Intertidal Mudflats Worldwide

Practical course at the Common Wadden Sea Secretariat (CWSS) in Wilhelmshaven 1st June - 30th September 1999.

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Chapter 1 Introduction

In the last years, we have seen that the Wadden Sea in Denmark, Germany and the Netherlands is not unique on earth. Indeed, the Wadden Sea has one of the largest intertidal zones with mud flats on earth, but many more of these ecosystems occur along the world's coasts. A common characteristic of almost all intertidal mud flats is the high productivity. This fact makes them attractive breeding, nesting, over-wintering and migration stop-over grounds for birds and as nursery ground for many fish species.

For the protection of the European Wadden Sea, it is important to know about other intertidal mud flats on the migration route of birds, which use the Wadden Sea too, especially concerning their conservation status along their whole migration route. For this reason, for example, research is done in Mauritania and Guinea Bissau. But isn't it interesting to know about all intertidal mud flats worldwide - their ecological importance, threats and management concepts? After all, the East Atlantic Flyway isn't the only migratory route.

Concerning this, the subject of the practical course, extend fom 1st June to 30th September 1999, is to make an inventory of all intertidal mud flats as the first step. As the second step, to make a list of the most important sites with a short description. Out of this list, to chose, as the third step, a few sites and compare them, concerning management concepts, ecological importance, main threats and uses with the crossborder area of the Wadden Sea In Denmark, Germany and The Netherlands. Main issues are: Are the sites managed?, By whom are the managed?, and How are the managed? The sites can be already protected sites but also unprotected sites. Because of time limitation, not all gaps could be filled. Therefore any comments or additional information are welcome.

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Chapter 2 Aims

The aims of the practical course were:

(a) to prepare an inventory list of almost all intertidal mud flats worldwide,

(b) to describe important intertidal mud flats concerning size, coordinates, type, ecological importance and climatic zone,

(c) to compile a list of contact addresses of, as many as possible, intertidal mudflat sites,

(d) to prepare a, as much as possible, detailed description of at least one intertidal mud flat region per continent and a comparison of these sites with the crossborder area of the Wadden Sea in Denmark, Germany and The Netherlands, concerning especially the management concepts and common features, main ecological value, main uses and main threats.

Chapter 3 Comprehensive inventory and overview of intertidal mud flats worldwide

Intertidal flats are defined as intertdal areas of bare mud and sand, drained and flooded through branching channels (Reise, K., de Jong, F., 1999). Mud flats have been selected because of their ecological and geomorphological characteristics, which are comparable to the Wadden Sea. Intertidal mud flats are high productive and are therefore an ecological very important part of an intertidal ecosystem.

Because of time limitation, other

To get a list of ”all” intertidal flats one needs many sources of information. We started with the Ramsar Sites Overview - A Directory of Wetlands of International Importance (Frasier, S, 1999), because this is the best overview of wetlands. All protected sites with a portion of mud, sand or salt flats (Ramsar Wetland Type G) were put on our list. Sometimes we could not see which wetland type was dominant and we looked in the further description if we could find information about the type of wetland. Besides the wetland type, the Criteria for Identifying Wetlands of International Importance plaid a role (Table 3.1).

Tab. 3.1 Criteria for Identifying Wetlands of International Importance

1. Criteria for representative or unique wetlands
A wetland should be considered internationally important if:
(a) it is a particularly good representative example of a natural or near-natural wetland, characteristic of the appropriate biological region;
or (b) it is a particularly good representative example of a natural or near-natural wetland, common to more than one biological region;
or (c) it is a particularly good representative example of a wetland which plays a substantial hydrological, biological or ecological role in the natural functioning of an major river basin or coastal system, especially where it is located in a trans- border position;
or (d) it is an example of a specific type of wetland, rare or unusual in theappropriate biogeographical region.
2. General criteria based on plants or animals
A wetland should be considered internationally important if:
(a) it supports an appreciable assemblage of rare, vulnerable or endangered species or subspecies of plant or animal,
or an appreciable number of individuals of any one or more of these species;
or (b) it is of special value for maintaining the genetic and ecological diversity of a region because of the quality and peculiarities of its flora and fauna;
or (c) it is of special value as the habitat of plants or animals at a critical stage of their biological cycle;
or (d) it is of special value for one or more endemic plant or animal species or communities.

Tab. 3.1 cont.

3. Specific criteria based on waterfowl

A wetland should be considered internationally important if:

(a) it regularly supports 20,000 waterfowl;

or (b) it regularly supports substantial numbers of individuals from particular groups of waterfowl, indicative of wetland values, productivity and diversity;

or (c) where data on populations numbers are available, it regularly supports 1% of the individuals in a population of one species or subspecies of waterfowl.

4. Specific criteria based on fish

A wetland should be considered internationally important if:

(a) it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interaction and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity;

or (b) it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

We tried to put sites on the list that met as many as possible of the 4 criteria. In practice, it it was weight higher if the area had a mean portion of intertidal mud flats rather than reaching all above mentioned criteria. But, in borderline cases, where a site has a less portion of intertidal mud flats but the site met all criteria for being identified as a Wetland of International Importance, the site has been put on the list. This is done to prevent that little intertidal mud flats with a high ecological value are being taken into consideration.

