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

Title/Name of the area: Sonmiani Bay, Baluchistan, Pakistan

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Abstract (*in less than 150 words)*

Miani Hor is a lagoon located on southwestern coast of Balochistan at a distance of 90 Kilometers from Karachi. The average width of this lagoon is 7 kilometers, with a narrow and shallow connection with the open sea. The large sand complex on the east side of the Las Bela Valley, West Pakistan, is thought to have been derived from the nearby mountain ranges rather than from an exposed continental shelf. Sea level changes and Recent tectonism complicate the sequence of events (Snead and Frishman, 1968). The lagoon is of special significance for migratory and resident birds as it has been declared a Ramsar site and is the only habitat in Pakistan where three species of mangroves that is, *Avicenia marina, Rhizophora mucronata and Ceriops tagal* are found encapsulated by shifting sand dunes. Biological diversity is rich in the area and comprise of fishes, crustaceans, cetaceans and provides economic benefits to the local communities.

Introduction

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

The site is the only area of Pakistan's coast where three species of mangroves,*Avicennia marina*, *Rhizophora mucronata* and *Ceriops tagal*, occur naturally. The site is an important staging and wintering area for migratory shorebirds, flamingos and pelicans. Large flocks of little ringed plovers, sanderlings, curlew sandpipers, Caspian terns, herring gulls, lesser blackbacked gulls and slenderbilled gulls have been recorded. Turnstone and osprey are also commonly seen. According to the Asian Water bird Census carried out between 1995-1999, the site supports an average of 22,700 water birds on a regular basis. As many as 50,000 water birds were counted in January 2000.

A large shallow sea bay and estuarine system with several low-lying islands and extensive mangrove swamps and intertidal mudflats, separated from the adjacent Sonmiani Bay in the Arabian Sea by a broad peninsula of sand dunes.

In addition to the mangrove swamps which are situated just off the coast along the numerous creeks and sub-tidal mudflats, there are other types of vegetation, particularly grasses and shrubs along the beach area. Prominent shrubs include*Salsola baryosma, Abutilon indicum*, *Cressa cretica* and *Heliotropium undulatum*. Sparse growth of *Tamarix* spp., *Acacia senegal, A. nilotica, Polycarpa corymbosa, Atriplex griffithsii* can be found inside the coastline in sandy sheltered areas, fed by seasonal rainwater. Occasionally cetaceans are sighted in the area.

The Hor receives freshwater input from a number of seasonal streams rising in the hills of eastern Balochistan to the north. Flash floods are quite common and even moderate to slight rains heavily erode the uncovered hillsides and muddy banks. Considerable silt deposition

occurs along the mouth of these seasonal rivers. Seepage and flood spills of the river system contribute to groundwater recharge of the basin. Climate conditions are arid sub-tropical with very hot summers and mild winters. Average annual rainfall is less than 150 mm.

Most of the area is state owned except a small portion of mangrove forest on the northern side, which is owned by the Forest Department of Balochistan. Local communities have the cutting and utilising rights. Fishing is the main activity throughout the site area. Mangrove stands are also cut in increasing numbers for fuel wood and fodder by the local inhabitants.

Marine protected areas, like any protected area, are regions in which human activity has been placed under some restrictions in the interest of conserving the natural environment, its surrounding waters and the occupant ecosystems, and any cultural or historical resources that may require preservation or management. Marine protected areas' boundaries will include some area of ocean, even if it is only a small fraction of the total area of the territory. Natural or historic marine resources are protected by local, state, territorial, native, regional, or national authorities and may differ substantially from nation to nation. This variation includes different limitations on development, fishing practices, fishing seasons and catch limits, moorings, bans on removing or disrupting marine life of any kind. In some situations MPAs also provide revenue for countries, often of equal size as the income that they would have if they were to grant companies permissions to fish.

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.)

Miani Hor or Sonmiani Bay is situated at a distance of 90 km, from Karachi on the east Balochistan coast. It comprises of three villages viz. Dam, Sonmiani, Bhira and a settlement called Baloch Goth. Sonmiani constitutes the smallest administrative unit known as Tehsil of the District Lasbela.

These villages are directly dependent on coastal resources, especially fisheries and mangrove forests. The people belong to different tribal groups such as Lasi, Rajput, Khaskheli, Mirbahar, Jumari, Soomra and Zikri Baloch. Families of the same group live in their own mohallas or paras (neighbourhoods). A few Hindu families also live in the area. The main occupations of the local people is fishing (only a few people work for government departments (e.g. fisheries, electricity and education) or are involved in trade. According to Balochistan Fisheries Department Statistics (2003), there are 5,610 fishermen (3,320 fulltime, 1,490 part time and 800 occasional fishermen) in the area (Syed Ali Hasnain 2005).

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)

Miani Hor is a lagoon located on southwestern coast of Balochistan at a distance of 90 Kilometers from Karachi. The average width of this lagoon is 7 kilometers, with a narrow and shallow connection with the open sea. The large sand complex on the east side of the Las Bela Valley, West Pakistan, is thought to have been derived from the nearby mountain ranges rather than from an exposed continental shelf. Sea level changes and Recent tectonism

complicate the sequence of events (Snead and Frishman, 1968). The lagoon is of special significance as it has been declared a Ramsar site and is the only habitat in Pakistan where three species of mangroves that is, *Avicenia marina, Rhizophora mucronata and Ceriops tagal* are found encapsulated by shifting sand dunes. The mangroves at Miani Hor lagoon have been a source of gazing, fuelwood and building material for the coastal dwellers of villages of Sonmiani, Dam and Bhira. Increasing human pressure, lack of awareness and unsustainable harvesting of mangroves had depleted these forests.

Arabian Sea Eco-region which starts from Sonmiani and extend westward to Iran, Oman, Persian Gulf countries Yemen and Somalia is uniquely different from the other parts of the Arabian Sea and Indian Ocean. (See figure 4 and 5).

