species.				X
<i>Explanation for ranking</i>					

Green turtles have been afforded legislative protection under a number of treaties and laws (e.g. Navid 1982, Humphrey and Salm 1996, Fleming 2001, Fretey 2001). Among the more globally relevant designations are those of ‘endangered’ by the World Conservation Union (IUCN; Baillie and Groombridge 1996, Hilton-Taylor 2000).					
Vulnerability, fragility, sensitivity, or slow recovery	Areas that contain a relatively high proportion of sensitive habitats, biotopes or species that are functionally fragile (highly susceptible to degradation or depletion by human activity or by natural events) or with slow recovery.		X		
<i>Explanation for ranking</i>					
Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.			X	
<i>Explanation for ranking</i>					
During the regular monthly sampling of <i>Macrophthalmus (Ventilus) dentipes</i> Lucas from mangrove area and Sandspit including backwaters showed relatively greater size (Qureshi and Saher, 2011)					
Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.				X

Explanation for ranking

The area also hosts other reptile species and in a study it has been revealed that total 27 reptilian species including 9 lizard species, 15 snake species along with 3 species such as Cliff racer, saw scaled viper and black cobra are recorded from the area (Khan et al 2010)

Moreover, 114 species of birds, belonging to 14 orders and 38 families were recorded from the area, among which majority were migratory, and 66 winter visitors including vulnerable species (J. Durrani et al, 2004).

Kabraji and Firdous (1984) estimated that 6,000 green turtles, and about 200 olive ridley turtles, nest in Hawksbay–Sandspit per year. A hatchery was developed to protect eggs and hatchlings and in recent years has released upto 30,000 hatchlings each season. Hatching success in the hatchery averages about 40 per cent and is quite variable (Firdous 1988).

A GIS based land cover classification identified the extent of different classes in Sandspit, as Water, 182; Sparse Mangroves, 93; Dense Mangroves, 307; Tidal Mud Flats, 77; Terrestrial Vegetation, 15 and Dry Land, 106 (*Source: GIS Laboratory, WWF – Pakistan*) (WWF-Pakistan, 2004).

Naturalness	Area with a comparatively higher degree of naturalness as a result of the lack of or low level of human-induced disturbance or degradation.		X		
--------------------	---	--	----------	--	--

Explanation for ranking

The area has very low naturalness as the surrounding areas are confined with open access to public with beach huts developed about 50 m from the high tide water mark and in some areas the high tide reaches the boundaries of the beach huts located. The area's back waters are also not open to naturalness as the area exposed to discharge of waste from the lyari river into the back waters.

Sharing experiences and information applying other criteria (Optional)

Other Criteria	Description	Ranking of criterion relevance (please mark one column with an X)			
		Don't Know	Low	Medium	High
Add relevant criteria	NA				
Explanation for ranking					

References

(e.g. relevant documents and publications, including URL where available; relevant data sets, including where these are located; information pertaining to relevant audio/visual material, video, models, etc.)

M. Zaheer Khan, Syed Ali Ghalib, and Babur Hussain; Status and new nesting sites of sea turtles in Pakistan accessed from (<http://www.chelonianjournals.org/doi/abs/10.2744/CCB-0767.1>) on 9 February 2015 at 1200 hours

WWF-Pakistan; Conservation of Green turtle (*Chelonia mydas*) at Daran Beach, Jiواني Baluchistan, (downloaded from ([http://www.zsp.com.pk/85-90%20\(14\)%20PJZ-167-09.pdf](http://www.zsp.com.pk/85-90%20(14)%20PJZ-167-09.pdf)) on 9 February 2015 at 1205 hours.

Shehri-Citizens for a Better Environment; GIS Mapping of Karachi coast and GIS based analysis of marine turtle habitat: Sandspit/Hawksbay Eco-system 2009 (report downloaded from www.shehri.org on 17 November 2014)

Nasira K, Kamran M. K, Shahina F (2007); Two new species of free-living nematodes of the family Cyatholamidae (Nematoda Chromadorida) from Arabian Sea of Pakistan. Pakistan Journal of Nematology 2007 Vol. 25 No.1 pp 91-98.