But not all intertidal mud flats are protected under the Ramsar Convention. Therefore, we began to search the literature and on the internet. The information we got was superficial and mostly about biological features, and it was very difficult to get information about management concepts, the mean feature we were looking for. To get contact to people or institutions was also difficult and more time was necessary than planned. With the help of ”Intertidal Deposits” (Eisma, D., 1998) we got information about the existence of other intertidal mud flats. But, the book deals with the morphology of the sites and tells less about location and size and nothing about the ecological importance and management concepts. At least, we got to know about the existence of intertidal mud flats and many people give links to intertidal mud flats elsewhere.

In total, 350 intertidal mud flat sites have been listed (details in Table 3.2) which can be grouped into as following:

Region	**No. of Sites**
Europe	150
Africa	39
North America	44
Central America	13
South America	18
Middle East	11
Indian Ocean	10
South East Asia	12
Yellow Sea	3
the Far East	18
Oceania	32
Total	**350**

Most of the intertidal mud flats are situated at estuaries (deltas), bays and combinations of other morphologytypes with them**.** But the list isn't really representive, because sometimes we don't know what size the intertidal mud flats have at a site. For example, many of the tropic sites have only a little portion of intertidal mud flats and most of the area is covered with mangroves. Furthermore, we may have missed sites or put sites on the list which haven't got intertidal mud flats. Therefor, we would like to receive additive information to complete the list as far as possible.

Table 3.2 List of intertidal mud flats worldwide

* = Information from *A Directory of Wetlands of International Importance.*
° = Information from *Intertidal Deposits* (Eisma 1998)
~ = Other sources
? = Information about existence of intertidal mud flats but specisl sites not known.

Europe

Belgium:

-Schorren van de Beneden Schelde*
-Zwin*

Denmark:

-Horsens Fjord & Endelave*
-Laeso*
-Naera Coast & Aebelo area*
-Nissum Bredning with Harbore & Agger Peninsulas*
-Praesto Fjord, Jungshoved Nor, Ulfshale & Nyord*
-Randers & Mariager Fjords & adjacent sea Ringkobing Fjord*
-Skaelskor Nor & Glaeno (waters south of)*
-Vadehavet*
-Aqajarua-Sllorsuaq (Greenland)*
-Ikkattoq & adjacent archipelago (Greenland)*
-Qínnquata Marraa-Kuussuaq (Greenland)*

France:

-Aber Benoit Rias°
-Aber Wrac'h°
-Anse de l'Aiguillon°
-Aulna Ria°
-Baie d'Authie°
-Baie de Bourneuf°
-Baie de Canche°
-Baie du Mont Saint-Michel*
-Baie de Somme°
-Basse-Mana*
-Bassin d'Arachon~
-Faou Ria°
-Goayen Ria°
-Golfe du Morbihan*
-Grand Cul-de-Sac Marin de la Guadeloupe* (Guadeloupe)
-Marais de Kaw*
-Kerroule Estuary°
-Marais salants de Guéranda et du Més*
-Le Conquet Ria°
-L'Auberlac'h Ria°
-La Petite Camargue*
-Perthuis d'Oleron°
-Tariec Estuary°

Germany:
-Niederelbe, Barnkrug - Otterndorf*
-Ostseeboddengewässer Westrügen - Hiddensee - Zingst*
-Wattenmeer (Hamburgisches Wattenmeer*,
Schleswig-Holsteinisches Wattenmeer*,
Wattenmeer, Elbe, Weser - Dreieck*,
Wattenmeer, Jadebusen & westliche Wesermündung*,
Wattenmeer, Ostfriesisches Wattenmeer & Dollart*)

Greece:

-Amvrakikos gulf*
-Axios, Loudias, Aliakmon delta*
-Messolonghi lagoon*
-Nestos delta & adjoining lagoons*

Iceland:
-Grunnafjördur*
-Southeast coast°

Ireland:

-Baldoyle Bay*
-Ballycotton Bay*
-Ballymacoda*
-Bannow Bay*
-Blackwater Estuary*
-Broadmeadow Estuary*
-Castlemaine Harbour*
-Cumeen Strand*
-Dundalk Bay*
-Dungarvan Harbour*
-Inner Galway Bay*
-Killala Bay/Moy Estuary
-North Bull Island*
-Rogerstown Estuary*
-Sandymouth Strand/Tolka Estuary*
-Tralee Bay*

Italy:

-Laguna di Marano: Foci dello Stella*
-Ortazzo e Ortazzino*
-Piallassa della Baiona e Risega*
-Sacca di Belocchio*
-Valli di Gorino*
-Valli residue del comprensorio di Comacchio*

The Netherlands:

-Boschplaat*
-Griend*
-Oosterschelde & Markiezaatmeer*
-Waddenzee*
-Spaans Lagoon (Aruba)*

Norway:

-Giske Wetlands System*
-Haroya Wetlands System*
-Ilene & Presterodkilen*
-Kurefjorden*
-Mellandsvagen*
-Ora*
-Orlandet*
-Sandblast/Gaustadvagen Nature Reserve*
-Stabbursneset*

Potugal:

-Estuário do Tejo*
-Estuario do Sado*
-Ria de Alvor*
-Ria Formosa*

Russian Federation:

-Berezovye Island, in the Gulf of Finland, baltic Sea*
-Gulf of Anadyr°
-Kandalaksha Bay*
-Karaginsky Island, Bearing Sea* (Kamchatka°)
-Sakhalin°
-Sea of Okhotsk° (northern part, Bay of Penzhinskaya)
-Southern coast of the Gulf of Finnland, Baltic Sea*
-Thamir Peninsula~
-White Sea Coast°

Spain:

-Complejo intermareal Umia-Grove*
-Delta del Ebro*
-Marismas de Santona*
-Ria de Mundaka-Guenika*
-Ria del Eo*
-Ria de Foz°
-Rias de Ortigueira y Ladrido*
-Ria de Vigo°

Sweden:

-Getterön*
-Stigfjorden*
-Träslövsläge - Morups Tange*

Turkey:

-Gediz Delta

United Kingdom:

-Alde-Ore Estuary*
-Alt Estuary*
-Benfleet & Southend Marshes*
-Brydon Water*
-Bridgend Flats, Islay*
-Bridgwater Bay* (Severn Estuary)
-Burry Inlet*
-Chesil Beach & The Fleet*
-Chichester & Langstone Harbours*
-Colne Estuary*
-Cors Fochno & Dyfi*
-Crouch & Roach Estuaries*
-Deben Estuary*
-Dee Estuary*
-Dengie*
-Dornoch Firth & Loch Fleet*
-Duddon Estuary*
-East Sanday Coast*
-Exe Estuary*
-Foulness*
-Gibralta Point*
-Gruinart Flat, Islay*
-Hamford Water*
-Humber Flats, Marshes & Coast*
-Larne Lough*
-Lindisfarne*
-Liverpool Bay
-Loch an Duin*
-Medway Estuary & Marshes*
-Mersey Estuary*
-Milford Haven°
-Minsmere - Walberswick*
-Montrose Basin*
-Moray & Narin Coast*
-Morecambe Bay*
-Northfolk Coast*
-Old Hall Marshes*
-Pagham Harbour*
-Portsmouth Harbour*
-Ribble & Alt Estuaries*
-Severn Estuary*
-Solvent and Southampton Water*
-Stour & Orwell Estuaries*
-Strangford Lock*
-Teesmouth & Cleveland Coast*
-Thanet Coast & Sandwich Bay*
-The Swale*
-The Thames Estuary
-The Wash*
-Upper Severn Estuary*
-Upper Solway Flats & Marshes*

UK, Turks & Caicos Islands:

-North, Middle & East Caicos Islands*

Westcoast Africa

Benin:- ?°

Cameroon:- ?°

Equatorial Guinea:- ?°

Gambia:

-Baobolon Wetland Reserve*
-Sine River Mouth°
-Saloum River Mouth°
-Casamance River Mouth°

Ghana:- ?°

Guinea:

-Ile Alcatraz*
-Konkoure*
-Rio Kapatchez*

Guinea- Bissau:

-Lagoa de Cufada*
-Archipelago dos Bissagos~

Ivory Coast:- ?°

Liberia- ?

Mauretania:

-Banc d'Arguin*

Morocco:

-Baie de Khniffiss*
-Merja Zerga* (Moulay Bou Salham°)
-Qualidia Lagoons°
-Sidi Moussa Lagoons°

Namibia:

-Orange River Mouth*
-Sandwich Harbour*
-Walvis Bay*

Nigeria:

-Niger Delta°

Senegal:

-Senegal River Mouth°

Sierra Leone:-?°

South Africa:

-De Mond*
-Langebaan*

Togo:- ?°

Tunesien:

-Golf de Gabes~

Zaire:

-Zaire river mouth

Eastcoast Africa

Kenya:-?°

Madagascar:

-Westcoast°

Mocambique:

-around Beira°

Somalia:- ?°

South Africa:

-Kosi Bay*
-Kwazulu-Natal°
-St. Lucia System*

Tansania:-?°

North America

Canada:

-Alaksen*
-Baie de l'Isle-Verte*
-Bay of Fundy~
-Cap Tourmente*
-Dewey Soper Migratory Bird Sanctuary*
-Fraser River Delta°
-Grand Codroy Estuary*
-Mackenzie River Delta°
-Malpeque Bay*
-Mary's Point*
-McConnell River*
-Musquodoboit Harbour *
-Polar Bear Pass*
-Polar Bear Provincial Park*
-Queen Charlotte Island°
-Queen Maud Gulf*
-Rasmussen Lowlands*
-Shepody Bay* (Bay of Fundy)
-Southern Bright-Minas Basin* (Bay of Fundy)
-Southern James Bay* (Southern Hudson Bay)
-(St. Lawrence Estuary)°
-Tabusintac Lagoon & River Estuary*
-Ungave Bay Leaf Bassin°

USA:

-around Point Barrow°
-Bolinas Lagoon*
-Bristol Bay°
-Chesapeake Bay Estuarine Complex*
-Connecticut River Estuary & Tidal wetlands Complex*
-Cook Inlet°
-Copper River Delta~
-Delaware Bay Estuary*
-East coast: Georgia, South Carolina, Maine°
-Edwin B Forsythe National Wildlife Refuge*
-Everglades*
-Izembek Lagoon National Wildlife Refuge*
-Kuskokwim Bay°
-Norton Sound°
-Northwest Florida°
-Pelican Island National Wildlife Refuge*
-San Francisco Bay°
-South Carolina to Massachusetts°
-The Louisiana coast - Mississippi Delta°
-Yaquina Bay°
-Yokon river delta°