- Murray Ridge which obliquely cross the Arabian Sea make the area isolated from Eastern Arabian Sea
- The open sea ecosystem is highly dependent on the mesopelagic fishes (dominated by *Benthosema pterotum*). Although less dense concentration is found in other part of the Arabian sea but it consists of many species. *Benthosema pterotum* is estimated to have an stock of about 100 million m. tons making it second largest living resource (after krill) in the world. The main concentration are found along Mekarn Coast (Pakistan), Iran, Oman and Yemen. Pelagic and mesopelagic food chain is dependent on mesopelagic fishes which is not the case in eastern Arabian Sea.
- World most pronounced upwelling takes places in Arabian Sea Eco-region . Upwelling on small scale occurs in other parts of the Arabian Seas, but the scale of upwelling is highest in the Arabian Sea Eco-region making it to the most productive area (in terms of primary productivity) in the world.
- Arabian Sea Eco-region has very little rainfall making it one of the most parched landmass. As compared Eastern Arabian Sea is strongly influenced by monsoon and considered to world heaviest rainfall areas.
- Arabian Sea Eco-region is unique because no large rivers fall in the sea making it comparatively high saline to very high saline sea of the world and its ecology is significantly affected by high salinity.
- The coastal communities are entirely dependent on fisheries as there is no major agriculture in the area. Archaeological studies have confirmed that old civilization of the Arabian Sea Eco-region is mainly dependent on fisheries and oceanic trades because of limited agriculture.
- Arabian Sea Eco-region is a subduction zone along Mekran Coast as the Indian Plate consisting of ocean floor is subducting beneath the continental mass of Arabian Plate. This unique feature is not found on Indian Plate covering eastern Arabian Sea.

Realizing the ecological significance of the area, WWF-Pakistan initiated preliminary survey of mangroves at Sonmiani in collaboration with the Department of Botany, University of Karachi to identify potential sites for rehabilitation and conservation. This was followed by initiation of mangrove conservation activities in 1995. The main focus of these activities was to rehabilitate the degraded areas and to bring the area under local sustainable management.

These are perhaps the earth's greatest natural resource, with life from tiny plankton to huge whales. More than 90% of the living biomass is found in the sea or ocean. The living resource under ocean and sea has not yet been fully explored. The invertebrate fauna include protozoan, coelenterates, annelids, mollusks, crustaceans and echinoderms. Fish, reptiles,

mammals and birds represent the vertebrate fauna in which fish is the major group. Marine flora also 7 shows high diversity. Sonmiani is a bay on Balochistan coast and the total area of the bay is 125.25 sq. km and the shelf adjacent to it is 80 km wide1.

The site is important for large concentration of water birds including migratory and resident population. More than 20,000 birds representing 52 species usually visit Sonmiani/Miani Hor in winters. Greater Flamingo populations nest in the area and their juveniles can be observed. The area is one of the designated Ramsar sites in Pakistan.

Mangrove forest has a great economic and ecological significance. It is the habitat of a diverse community of organisms ranging from bacteria and fungi to fish, shrimps, birds, reptiles and mammals. It provides fuel wood and fodder for domestic animals of the local communities. The mangrove forest in Miani Hor is spread over an area of about 2500 ha, which represents 42% of total cover of mangrove forest in Balochistan. It is the only area in Pakistan where three species of mangroves i.e. Avicennia marina, Ceriops tagal and Rhizophora mucronata grow in natural condition.

Marine fish is the major natural resource of the area, on which the livelihood of the community depends. More than 350 species of fish are known to exist. Marine fishing is an important activity in the area. More than 90% of the population earns an income through fishing or fishing related activities. Shrimping is also carried out in shallow waters and shrimp trawling grounds are located in Miani Hor/ Sonmiani bay. Karachi is the main market of fish and shrimp catch in Miani Hor. The reproductive biology of *Penaeus indicus* H. Milne Edwards, 1837 was studied from the coastal water of Pakistan during the period July 2006 to June 2007 to assist with establishment of minimum permissible capture size for this fishery. This is a first attempt to study ovarian maturation stages and size at sexual maturity of this species that was abundantly collected from Sonmiani Bay. The shrimps were collected from the Damb Bunder, Sonmiani Bay Lagoon locally known as Miani Hor (25° 27' N/ 66° 33' E), which is 95 km from Karachi (Zunaira and Naureen, 2011).

Two species viz, Catostylus mosaicus and Rhizostoma pulmo were found abundantly during March to August with a peak in June–July. The survey revealed the abundance of Catostylus mosaicus over Rhizostoma pulmo. Catostylus mosaicus was being fished at Sonmiani Bay (Balouchistan coast) Gharo Creek, Mirpur Sakro and Keti Bandar (Sindh coast; Indus delta), whereas, Rhizostoma pulmo was fished at Kemari and Keti Bandar (F. Muhammad and R. Sultana, 2008).

Distribution, abundance and biomass of five commercially important families (Ariidae; Sciaenidae; Pomadasyidae (Haemulidae); Serranidae and Lutjanidae) are estimated off Pakistani coastal waters and Shelf area during north east monsoon period. Catch rates and biomass estimates are found to be 12-25% of total biomass in Sonmiani Bay and Sindh region (M. Iqbal, 1993).

Two rare species of xanthid crab (Brachyura: Xanthidae) are reported for the first time in the territorial waters of Pakistan. *Odhnea echinus* and *Paraxanthodes cumatodes* were collected from Sonmiani Bay, on the coast of Pakistan. These species are known from only a few specimens and localities globally (Mendoza et al, 2011).

Molluscan shells are used to make artificial ornaments and many types of decoration pieces. A variety of gastropod and pelecypod shells are available that could be used for making ornaments or decoration pieces. But the locals lack knowledge of proper marketing; values of

these resources, hence these resources are not being utilized at all.

Humpback dolphin and bottle nosed dolphin are commonly observed in the Hor. The people are however unaware of its importance but it could be a source of income if local people are trained to organize dolphin watch trips for tourists/visitors. The proper season for dolphin watch is from October through March.

Considering paucity of the information about diversity of marine life in the area as well as the need for establishing a Marine Protected Area, it was considered important to initiate a study which will enable to document the diversity of marine animals and plants occurring in the area which will form basis for taking further steps for declaring the area as marine protected area so that fragile ecosystem of the area is preserved.