Khan, M.Z, Babur Hussain, Ghalib S.A, Afsheen Zehra, Nazia Mahmood (2010); Distribution, population status and environmental impacts on reptiles in Manora, Sandspit, Hawkesbay and Cape Monze areas of Karachi coast. Canadian journal of Pure and Applied Sciences 2010 Vol. 4 No. 1 pp 1053-1071.

Nasira K, Shahina F, Kamran M (2005); Description of *Diodontolaimus karachiensis* n sp. (Chromadorida: Leptolaimidae) from Arabian Sea. Pakistan Journal of Nematology 2005 Vol. 23 No.1 pp 115-118.

Samad Mateen, Abbas Ghulam (1999); Population structure of the mullets *Liza subviridis*, *L. carinata* and *Valamugil cunnesius* (Family Mugilidae) from Sandspit backwaters along Karachi coast (Northern Arabian Sea). NISCAIR-CSIR, India

Mustaquim J, Imtiaz R, Sultana R; Population biology and larval morphology of the edible crab (*Scylla serrata*) from Karachi backwaters. Pakistan journal of marine biology Vol. 7.

Qaseem Tahera and Quddusi B. Kazmi (2006); New records of two jellyfish medusa (Cnidaria: Scyphozoa: Catostylidae: Cubozoa: Chirdodpropidae) from Pakistani waters.

Furqana Chaghtai and S.M. Saifullah (1992); First Recorded bloom of *Navicula bory* in a mangrove habitat of Karachi. Pakistan journal of marine sciences Vol.1(2), 1992.

Aleem, AA. 1950. Distribution and ecology of British littoral diatoms. *Journal of Ecology* 38: 75-106.

Eaton, J.W. and B. Moss, 1966. The estimation of numbers and pigment content in epipelagic algal populations. *Limnology and Oceanography* 11: 584-595.

Maple, R.S. 1983. Community structure of diatoms epiphytic on pneumatophores of black mangrove *Avicennia germinans* in Louisiana, U.S.A. salt marsh. *Gulf Research Report* 7: 255-260.

Navarro, J.N. 1983. A survey of marine diatoms of Puerto Rico. VI. Suborder Raphidineae; Family Naviculaceae. *Botanica Marina* 26: 119-136.

Reyes-Vasquez, G. 1975. Diatoms letorales de la Familia Naviculaceae de la Laguna la Restinga, Isla de Margarita, Venezuela *Bol. Inst. Oceanogr. Univ. Oriente* 14: 199-224.

Riznyk, R.Z. 1973. Interstitial diatoms from two tidal flats in Yaquina Estuary, Oregon, U.S.A. *Botanica Marina* 16: 113-138.

Sullivan, M.J. 1980. Taxonomy and community structure of diatoms epiphytic on red and black mangroves and turtle grass in Bikini Harbour. *Bahamas Journal of Phycology* 16 (Suppl.): 43.

Wah, RR and Y.C. Wee. 1988. Diatoms from mangrove environment of Singapore and Southern Peninsular Malaysia. *Botanica Marina* 31: 317-327.

N.A. Qureshi and Z. Ali (2011); Climate Change Biodiversity Pakistan's Scenario. The Journal of Animal and Plant Sciences, 21(2 Suppl.): 2011, Page 358-363.

T. Collins, A Preen, A Willson, G. Braulik, R.M. Baldwin; Finless Porpoise (*Neophocaena phocaenoides*) in waters of Arabia, Iran and Pakistan.

Sohail Barkati and Solaha Rahman (2005); Species Composition and Faunal Diversity at three sites of Sindh Mangroves. *Pakistan Journal of Zoology*, Vol 37(1), pp 17-31, 2005.