Central America

Bahamas:

-Andros°

Costa Rica:

-Terraba-Sierpa*

Ecuador:

-Gulf of Guayaquil°
-Ancon de Sardinas Bay°

Guatemala:
-Manchón-Guamuchal*

Mexico:

-Humedales del Delta del Rio Colorado*
-Marismas Nacionales*
-Ria Lagartos*

Panama:

-Golfo de Montijo*
-Punta Patino*
-San Ssan - Pond Sak*

South America

Argentina:

-Bahia Blanca°
-Bahía de Samborombón*
-Reserva Costa Atlantica de Tierra del Fuego(San Sebastian Bay)*
-San Antonia Oeste Rio Negro (San Antonio Bay)~

Brazil:

-Lagamaar~
-Reentrancias Maranhenses*

Chile:

-Southern Chile~

Colombia:

-Bay of Buenaventura°
-Magdalena Delta°

Ecuador:

-Gulf of Guayaquil°

Fench-Guayana:-?°

Guyana:-?°

Peru:

-Zona Reservada Los Pantanos de Villa*

Suriname:

-Bigi Pan~
-Coppenamemonding*
-Wia Wia~

Venezuela:

-Archipielago Los Roques*
-Ciénga de Los Olivitos*

Middle East

Bahrein:

-Gulf of Tubli*
-Huwar Islands*

Iran:

-Deltas of Rud-e-Gaz & Rud-e-Hara*
-Deltas of Rud-e-Shur, Rud-e-Shirin & Rud-e-Mindab*
-Khuran Straits*
-Shadegan Marshes & mudflats of Khor-al Amaya & khor Musa*

Irak:

-Shatt el Arab°

Kuwait:

-Bay of Kuwait°

Qatar:

-Qatar Peninsula°

Saudia Arabia:-?°

United Arabian Emirates:-?

Indian Ocean

Bangladesh:

-The Sundarbans*

Burma (Myanmar):

-Irrawaddy°

India:

-Ganges-Brahmaputra (Megna) River Mouths°
-Gulf of Kachchh°
-Gulf of Khambhat°
-Keralacoast*
-Godavari Delta°

Sri Lanca:

-Gulf of Mannar°
-Palk Bay°

Pakistan:

-Indus River Delta°

South East Asia

Indonesia:

-Berbak*
-Mahakam River Delta°
-Southeast coast of Sumatra°

Malaysia:

-Pantai Remis°

Papua New Guinea:

-Gulf of Papua (Fly River Mouth and Puari River Mouth)°

Philippines:

-Olango Island Wildlife Sanctuary*

Taiwan:

-Westcoast°~

Thailand:

-Northern Gulf of Thailand (Chao Phraya River Mouth, from Phetchaburi to Chonburi)°
-Pattani Bay~
-Western Gulf Of Thailand (Ao Ban Don embayment, Songklah-Tha Sala coast)°

Viet Nam:

-Red River Delta° **(**-Xuan Thuy Natural Wetland Reserve*)
-Mekong°

Yellow Sea

China:

-Coast of the Yellow Sea* (Bohai Sea/ BohaiBay)

North Korea:

-Coast of the Yellow Sea~

South Korea:

-Coast of the Yellow Sea~

Far East

China:

-Dongzhaigang* (Hainan Island)
-Hangzhou Bay~ (Zhejiang coast)
-Hangzhou Bay to Fuzhou, Min Jiang river estuary (Taizhou Bay and Wenzhou Bay)°
-Mai Po Marshes & Inner Deep Bay* (Hongkong)
-The Chang Jiang River Mouth°(Jangtsekiang)

Japan:

-Fuyimae Flats~
-Imanzu tidal Flats (Hakata Bay)~
-Isahaya Bay~
-Man-Ko*
-Shiokawa tidal Flat~
-Wajiro tidal Flats (Hakata Bay)~
-Yatsu-higata*
-Yoshino Estuary~

Oceania

Australia:

-Bowling Green Bay*
-Broad Sound°
-Burdekin Estuary°
-Corner Inlet*
-Coburg Peninsula*
-Eighty-mile Beach*
-Fitzroy River Mouth°
-Gippsland Lakes°
-Gulf of St. Vincent°
-Kakadu National Park*
-King Sound°
-Kooragang*
-Missionary Bay°
-Moreton Bay*
-Moulting Lagoon*
-Ord River floodplain*
-Pittwater-Orielton Lagoon*
-Port Phillipp Bay°
-Princes Charlotte Bay°
-Roebuck Bay*
-Sea Elephant Conservation Area*
-Shark Bay°
-Shoalwater and Corio Bays*
-Spencer Gulf°
-Towra Point*
-Western Port*
-Wilsons Promontory°

Fiji:

-At Lauthala°

New Caledonia:

-Dumbea River Mouth°
-Ne'poui Delta°

New Zealand:

-Farewell Spit*
-Firth of Thames*

Chapter 4 Short description of important intertidal mud flats

Because of the limited time of the practical course, we can't describe and compare all of the 350 sites with the Wadden Sea, and besides this doesn't make sense, because not all sites are representative intertidal mud flats concerning the size. In our second list Tab. 4.1, we put only sites with a minimum extent of 5000 ha, because little areas are more influenced by the fringed areas and are less natural. Furthermore, we compared a few of these sites with the Wadden Sea and one can't compare a very little area with a big one such as the Wadden Sea. 5000 ha isn't big compared to the extent of the Wadden Sea, but from 5000 ha onwards, we have a better overview about sites, which are really important intertidal mud flats. Fortunately, by choosing this borderline, we selected a number of sites which were simple to describe in the available time. We separate the sites by state borderlines and the regions: Europe, coast of West Africa, coast of East Africa, Coast of East America, Coast of West America, Near East, Indian Ocean, Far East, Yellow Sea, South East Asia and Oceania. In this list we do not regard for cross-border sites.
We described the selected sites concerning the size, coordinates, type, ecological importance and climatic zone. Mostly we know the size of the whole site, which covers not only intertidal mud flats but the whole system including other habitats too. If the real size of the intertidal mud flats is known, the figure is written after the figure of the whole system. Sometimes we know only the size of the whole system, sometimes only the size of the intertidal mud flats and sometimes both of them. As we know the size of a protected area this is marked. The marks are defined in Tab 4.1.

The information on the coordinates we have from the site description or, if not available, from an atlas (Westermann Kartographie, 1992). For the type of intertidal mud flat we defined five types: back barrier islands, open mud flats, estuaries, bays and lagoons. Back barrier island, are defined as islands formed by sedimentation or remainders of earlier coastlines, which protect the area between the coast and the island so that sedimentation and intertidal mud flat formation can take place. Open mud flats are coastal stretches of intertidal areas without back barrier islands, estuaries, bays or lagoons. Estuaries have a tidal area with a significant freshwater inflow. A special type of estuary is a delta. Tidal lagoons have a seaward barrier with

a narrow throat for a tidal pass. Tidal Bays are wide open towards the sea (CWSS. 1999). Which type occurs at a site is given in the descriptions. Sometimes mixed types occur at one site.
The information about the ecological importance is mostly taken from the Ramsar description and, has been completed as possible, by other sources.
For the information about the climatic zone we compare the coordinates with the climatic zones defined in the atlas (Westermann Kartographie, 1992).
The location of the sites described in this chapter are shown in Map 4.2.

The information we got is very heterogeneous. This means that we often don't have all characteristics of a site to make a detailed description. Furthermore, the descriptions may differ from each other in words of extent and detail. This fact makes it sometimes difficult to compare the sites. About the sites which are protected under the Ramsar-Convention, we have the most information but from some areas we know about their existence and we believe they are important but about further characteristics we only can make assumptions. Here we hope to get help from people who know more.

The contact addresses for each site are on a separated list in Annex 1. Each site in Tab. 4.1 has a number and this number corresponded with the numbers in the list of the contact addresses. Besides, in Tab. 4.1 is written if there is a contact address or not. We tried to find an address for a whole state and a special address for each site. The addresses are from national responsible ministries, responsible administration, regional responsible administration, NGO’s and educational scientific institutions. The different kinds of addresses are marked with figures from 1 to 5. Because an address can have more than one function some addresses are marked with two figures. Most of the national authority addresses are taken over from a list of the Ramsar Convention Bureau which shows the administrative authorities responsible for implementing the convention in each of the contracting parties. Because of that it may be possible that the addresses of national contact points are not always identical with the authorities responsible for the site management.

Now we have 79 sites:

- 19 with a size from 5,000 to –20,000 ha,
- 28 sites up to 80,000 ha,
- 26 bigger than 80,000 ha
- and of 7 we don’t know the size.

Most of the sites, 66 are situated at Bays or Estuaries and combination of these types with other morphological types. The rest of the sites are mostly mixed types of the five morphological types. The coast of the Yellow Sea is the best to be compared with the Wadden Sea, because the intertidal mud flats are even larger than the one of the Wadden Sea, and further they have similar characteristics like both stretch across national borders and are important staging sites for migratory birds.

Tab. 4.1 Short description of intertidal mud flats bigger than 5,000 ha

1	Ramsar Site	7	UNESCO Man and Biosphere Reserve
2	National Park	8	Western Hemispheric Shorebird Reserve
3	EU Special Protection Area for Wild Birds	9	East Asian-Australasian Shorebird Reserve
4	Nature Conservation Area / Nature Reserve	10	Other Protection status
5	Wildlife Reserve	?	size of the Protection status is not known
6	UNESCO World Heritage Site		