There have been various reports of incidental sightings or strandings. Ahmed and Rizvi (1985) reported a humpback whale caught off Port Qasim on the Sindh coast, as well as records of humpback dolphins (*Sousa plumbea*), long-beaked common dolphins (*Delphinus capensis*) and melon-headed whales (*Peponocephala electra*) off Sonmiani, Balochistan. Ahmad and Ghalib (1975) collated reports of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), Indo-Pacific humpback dolphins, finless porpoises (Gore et al, 2012). A pygmy sperm whale (*K. breviceps*) was reported off Sonmiani (M. Khan and S.H.N. Rizvi, pers. comm). In addition Pilleri and Gihr (1972a; 1972b), on visiting coastal areas to search for cetacean remains, found four finless porpoises, seven humpback dolphins, five common dolphins and a bottlenose dolphin; they also found a vertebra that they suggested belonged to a Cuvier's beaked whale *Ziphius cavirostris* (see Gore *et al.*, 2007b for dicussion). Pilleri and Gihr (1972a, 1973–1974) had records of live porpoises at Gadani, Dahm and Sonmiani, all in Balochistan, and they encountered small groups in the Indus Delta creeks, although by 1979 fewer were being recorded (Pilleri and Pilleri, 1979). Roberts (1997) also noted that finless porpoises were found in mangrove creeks along the Baluchistan coast between September and April, since when a number of other records have been collated by Collins *et al.* (2005). The species has also been reported in neighbouring Oman (Braulik *et al.*, 2010a; Collins *et al.*,2005).

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?)

There is no documented information about diversity of marine life existing in Sonmiani however, scattered information about various groups of marine animals and plants occurring on sandy, muddy and subtidal habitats about some other parts of the coastal areas of Pakistan is available which can be consulted. WWF-Pakistan was involved in survey of marine animals and plants in various areas of Pakistan.

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 (Annex I to	**Description** (Annex I to decision IX/20)	**Ranking of criterion relevance** (please mark one column with an X)

decision IX/20)		**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**

Explanation for ranking

The site is the only area of Pakistan's coast where three species of mangroves,*Avicennia marina*, *Rhizophora mucronata* and *Ceriops tagal*, occur naturally. The site is an important staging and wintering area for migratory shorebirds, flamingos and pelicans. Large flocks of little ringed plovers, sanderlings, curlew sandpipers, Caspian terns, herring gulls, lesser blackbacked gulls and slenderbilled gulls have been recorded. Turnstone and osprey are also commonly seen. According to the Asian Water bird Census carried out between 1995-1999, the site supports an average of 22,700 water birds on a regular basis. As many as 50,000 water birds were counted in January 2000.

Humpback dolphin and bottle nosed dolphin are commonly observed in the Hor. There have been various reports of incidental sightings or strandings. Ahmed and Rizvi (1985) reported a humpback whale caught off Port Qasim on the Sindh coast, as well as records of humpback dolphins (*Sousa plumbea*), long-beaked common dolphins (*Delphinus capensis*) and melon-headed whales (*Peponocephala electra*) off Sonmiani, Balochistan. Ahmad and Ghalib (1975) collated reports of Indo-Pacific bottlenose dolphins (*Tursiops aduncus*), Indo-Pacific humpback dolphins, finless porpoises (Gore et al, 2012). A pygmy sperm whale (*K. breviceps*) was reported off Sonmiani (M. Khan and S.H.N. Rizvi, pers. comm). In addition Pilleri and Gihr (1972a; 1972b), on visiting coastal areas to search for cetacean remains, found four finless porpoises, seven humpback dolphins, five common dolphins and a bottlenose dolphin; they also found a vertebra that they suggested belonged to a Cuvier's beaked whale *Ziphius cavirostris* (see Gore *et al.*, 2007b for dicussion). Pilleri and Gihr (1972a, 1973–1974) had records of live porpoises at Gadani, Dahm and Sonmiani, all in Balochistan, and they encountered small groups in the Indus Delta creeks, although by 1979 fewer were being recorded (Pilleri and Pilleri, 1979). Roberts (1997) also noted that finless porpoises were found in mangrove creeks along the Baluchistan coast between September and April, since when a number of other records have been collated by Collins *et al.* (2005). The species has also been reported in neighbouring Oman (Braulik *et al.*, 2010a; Collins *et al.*,2005).

Special importance for life-history stages of species	Areas that are required for a population to survive and thrive.				**X**

Explanation for ranking

The reproductive biology of *Penaeus indicus* H. Milne Edwards, 1837 was studied from the coastal water of Pakistan during the period July 2006 to June 2007 to assist with establishment of minimum permissible capture size for this fishery. This is a first attempt to study ovarian maturation stages and size at sexual maturity of this species that was abundantly collected from Sonmiani Bay.

Humpback dolphin and bottle nosed dolphin are commonly observed in the Hor.

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.				

Explanation for ranking

The site is important for large concentration of water birds including migratory and resident population. More than 20,000 birds representing 52 species usually visit Sonmiani/Miani Hor in winters. Greater Flamingo populations nest in the area and their juveniles can be observed. The area is one of the designated Ramsar sites in Pakistan.

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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.				

Explanation for ranking

Biological productivity	Area containing species, populations or communities with comparatively higher natural biological productivity.			**X**	

Explanation for ranking

Distribution, abundance and biomass of five commercially important families (Ariidae; Sciaenidae; Pomadasyidae (Haemulidae); Serranidae and Lutjanidae) are estimated off Pakistani coastal waters and Shelf area during north east monsoon period. Catch rates and biomass estimates are found to be 12-25% of total biomass in Sonmiani Bay and Sindh region (M. Iqbal, 1993).

Biological diversity	Area contains comparatively higher diversity of ecosystems, habitats, communities, or species, or has higher genetic diversity.				

Explanation for ranking

Two species viz, Catostylus mosaicus and Rhizostoma pulmo were found abundantly during March to August with a peak in June–July. The survey revealed the abundance of Catostylus mosaicus over Rhizostoma pulmo. Catostylus mosaicus was being fished at Sonmiani Bay (Balouchistan coast) Gharo Creek, Mirpur Sakro and Keti Bandar (Sindh coast; Indus delta), whereas, Rhizostoma pulmo was fished at Kemari and Keti Bandar (F. Muhammad and R. Sultana, 2008).

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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.				
Explanation for ranking					

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**	**Mediu m**	**High**
Add relevant criteria	Economic Importance				**X**
Explanation for ranking More than 350 species of fish are known to exist. Marine fishing is an important activity in the area. More than 90% of the population earns an income through fishing or fishing related activities					

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(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.)