SIDDIQUI, P.J.A., MANSOOR, S.N., ZAIB-UN-NISA, HAMEED, S., SHAFIQUE, S., FAROOQ, S., ABDUL AZIZ, R. AND SAEED, S., 2000. Associated fauna and flora of macroalgal puffs inhabiting mangrove strands at Sandspit backwaters, Karachi. *Pakistan J. Mar. Biol.*, 6:43-53

ZAIB-UN-NISA, MANSOOR, S.N. AND SIDDIQUI, P.J.A., 2000. Species diversity of cyanobacteria growing on pneumatophores and in the adjacent surface sediments in the mangrove swamp at Sandspit backwater, Karachi. *Pakistan J. mar. Biol.*, 6: 59-68.

Fahmida Firdous, Sohail Barkati, Solaha Rahman (2010); Studies on nesting and tagging of two species of marine turtles of Karachi coast. *Pakistan journal of Oceanography*, Volume 6(1):1-14, 2010

Hala Bano, Quddusi Bashir Kazmi (2008); *Grandiderella trispinosa*, a new species of amphipod from the Karachi coast, Pakistan (Crustacea: Amphipod: Aoridae). *Turk Journal of Zoology*.

Sultana R and Mustaqim J. (2003); Some physical parameters of the Sandspit backwaters, Karachi coast. *Pakistan journal of science and Industrial Research*. 46:333-343.

Nuzhat Ibrahim, M. J. Muhammed and S.M.S. Zaidi (1992); Texture and compositional variations in beach sands along Karachi coast. Pakistan Journal of Marine Sciences, Vol. 1(2), 87-93, 1992.

Z Ali, F Bibi, A.Q. Mahel, F. Firdous and S.U. Zamaan (2011); Captive breeding practices in Pakistan, A review. The journal of animal and plant sciences, 21(2 Suppl.): 2011, Page:368-371

Minton, S. A., (1966). A contribution to the herpetology of West Pakistan. Bull. Amer. Mus. Hist. 134(2): 31-184.

Mirza, Z. B., (1998). Illustrated handbook of animal biodiversity of Pakistan. Centre for Environmental Research and Conservation, Islamabad, pp. 99.

Mirza, Z. B. and H. Wasiq, (2005). Field guide to birds of Pakistan, pp. 342.

Z. Khatoon, R Papernoz and S.M. Hussain (2014); Length-weight relationships of five fish species collected from Manora Channel and associated backwaters of the northern Arabian Sea. Journal of applied Ichthyology. 30 (2014), 235-238.

Hussain, S. M.; Khatoon, Z., 2004: Skeletal anomalies in fishes collected from Korangi Creek and backwater of Sandspit along the coast of Karachi. Pak. J. Sci. Ind. Res. 47, 462-466.

Hussain, S. M.; Samad, M., 1995: Some physico-chemical parameters of backwaters of Sandspit (Northern Arabian Sea, Pakistan coast). Pak. J. Zool. 27, 191-194

Jahangir Durrane, Syed Ali hasnain and Ejaz Ahmed (2008); Observations on the birds of Sandspit/Hawkesbay coastal wetland complex Karachi coast. Pakistan Journal of zoology, Vol. 40 (4), pp. 229-237, 2008.

WWF-P, 2004. *Mangrove Conservation at Sandspit through Promotion of Sustainable Livelihoods* (October 2002 – December 2003) – Final Report (Unpublished).

Naseem Moazzam and Mohammed Moazzam (2006); On Some Hydroids (Cnidaria) from the coast of Pakistan. *Pakistan Journal of Zoology*, vol 38(3), pp. 225-232.

MAMMEN, T.A., 1963. On a collection of hydroids from south India. I. Athecata. *J. mar. biol. Assoc. India*, 5: 27-61.