Europe

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Denmark						Yes
1 Vadehavet	**1** 140,830 ha 84,000 ha of mud and sand flats **4** 102,820 ha **5** 73,000 ha **2** ?	55°16'N 08°32'E	Back Barrier islands, estauries, open mud flats and lagoons.	Denmark's most important staging area for dabbling ducks and waders and a internationally significant numbers of seal.	Maritime, semi-humide warm-moderate.	Yes
2 Aqajarua-Sllorsuaq (Greenland)	**1** 30,000 ha	69°40'N 52°00'W	Estuary (Delta).	Internationally important for wintering, staging and breeding waterbirds.	Maritime, humid Polar region.	Yes
3 Qinnquata Marra-Kuussuaq (Greenland)	**1** 60,000 ha	69°56'N 54°17'W	Estuary.	Internationally important for breeding waterbirds.	Maritime, humid Polar region.	No
France						Yes
4 Baie du Mont Saint-Michel	**1** 62,000 ha **3** 18,000 ha **6** ?	48°40'N 01°40'W	Bay and Estuary	Wintering grounds for waders, nursery areas for fish and marine mammal haven. Salmon migrate route.	Maritime, semi-humide warm-moderate.	No
5 Golfe du Morbihan	**1** 23,000 ha **10** ?	47°35'N 02°47'W	Bay and Estuary.	Wintering, staging and breeding area for waterbirds.	Maritime, semi-humide warm-moderate.	No
Germany						Yes
6 Wattenmeer	**1,** 520,270 ha **2** 536,700 ha **3, 4, 7, 10** ?		Back barrier islands, open mud flats, bays, estuaries.	Internationally important wintering, staging and breeding area for waterbirds/waders.	Maritime, semi-humide warm-moderate.	Yes
The Netherlands						Yes
7 Ooster schelde	**1,4** 38,000 ha **4** 440 ha **10** 25,860 ha	51°30'N 04°10'E	Estuary (Delta).	Important for wintering and staging waterbirds.	Maritime, semi-humide warm-moderate.	Yes
8 Waddenzee	**1,3** 249,998 ha 120,000 ha intertidal mud flats **2** 5,400 ha **4** 15,150 ha **10** 168,031 ha	53°15'N 05°15E	Back barrier islands, open mud flats, bays and estuaries	Part of the largest unbroken stretch of intertidal mudflats in the world. Special botanical interest. Wintering, staging and breeding area for waterbirds/ waders.	Maritime, semi-humide warm-moderate.	Yes

Portugal						Yes
9 Estuario do Tejo	[1, 4] 14,563 ha [3] 40,000 ha	38°50'N 08°57W	Estuary	Most important wetland in Portugal. Key site for wintering and staging of waterbirds.	Maritime, semi-arid subtropics.	No
10 Estuario do Sado	[1,3] 25,588 ha [8] ?	38°27'N 08°57'W	Estuary	Outstanding boatanical value. Site for migrating waders and waterfowl. Site important in maintaining the water table in the area arouaround the estuary.	Maritime, semi-arid subtropics.	Yes
11 Ria Formosa	[1] 16,000 ha	37°03'N 07°47'W	Back barries islands and lagoon.	Botanical important. Key site for wintering, staging and breeding area of waterbirds and waders.	Maritime, semi-arid subtropics.	Yes
Russian Federation (european part)						Yes
12 Berezovye Island in the Gulf of Finnland	[1, 4] 12,000 ha	60°18'N 28°30'E	Archipelago with open mud falts and bays.	Important as staging site on migration of waterfowl.	Maritime, semi-humid cool-moderate.	No
13 White Sea (Kandalaksja Bay, Onega Bay, Dwina Bay, Mezen Bay)	Kandalaksja Bay: [1] 208,000 ha [4] 54,255 ha	~65°N 35°E	Bays, estuaries and open mud flats.	Internationally important as staging site for waterfowl.	Maritime, humid cool-moderate.	Yes
Spain						Yes
14 Delta del Ebro	[1, 3] 7,736 ha [4] ?	40°43'N 00°44'E	Estuary (Delta) and lagoons.	Important for wintering, staging and breeding waterfowl. Nursery area for fish. Outstanding mollusk fauna.	Maritime, semi-humid sub-tropics.	Yes
UK						Yes
15 Morecambe Bay	[1, 3] 35,864 ha 78.35 % mud, sand or salt flats [10] ?	54°07'N 02°57'W	Bay, estuary and back barries island.	Largest intertidal area in Britain of outstanding importance for wintering, staging and breeding waterfowl, gulls and terns.	Maritime, semi-humid warm-moderate.	No
16 Severn Estuary	[1, 3] 24,701 ha 85.10 % mud, sand or salt flats [10] ?	51°35'N 02°39'W	Estuary.	The species poor invertebrate community includes high densities of ragworms, lugworms and other invertebrates forming an important food source for staging and wintering waders.	Maritime, semi-humid warm-moderate.	No
17 The Wash	[1] 62,212 ha 41.40 % mud,sand or salt flats [3, 4 10] ?	52°56N 00°17'E	Bay and estuary	Most important staging post and wintering site for migrant wildfowl and wading birds. Nursery area for flat fish and large breeding population of Common Sea.	Maritime, semi-humid warm-moderate.	No
18 Upper Solway Flats & Marshes	[1] 30,706 ha 63.83 % mud, sand or salt flats [3, 4, 10] ?	54°54'N 03°25'W	Estuary	National and international important for wintering waterfowl, wading birds and migrating birds	Maritime, semi-humid/humid warm-moderate.	No