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Maps and Figures

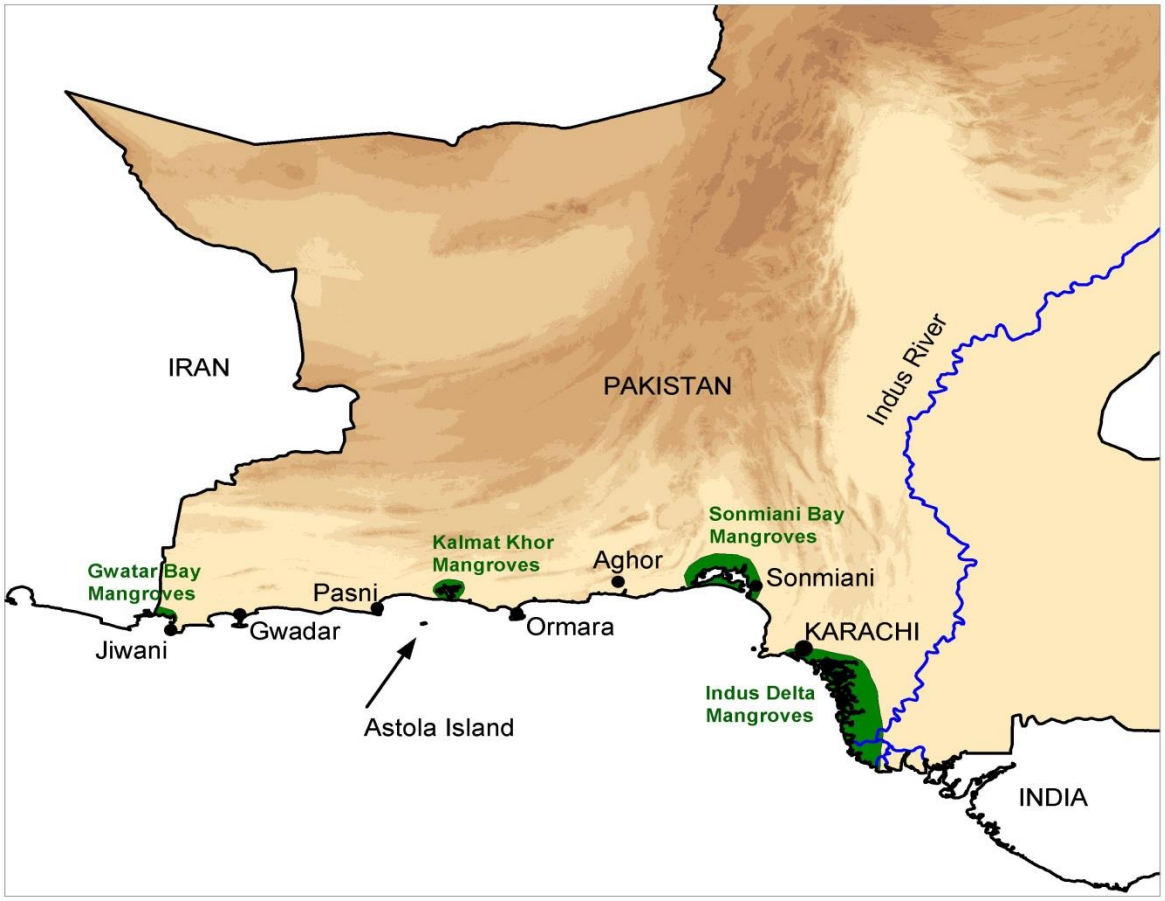


Figure 1: Map of Pakistan showcasing Sonmiani bay as a potential mangrove site

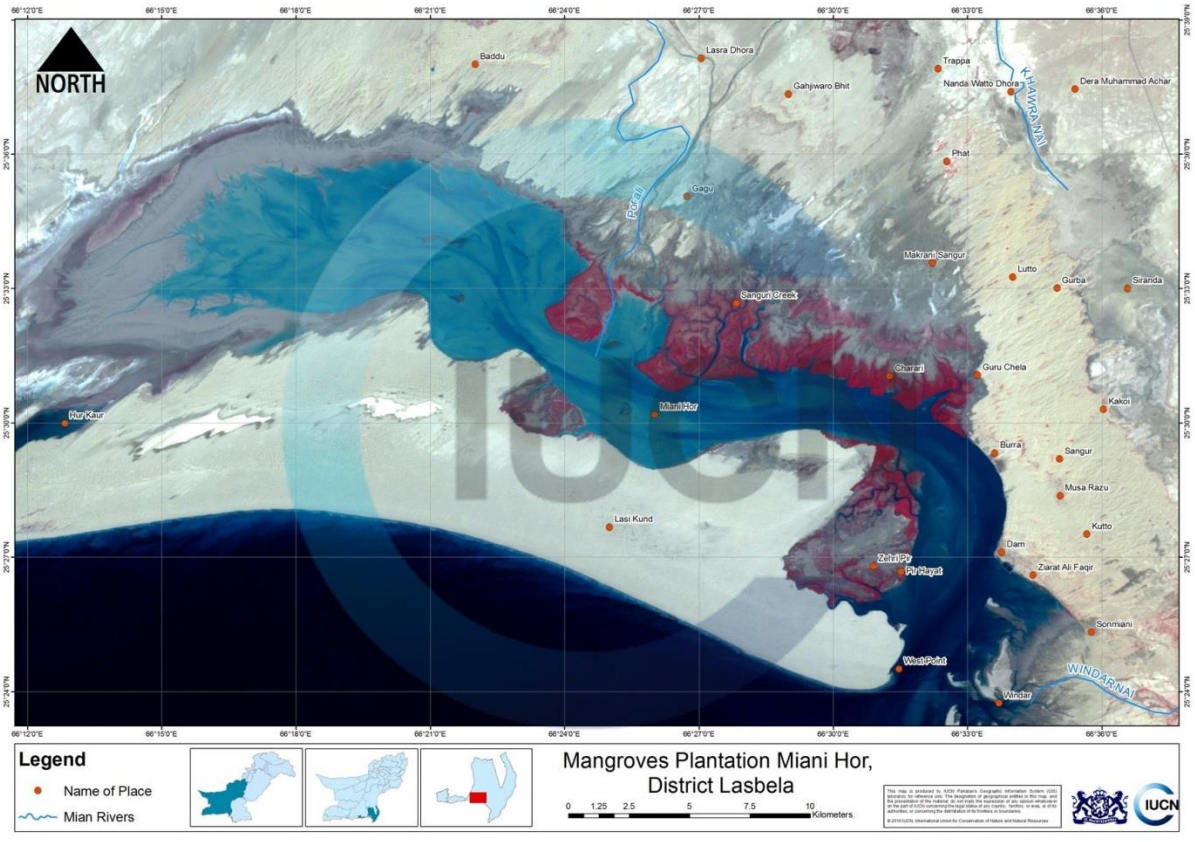


Figure 2: Map of Sonmiani

Figure 3: Biodiversity of Sonmiani Bay

Common name	Family	Scientific name	Refrences	Remarks
Avifauna of Miani Hor (Birds)				
Little Grebe	**Podicipedidae**	***Tachybaptus ruficollis***	***Fayyaz and Husnain 2008***	
Great white Pelecan	**Pelicanidae**	***Pelecanus onocrotalus***	*“*	
		Pelecanus crispus	***Jamshed et al 2012; WWF, Information Sheet on Ramsar Wetlands 2001***	
Large Cormorant	**Phalacrocoracidae**	***Phalacrocorax carbo***	***Fayyaz and Husnain 2008***	
Indian Shag		***Phalacrocorax fuscicollis***	*“*	
Grey Heron	**Ardeidae**	***Ardea cineria***	*“*	
Pond Heron		***Ardeola grayii***	*“*	
Large Egret		***Egretta alba***	*“*	
Median Egret		***Egretta intermedia***	*“*	
Little Egret		***Egretta garzetta***	*“*	
Reef Heron		***Egretta gularis***	*“*	
Spoonbill	**Threskiornithidae**	***Platalea leucorodia***	*“*	
Black headed Ibis		***Threskiornis melanocephalus***	***Jamshed et al 2012***	
Great Flamingo	**Phoenicopteridae**	***Phoenicopterus ruber***	***Jamshed et al 2012; WWF, Information Sheet on Ramsar Wetlands 2001***	
Lesser Flamingo		***Phoenicopterus minor***	***WWF, Information Sheet on Ramsar Wetlands 2001; Jamshed et al 2012***	
Common Crane	**Gruidae**	***Grus grus***	***Fayyaz and Husnain 2008***	
Demoiselle Crane		***Anthropoides virgo***	*“*	
Oysterctcher	**Haematopodidae**	***Haematopus ostralegus***	*“*	
Blackwinged stilt	**Recurvirostridae**	***Himantopus himantopus***	*“*	

Avocet		***Recurvirostra avosetta***	**“**	
Red-wattled Lapwing	**Charadriidae**	***Vanellus indicus***	**“**	
Grey Plover		***Pluvialis squatarola***	**“**	
Ringed Plover		***Charadrius hiaticula***	**“**	***Only mentioned as flamingo***
Little Ringed Plover		***Charadrius dubius***	***WWF, Information Sheet on Ramsar Wetlands 2001, Fayyaz and Husnain 2008***	
Kentish Plover		***Charadrius alexandrinus***	***Fayyaz and Husnain 2008***	