MAMMEN, T.A., 1965a. On a collection of hydroids from south India. II. Suborder Thecata (excluding Family Plumulariidae). *J. mar. biol. Assoc. India*, 7: 1-57.

MAMMEN, T.A., 1965b. On a collection of hydroids from south India. III. Family Plumulariidae. *J. mar. biol. Assoc. India*, 7: 291-324.

Zakia Khatoon and S.M. Hussain (1998); Distribution and abundance in the Karachi harbor backwaters of the flatfish *Cynoglossus* sp. eggs with descriptions of developmental stages. *Pakistan journal of marine sciences*. Vol 7(2), 137 – 146.

Sama<J, M. 1995. Age and Growth Patterns of Mugil Popultttions from Bacl<water of sandspit' M' Phil. Thesis. University of Karachi' 1-106'

Quddusi B. Kazmi (2004); Copepods from shore and offshore waters of Pakistan. *Journal of marine science and technology*, Vol. 12. No.4, pp. 223-238.

Qureshi, N.A. and Sultana, R., “Distribution and Abundance of Meiobenthos in Sandspit Backwaters Mangrove Area, Karachi,” *Proc. of the Nat. ONR Symposium on Arabian Sea as Resource of Biological Diversity*, pp. 90-103 (2000).

Naureen Aziz Qureshi and Noor Us Saher (2011); Relative growth and morphological sexual maturity of *Macrophthalmus (Venitus) dentipes* Lucas, in Geurin-Meneville, 1836 from two mangrove areas of Karachi coast. *BIHAREAN BIOLOGIST* 5 (1): pp.56-62

Twilley, R.R. (1985): The exchange of organic carbon on basin mangrove forests in a southwest Florida estuary. *Estuarine Coastal and Shelf Science* 20: 543-57.

Fehmida Firoud (2001); Sea turtle conservation and education in Karachi, Pakistan. *ASEAN Review of Biodiversity and Environmental Conservation (ARBEC)*

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

Balasingham, E., 1965. Conservation of green turtles (*Chelonia mydas*) in Malaya *Malayan Nat.J.* 19: 235-236

Bustard, H.R., 1972. Sea Turtles: Their natural history and conservation. Taplinger Publ. Co., New York. Carr, A.F., 1967. Nat. Hist. Press, New York.

Castroviejo, J., J. Juste, J. Perez Del Val, R. Castelo & R. Gil, 1994. Diversity and status of sea turtle species in the Gulf of Guinea islands. *Biodiversity and Conservation* 3: 828-836.

Castroviejo, J., J. Thomas & J. A. Raga, 1999. Sea Turtles in the South of Bioko Island (*Equatoria*) Guinea).

Firdous, F., 1985. Research and Conservation of Marine Turtle along Karachi Coast. *In Proc. Symp. Endangered Marine Animals and Parks, India.* (E.G. Silas, ed.) Marine Biological Association of India, 1: 280-282.

Firdous, F., 1988. Conservation of Turtles at Sandspit and Hawkes Bay, Karachi". *In Proc. of International Conference on Marine Sciences of the Arabian Sea* (Thompson, M.F. and

N.M. Tirmizi) American Institute of Biological Sciences, Washington, D.C.: 217-222.

Groombridge, B., A.M. Kabraji, & A.L. Rao, 1988. Marine turtles in Baluchistan (Pakistan). *Marine Turtle Newsletter* 42:1-3.

Harrison, T. 1962. Notes on green turtle, *Chelonia mydas*, 2. West Borneo numbers. *Sarawak Museum Journal* 10: 614-23.

Kabraji, A.M. & F.F. Asrar, 1984. Conservation of Turtles at Sandspit & Hawkes Bay, Pakistan. World Wildlife Fund Project 1451. Unpublished Report, WWF International and Sindh Wildlife Management Board: 52 p.

Minton, S. A., 1966. A contribution to the Herpetology of West Pakistan. *Bulletin of the American Museum of Nat. Hist.* 134: 27-184.