Coast of West Africa

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Guinea-Bissau						No
19 Archipelago dos Bissagos (Orango-NP)	157,000 ha intertidal mud flats [2] ?	~12°20'N 16°00'W	Back barrier islands and Estuaries.	Internationally important wintering site for waders.	Semi-humid warm tropics.	Yes
Mauretanie						Yes
20 Banc d'Arguin	[1] 1,173,000 ha 30,000 ha mud, sand or salt flats [2] 1,200,000 ha [6] ?	20°50'N 16°45'W	Back barrier islands and open mud flats.	Internationally important site for wintering, staging and breeding of waders and waterbirds. Also an important reproduction site of fish.	Continental, arid sub-tropics.	Yes
Morocco						Yes
21 Baie de Khniffis	[1] 6,500 ha [10] ?	28°00'N 12°15'W	Lagoon.	Strategic position on the East Atlantic Flyway. Internationally important as wintering site for waders.	Maritime, semi-arid sub-tropics.	No
22 Merja Zerga (Moulay Bou Salham)	[1] 7,000 ha [4] ?	34°50'N ~06°20'W	Lagoon.	Internationally important as wintering and staging site for waterfowl and waders.	Maritime, semi-arid sub-tropics.	No
Namibia						Yes
23 Sandwich Harbour	[1] 16,500 ha [4] ?	23°23'S 14°29'S	Lagoon	Namibia's most important coastal wetland. Important site for waders.	Maritime, arid sub-tropics.	Yes
24 Walvis Bay Wetland	[1, 8] 12,600 ha	23°00'S 14°27'E	Lagoon	Important for wetland birds.	Maritime, arid sub -tropics.	Yes
South Africa						Yes
25 Langebaan	[1] 6,000 ha [2] ?	33°06'S 18°01'E	Lagoon	Important site for seabirds and waders.	Maritime, semi-humid sub-tropics.	Yes
Tunesia						Yes
26 Golf of Gabes	25,000 ha mud flats [8] ?	33°50'N 10°00'E	Bay	Internationally important site for wintering and staging of waders.	Continental, semi-humid sub-tropics.	No

Coast of East Africa

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Mozambique						Yes
27 Between Save and Buzi River (South of Beira)	600 km coastline	~21°00'S 35°00'E	Estuaries and open mud flats.		Semi-arid, warm tropics.	Yes
South Africa						Yes
28 St. Lucia System	[1] 155.500 ha [4] ?	28°00'S 32°28'E		Important for migrating and breeding waterfowl and waders.	Semi-humid, warm tropics.	No

Coast of East America

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Argentina						Yes
29 Bahia Blanca	300,000 ha	~38°50'S 62°00'W	Bay and estuary.		Maritime, semi-arid sub-tropics.	No
30 Bahia de Samborombon	[1] 243,965 ha [5, 10] ?	35°47'S 57°50'W	Estuary	High productive area. Important for migratory shorebirds as staging area.	Maritime, semi-humid sub-topics.	No
31 Reserva Costa Atlantica de Tierra del Fuego (Bahia San Sebastian)	[1] 28,600 ha [4, 8] ?	53°20'S 68°30'W	Open mud flats.	Important wintering and breeding site.	Maritime, semi-humid warm-moderate.	No
32 San Antonio Oeste Rio Negro	[8] ~35,000 ha [10] ?	64°55'S 40°45'W	Bay.	Internationally important for migratory shorebirds	Maritime, semi-arid sub-tropics.	No
Canada						Yes
33 Dewey Soper Migratoryy Bird Sanctuary	[1] 815,900 ha [10] ?	66°10'N 74°00'W	Open mud flats.	Important summer breeding site for migratory birds.	Maritim, humid polarregion.	Yes
34 Polar Bear Provincial Park (Hudson Bay)	[1] 2,408,700 ha [10] ?	52°30'N 84°30'W	Bay, Estuaries and open mud flats.	Forms a mayor migration pathway for many shorebird species.	Continental, semi-humid cool-moderate.	No
35 Queen Maud Gulf	[1] 6,278,200 ha [10] ?	67°00'N 102°00'W	Bay, estuaries and open mud flats.	Important breeding area for geese.	Continental, humid polarregion.	No
36 **Bay of Fundy** Mary's Point Shepody Bay Southern Bright-Minas Bassin	[8] 62,000 ha [1] 1,200 ha [1] 12,200 ha [8] 5,060 ha [10] ? 4,000 ha mud flats [1] 26,800ha [8] 16,900 [5, 10] ? 7,800 ha of mud-sandflats	45°30'N 64°20'W	Bay and estuaries.	Internationally important site for migration birds. Also a breeding area.	Maritime, humid warm-moderate.	Yes
37 Southern James Bay (Hudson Bay)	[1] 25,290 ha [10] 25290 ha	51°20'N 80°25'W	Bay and estuaries.	Forms a mayor migration pathway for many shorebird species.	Continenta, semi-humid cool-moderate.	No

38 Ungave Bay Leaf Bassin	~15,000 ha intertidal area	59°30'N 69°70'W	Bay		Maritime, humid cool-moderate.	No
Suriname						Yes
39 Bigi Pan	[8] 68,320 ha	05°55'N 56°45'W	Estuary and open mud flats.	Internationally important (twinned with the Bay of Fundy) wintering, staging and breeding site for shorebirds and waders. Also nursery area for fish and shrimps.	Semi-humid warm-tropics.	No
40 Coppenamemoding	[1] 12,000 ha [4] ? [8] 100,000 ha	05°56'N 55°43W	Estuary, open mud flats and lagoons.	Internationally important (twinned with the Bay of Fundy) wintering, staging and breeding site for shorebirds and waders. Also nursery area for fish and shrimps.	Semi-humid warm-tropics.	No
41 Wia Wia	[8] 90,000 ha	05°56'N 54°55'W	Estuary, open mud flats and lagoons.	Internationally important (twinned with the Bay of Fundy) wintering, staging and breeding site for shorebirds and waders. Also nursery area for fish and shrimps.	Semi-humid warm-tropics.	No
USA						Yes
42 Chesapeake Bay	[1] 45,000 ha	38°00'N 76°20'W	Bay and estuaries.	Internationally important for migratory waterfowl.	Maritime, semi-humid warm-moderate.	No
43 Delaware Bay Estuary	[1] 51,252 ha [8] ?	39°11'N 75°14'W	Bay and estuaries.	Internationally important staging and wintering area.	Maritime, semi-humid warm-moderate.	No