Mongolian plover		***Charadrius mongolus***	**“**	
Great Sand Plover		***Charadius leschenaultii***	**“**	
Black tailed Godwit	**Scolopacidae**	***Limosa limosa***	***“Fayyaz and Husnain 2008 and Jamshed et al 2012***	
Whimbrel		***Numenius phaeopus***	***Fayyaz and Husnain 2008., Jamshed et al 2012***	
Curlew		***Numenius arquta***	**“**	
Common Redshank		***Tringa totanus***	**“**	
Greenshank		***Tringa nebularis***	**“**	
Terek Sandpiper		***Xenus cinerius***	**“**	
Common Sandpiper		***Actitis hypoleucos***	**“**	
Ruddy Turnstone		***Arenaria interpres***	**“**	
Great Knot		***Calidris tenuirostris***	***Fayyaz and Husnain 2008 ; Jamshed et al 2012 and WWF, Information Sheet on Ramsar Wetlands 2001***	
Sanderling		***Calidris alba***	***Fayyaz and Husnain 2008***	
Little Stint		***Calidris minta***	**“**	
Teminck’s Stint		***Calidris temminckii***	**“**	
Dunlin		***Calidris alpina***	**“**	

Curlew Sandpiper		***Calidris ferruginea***	***Fayyaz and Husnain 2008 and WWF, Information Sheet on Ramsar Wetlands 2001***	
Sooty Gull	**Laridae**	***Larus hemprichii***	***Fayyaz and Husnain 2008***	
Herring Gull		***Larus argentatus***	***Fayyaz and Husnain 2008 and WWF, Information Sheet on Ramsar Wetlands 2001***	
Lesser Black backed Gull		***Larus fuscus***	***Fayyaz and Husnain 2008 and WWF, Information Sheet on Ramsar Wetlands 2001***	
Great Black headed Gull		***Larus ichthyaetus***	***Fayyaz and Husnain 2008***	
Black headed Gull		***Larus ridibundus***	***“***	
Slenderbilled Gull		***Larus genei, Chroicocephalus genei***	***Fayyaz and Husnain 2008, WWF, Information Sheet on Ramsar Wetlands 2001***	
Caspian Tern	**Sternidae**	***Hydroprogne caspia***	***Fayyaz and Husnain 2008 and WWF, Information Sheet on Ramsar Wetlands 2001***	
Common Tern		***Sterna hirundo***	***Fayyaz and Husnain 2008***	
Little Tern		***Sterna albifrons***	***“***	
Sandwich tern		***Thalasseus sandvicensis***	***“***	
Black-bellied Tern		***Sterna acuticauda***	***Jamshed et al 2012***	
Black Kite	**Accipitridae**	***Milvus migrans***	***Fayyaz and Husnain 2008***	
Brahminy Kite		***Haliastur indus***	***“***	
Shikra		***Accipiter badius***	***“***	