Schulz, J.P., 1975. Sea turtles nesting in Surinam. *Neder. Comm. Int. Med.* 23. Sticking Natuur. Surinam (Stinasu).

Syed Najam Khurshid (2004); Ecological studies of waterfowl of Karachi coast, PhD thesis, University of Karachi. (<http://eprints.hec.gov.pk/1378/>) accessed on 14 February 2015 at 1100am.

Maps and Figures

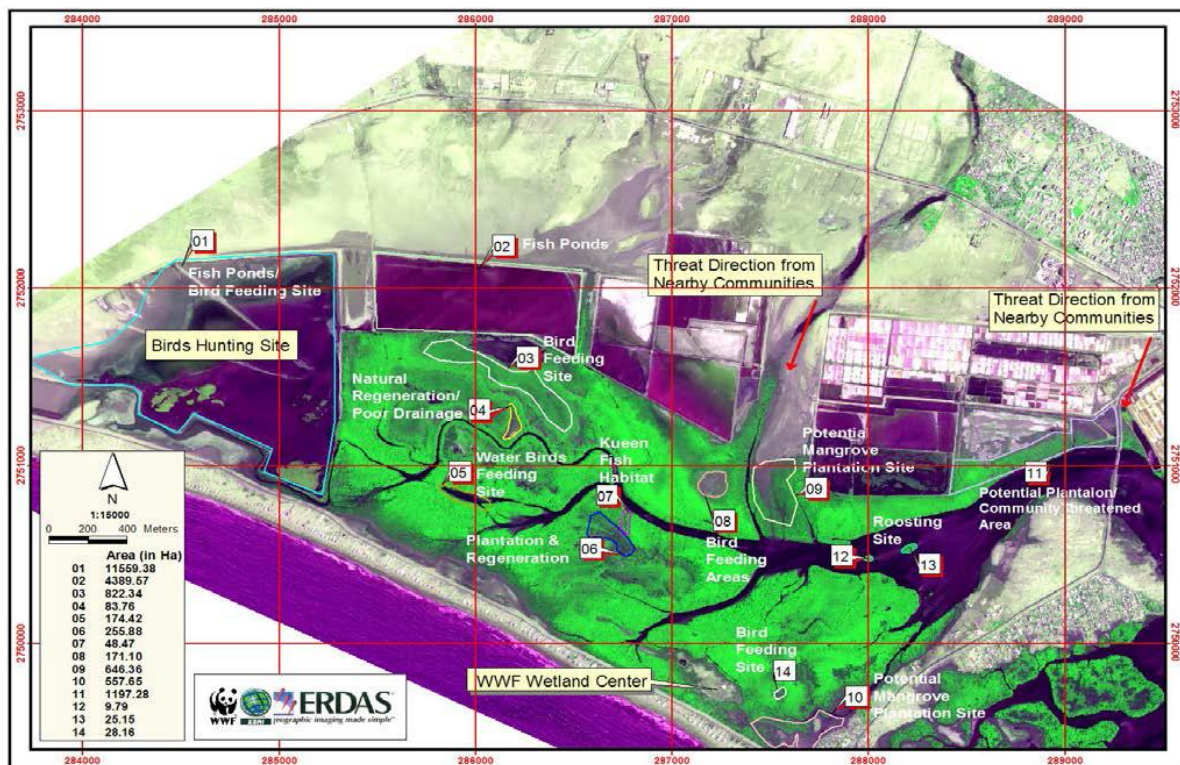




Image 1: Humpback dolphins visible from Sandspit beach

Rights and permissions

(Indicate if there are any known issues with giving permission to share or publish these data and what any conditions of publication might be; provide contact details for a contact person for this issue)

The data provided in this proposal is from published scientific research and any queries maybe directed to WWF-Pakistan office to either Rab Nawaz (Director) at rnawaz@wwf.panda.org.