Common Buzzard		***Buteo buteo***	**“**	
Steppe Eagle		***Aquila rapax***	**“**	
Eygptian Vulture		***Neophron percnopterus***	**“**	
Marsh Harrier		***Circus aeruginosus***	**“**	
Osprey	**Pandionidae**	***Pandion halietus***	**“**	
Peregrine Falcon	**Falconidae**	***Falco peregrinus***	**“**	
Grey Patridge	**Phasianidae**	***Francolinus pondicerianus***	**“**	
Pintailed Sandgrouse	**Pteroclididae**	***Pterocles alchata***	**“**	
Collared Dove	**Columbidae**	***Streptopelia decaocto***	**“**	
White breasted Kingfisher	**Alcedinidae**	***Halcyon smyrnensis***	**“**	
European Bee-eate	**Meropidae**	***Merops orientalis***	**“**	
Crested Lark	**Alaudidae**	***Galerida cristata***	**“**	
Desert Lark		***Ammomanes deserti***	**“**	
Plain Sand Martin	**Hirundinidae**	***Riparia paludicola***	**“**	
Eurasian Barn Swallow		***Hirundo rustica***	**“**	
House Sparrow	**Passeridae**	***Passer domesticus***	**“**	
Common Starling	**Sturnidae**	***Sturnus vulgaris***	**“**	
Black Drongo	**Dicruridae**	***Dicrurus macrocercus***	**“**	
Common Crow	**Corvidae**	***Corvus splendens***	**“**	
Indian Darter (Snake Bird)	**Anhingidae**	***Anhinga melanogaster***	***Jamshed et al 2012***	
Pallas’s Sea Eagle	**Accipitridae**	***Haliaeetus leucorphyus***	**“**	
Fauna of Miani Hor				
Shrimp	**Penaeidae**	***Penaeus indicus Shrimps***	***Zunaira and Naureen 2011***	
Coelenterates		***Scyphozoa,***	***Farzana and kiran 2006***	
		Ephyra sp	**“**	
Annelidas	**Polychaeta(class)**	***Polychaeta worms***	**“**	
	Terebellidae	***Terebellid larvae***	**“**	
	Pectinariidae	***Pectinaria larvae***	**“**	
	Spionidae	***Spinoid larvae***	**“**	
Arthropods	**Mexillopoda(class)**	***Cirripedia***	**“**	
	Artemiidae	***Nauplii***	**“**	
	Euphausiidae	***Euphausiid-larvae***	**“**	
	Caridea(order)	***Caridean-larvae***	**“**	

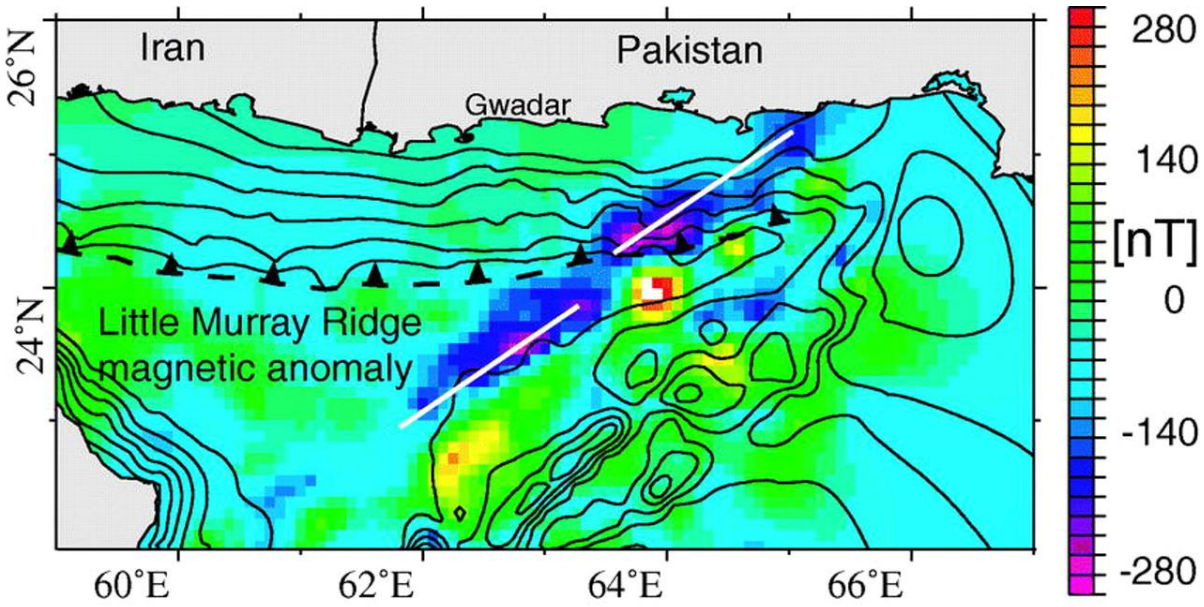
	Copepoda	***Copepoed-larvae***	**“**	
	Porcellanidae	***Porcellanid-larvae***	**“**	
	Palaemonidae	***Zoea***	**“**	
Molluscas		***Gastropoda***	**“**	
		Lamillibranch-larvae	**“**	
Urochordata	**Oikopleuridae**	***Oikopleura sp***	**“**	
grey mullets (ray-finned fish)	**(Chordata) Mugilidae**	***Mullet***	**“**	
Dolphin	**Delphinidae**	***Humback***	**“**	
Bonefish, ladyfish	**Albulidae**	***Albula vulpes***	***Jamal and Shabir 2011***	
Spotted catfish	**Ariidae**	***Arius maculates***	**“**	
Thinspine catfish	**Ariidae**	***Arius tenuispinis***	**“**	
Giant catfish	**Ariidae**	***Arius thalassinus***	**“**	
	Arridae	**Ancharius brevibarbis**	**“**	
Banded needlefish	**Belonidae**	***Strongylura strongylura***	**“**	
Largetoothed flounder	**Bothidae**	***Pseudorhombus arsius***	**“**	
Shrimp scad	**Carangidae**	***Alepes djedaba***	**“**	
Longnose trevally	**Carangidae**	***Carangoides chrysophrys***	**“**	
Bigeye trevally	**Carangidae**	***Caranx sexfasiatus***	**“**	
Banded scad	**Carangidae**	***Caranx para***	**“**	
Blacktip leatherskin	**Carangidae**	***Scomberoides commersonnianus***	**“**	
Slender qeenfish	**Carangidae**	***Scomberoides tol***	**“**	
Small spotted dart	**Carangidae**	***Trachinotus baillonii***	**“**	
Snubnose pompano	**Carangidae**	***Trachinotus blochii***	**“**	
A r i a n scad	**Carangidae**	***Trachurus indicus***	**“**	
B I ack pomf ret	**Carangidae**	***Parastromateus niger***	**“**	
(Dora) wolf	**Chi rocentridae**	***Chirocentrus dorab***	**“**	
Whitef i n wolf-	**Chi rocentridae**	***Chirocentrus nudus***	**“**	
K el ee shad	**CI upeidaae**	***Nematalosa nasus***	**“**	
Goldsti pr Sardi ne	**CI upeidaae**	***Sardinella gibbosa***	**“**	
Oil Sardine	**CI upeidaae**	***Sardinella longiceps***	**“**	
	CI upeidae	***Dussumieria acuta***	**“**	
	CI upeidae	**S. gi bbosa**	**“**	
Shortnose	**CI upeidae**	***Anodontostoma chacunda***	**“**	
Bigeye i I i sha	**CI upeidae**	***Ilisha megaloptera***	**“**	
Tardoore	**CI upeidae**	***Opisthopterus tardoore***	**“**	

Largescale	**Cy nogl ossi dae**	***Cynoglossus are!***	**“**	
Tonguasol es	**Cynoglossidae**	***Cynoglossus puncticeps***	**“**	
Tonguasol es	**Cynoglossidae**	***Cynoglossus bilineatus***	**“**	
Stingrays	**Dasyatidae**	***Dasyatis zugei***	**“**	
Stingrays	**Dasyatidae**	***Himantura walga***	**“**	
Spotted batf ish	**Drepani dae**	***Drepane punctata***	**“**	
Batf i sh	**Drepani dae**	***Drepane longimana***	**“**	
Dussumier's flag-tail	**Engraul i dae**	***Coilia dussumieri***	**“**	
Thryssa	**Engraul i dae**	**Thryssa dussumi eri**	**“**	
Thryssa	**Engraul i dae**	***Thryssa hamiltonii***	**“**	
Long-rayed	**Gerrei dae**	***Gerres filamentosus***	**“**	
si I verbi ddy	**Gerrei dae**	***Gerres oyena***	**“**	
Mud skipper	**Gobi i dae**	***Bolepthalmus dusumeri***	**“**	
B Iack sweet! i p	**Haemul i dae**	***Plectorhinchus gibbosos***	**“**	
Grunter	**Haemul i dae**	***Pomadasys kaakan***	**“**	
Saddle grunt	**Haemul i dae**	***Pomadasys maculatum***	**“**	
half beak	**Hemi ramphi dae**	***Hyporamphus limbatus***	**“**	
half beak	**Hemi ramphidae**	***Hemiramphus far***	**“**	
White	**Lactari idae**	**Lactari us I actari us**	**“**	
Toothpony	**Lei ognathi dae**	**Gazza mi nuta**	**“**	
	Lei ognathi dae	***Leiognathus equulus***	**“**	
Ponyf ish	**Lei ognathi dae**	***Leiognathus blochii***	**“**	
Pugnose	**Leiognathidae**	***Secutor insidiator***	**“**	
Emperors	**Lethri nidae**	***Lethrinus nebulosus***	**“**	
John's snapper	**Lutjanidae**	***Lutjanus johnii***	**“**	
Mangrove red	**Lutjanidae**	***Lutjanus argentimaculatus***	**“**	
Tarpon	**M egalopidae**	***Megalops cyprinoides***	**“**	
Green back	**Mugilidae**	***Liza subviridis***	**“**	
Large scale	**Mugilidae**	***Liza melinoptera***	**“**	
Keeled mullet	**Mugilidae**	***Liza carinata***	**“**	
Large scale mullet	**Mugilidae**	***Mugil cephalus***	**“**	
Long arm mullet	**Mugilidae**	***Valamugil cunnesius***	**“**	
Speigler's	**M ugi I i dae**	***Valamugil speigleri***	**“**	
	Nemi pteridae	***Nemipterus japonicus***	**“**	
Whitecheek monocle	**Nemi pteridae**	***Scolopsis vosmeri***	**“**	
Bartai I flathead	**PI atycephal i dae**	***Platycephalus indicus***	**“**	
Striped eel catfish	**PI otosi dae**	***Plotosus lineatus***	**“**	

	Haemulidae	***Pomadasys maculatum***	**“**	
Indian flounder	**Psettodidae**	***Psettodes erumei***	**“**	
Guitar f ish	**Rhi nobatidae**	***Rhinobatos annandalei***	**“**	
	Sci aenidae	***Paranibea semiluctusa***	**“**	
	Sci aenidae	***Nibea albida***	**“**	
Southern meagre		***Argyrosomus hololepidotus***	**“**	
Jewf ish	**Sci aenidae**	***Protonibea diacan***	**“**	
Silver Jewfish	**Sci aenidae**	***Johnius dussumieri***	**“**	
Jewf ish	**Sci aenidae**	***Johnius belangerii***	**“**	
Rosy jew f ish	**Sci aenidae**	***Otolithes rubber***	**“**	
Korean seed i sh	**Sci aenidae**	***Scomberomorus koreanus***	**“**	
Barred Spanish mackerel	**Sci aenidae**	***Scomberomorus commerson***	**“**	
Spotted Spanish	**Scombridae**	***Scomberomorus guttatus***	**“**	
Indian mackerel	**Scombridae**	***Rastrelliger kanagurta***	**“**	
Lunartail puffer	**Tetradontidae**	***Lagocephalus lunaris***	**“**	
Greasy reefcod	**Serranidae**	***Epinephelus tauvina***	**“**	
Thornycheek grouper	**Serranidae**	***Epinephelus diacanthus***	**“**	
Orrangespotted	**Serranidae**	***Epinephelus coioides***	**“**	
Silver whiting	**Sillaginidae**	***Sillago sihama***	**“**	
Black Bream	**Sparidae**	***Acanthopagrus berda***	**“**	
Yellofin seabream	**Sparidae**	***Acanthopagrus latus***	**“**	
Karanteen seabream	**Sparidae**	***Crenidens crenidens***	**“**	
Sobaity seabream	**Sparidae**	***Sparidentex hasta***	**“**	
Barracuda	**Sphyraenidae**	***Sphyraena putnamiae***	**“**	
Silver pomfret	**Stromateidae**	***Pampus argenteus***	**“**	
Jerbua terapon	**Teraponidae**	***Terapon jerboa***	**“**	
	Trichiuridae	***Trichiurus lepturus***	**“**	
Hairtail	**Trichiuridae**	***Lepturacanthus savala***	**“**	
Pike conger	**Muraenesocidae**	***Muraenesox bagio***	**“**	
<u>Flora of Miani Hor</u>				
Timmer	**Acanthaceae**	***Avicennia marina***	***Saifullah&Fayyazl 2002., Saima and Iftikhar 2005 Amjad et al.,***	

			2007, Fayyaz Rasool ., et al 2002	
Kumri		***Rhizophora mucronata***	***Saifullah&Fayyazl 2002., Saima and Iftikhar 2005 Amjad et al., 2007,*** **Irfan Aziz and M Ajmal Khan 2001,** ***Fayyaz Rasool ., et al 2002***	
Kain		***Ceriops tagal***	***Saifullah&Fayyazl 2002., Saima and Iftikhar 2005 Amjad et al., 2007, Fayyaz Rasool ., et al 2002***	
blue-green algae	**Oscillatoriaceae**	***Lyngbya majuscula***	***Aftab and Shameel 2008***	
		Lyngbya martensiana	*“*	
green algae	**Cladophoraceae**	***Cladophora glomerata***	***Javed Aftab 2006***	
		Chaetomorpha antennina	***Javed Aftab 2006, Mustafa Shameel 1992***	
		Chaetomorpha linum	*“*	
		Chaetomorpha prostrata	*“*	
green algae		***Cladophora okamurai***	***Javed Aftab 2006***	
	Characeae	***Chara zeylanica***	*“*	
		Nitella hyaline	*“*	
	Rivulariaceae	***Gloeotrichia raciborskii***	*“*	
	Oscillatoria(Order)	***Lyngbya markensiana***	*“*	
	Microcystaceae	***Microcystis aeroginosa***	*“*	
	Microsporaceae	***Microspora floccosa***	*“*	
	Oscillatoriaceae	***Oscillatoria princps***	*“*	
	Zygnemataceae	***Spirogyra hyaline***	*“*	
		Spirogyra rhizoides	*“*	
	Chlorophyceae	***Enteromorpha clathrata***	***Mustafa Shameel 1992***	
		Enteromorpha intestinalis	*“*	
	Ulvaceae	***Ulva fasiata***	*“*	
		Ulva indica	*“*	

Yellow green algae	**Vaucheriaceae**	*piloboloides*	“	
	Codiaceae	***Codium flabellatum***	“	
brown algae	**Ectocarpaceae**	***Hincksia mitchelliae***	“	
brown algae	**Ralfsiaceae**	***Ralfsia ceylanica***	“	
brown algae	**Dictyotaceae**	***Dictyopteris dichotoma***	“	
		Dictyopteris idica	“	
		Padina pavonia	“	
		Padina tetrastromatica	“	
	Cystoseiraceae	***Hormophusa cuneiformis***	“	
		Stokeyia indica	“	
	Sargassaceae	***Sargassum boveanum***	“	
		Sargassum crassifolium	“	
		Sargassum polycystem	“	
	Erythropeltidaceae	***Erythrotrichia carnea***	“	
	Galaxauraceae	***Pseudogloiophloea fascicularis***	“	
	Gelidiaceae	***Gelidium pusillum***	“	
	Cryptonemiaceae	***Halymenia porphyroides***	“	
	Corallinaceae	***Amphiroa fragilissima***	“	
		Jania adherens	“	
		Lithothamnium fruticulosum		
	Gracilariaceae	***Gracilaria crassa***	“	
		Gracilaria foliifera	“	
		Gracilaria verrucosa	“	
	Plocamiaceae	***Plocamium cartilagineum***	“	
	Hypneaceae	***Hypnea valentiae***	“	
	Rhodymeniaceae	***Botryocladia leptopoda***	“	
	Delesseriaceae	***Cottoniella fusiformis***	“	
	Dasyaceae	***Heterosiphonia wurdemannii***	“	
	Rhodomelaceae	***Acanthphora spicifera***	“	
		Polysiphonia elongata	“	
		Polysiphonia ferulacea	“	
		Polysiphonia platycarpa	“	
		Polysiphonia variegata	“	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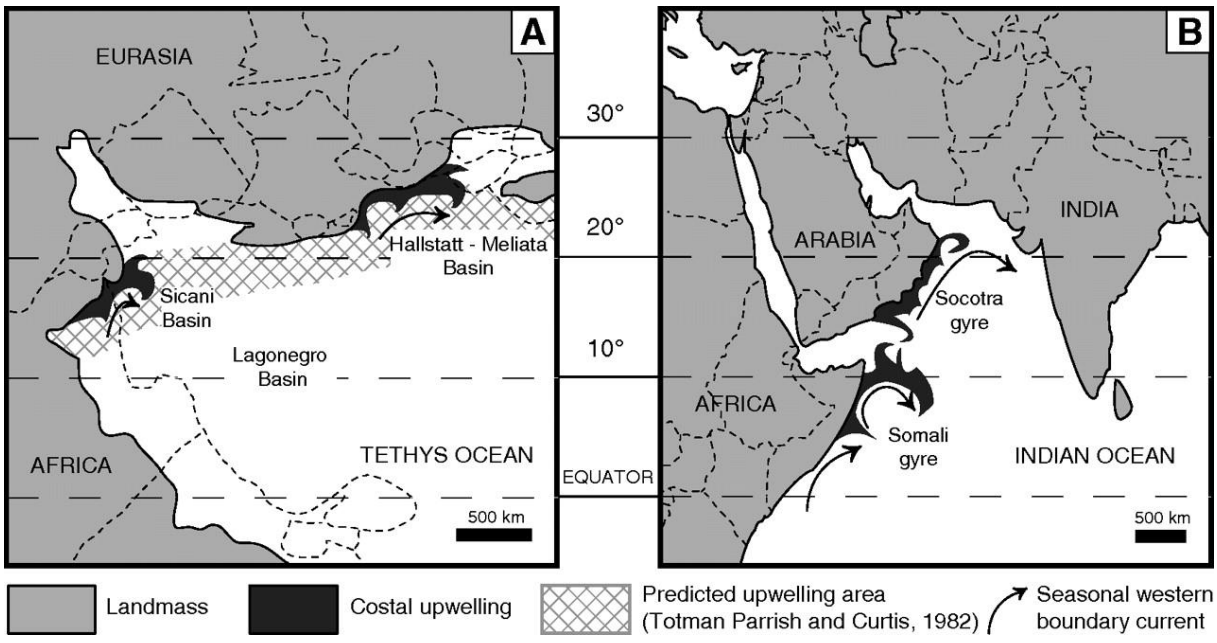
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Predicted upwelling area
(Totman Parrish and Curtis, 1982)
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