Coast of West America

State	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Mexico						Yes
44 Humedales del Delta del Rio Colorado	[1] 250,000 ha [8] 240,000 ha [11] ?	31°50'N 114°59'W	Estuary	Important staging site on the Pacific flyway for migratory waterfowl.	Maritime, arid sub-tropics.	Yes
USA						Yes
45 Copper River Delta	[8] 151,265 ha [11] ?	60°30'N 145°00'W	Back barrier island and estuary.	Possibly the most important shorebird concentration site in the world. Also breeding site.	Maritime, humid cool-moderate.	No
46 San Francisco Bay California	[8] 22,489 ha [10] ?	37°06'N 122°03 W	Bay and estuary.	Internationally important staging area for shorebirds.	Maritime, semi-arid sub-tropics.	No

Near East

State	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Iraq						No
47 Shatt el Arab (Abadan and Fao)	~200,000 ha	29°30'N	Estuary (Delta)		Arid, continental sub-tropics.	No
Iran						Yes
48 Deltas of Rud-e-Gaz and Rud-e-Hara	[1, 10] 15,000 ha	26°40'N 57°40'E	Estuary (Delta)	Important wintering areas for shorebirds and breeding and nursery grounds for many species of crustaceans and fishes.	Arid, continental sub-tropics.	No
49 Deltas of Rud-e-Shur, Rud-e-Shirin and Rud-e-Minab	[1] 11,800 ha	27°05'N 56°45'E	Estuary (Delta)	Important wintering areas for shorebirds and spawning and nursery grounds for many fish species.	Arid, continental sub-tropics.	No
50 Khuran Straits	[1, 7, 10] 100,000 ha	26°45'N 55°40'E	Estuary and back barrier island.	Important as wintering and breeding ground for waterfowl. Also breeding and nursery grounds for many species of crustaceans and fishes.	Arid, continental sub-tropics.	No
51 Shadegan Marshes & mudflats of Khor-al Amaya & Khor Musa (Bandar Khomeyni and Bandar Mashar)	[1] 400,000 ha [5] 296,000 ha	30°30'N 48°45'E	Estuaries (Delta), bay and back barrier islands.	Important area for wintering and breeding waterfowl and wintering shorebirds. Also important breeding and nursery ground for various fish species.	Arid, continental sub-tropics.	Yes
Kuwait						No
52 Kuwait Bay	~200,000 ha	29°20'N 48°00'E	Bay		Arid, continental sub-tropics.	No
Saudi Arabia						No
53 Along the Persian Gulfcoast (Tarut Bay)	~250 km coastline	27°00'N 49°50'E			Arid, continental sub-tropics.	No
United Arabian Emirates						No
54 Along the coast of the Persian Gulf (Bas Al Khaymas)	~300,000 ha 300 km ~coastline	~24°50'N 53°00'E			Arid warm-tropics.	No

Indian Ocean

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
India						Yes
55 Gulf of Khambhat	~250,000 ha	21°50'N	Estuary (Delta)		Arid, continental warm-tropics.	No
56 Gulf of Kachchh		22°30'N	Estuary (Delta)		Arid, continental warm-tropics.	No
Pakistan						Yes
57 Indus River Delta		~35°00'N 67°00'E	Estuary (Delta)		Arid, continental warm-tropics.	No

Far East

State/Site	Size	Coord.	Typ	Ecological Importance	Climatic Zone	Contact
Japan						Yes
58 Hakata Bay (Imanzu tidal flat and Wajiro tidal flat)	~13,000 ha ~ 900 ha tidal mud flats	~34°00'N 130°50'E	Estuaries and bay.	Strategic position on the East Asian/Australasian Flyway.	Continental, humid sub-tropics.	No
59 Isahaya Bay	10,094 ha 3,000 ha tidal mud flats	~33°00'N 130°30'E	Bay	Premier staging and wintering site for migratory shorebirds in Japan. Tidal flats have a extraordinary diversity of biota.	Continental, humid sub-tropics.	No
Russion Federation (Asian part)						Yes
60 Thamir Peninsula		~75°N 100°E		Breeding area for waterfowl.	Maritime, humid polarregion.	No
61 Karaginsky Island, Bering Sea	[1] 193,597 ha [5] ?	58°45'N 163°42'E	Estuaries and open mud flats.	Important as breeding and staging site for waterbirds.	Maritime, humid cool-moderate.	No

Yellow Sea

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
China						Yes
62 Korea Bay	75,700 ha intertidal mudflats	~39°50'N 124°00E	Estuary and bay.	Internationally important as staging site for migratory waders and shorebirds.	Continental, semi-humid sub-tropics.	No
63 Liaodong Wan	124,700 ha intertidal mudflats	~40°00'N 121°50'E	Bay	Internationally important as staging site for migratory waders and shorebirds.	Continental, semi-humid sub-tropics.	No
64 Yellow river delta (Bo Hai)	371,200 ha intertidal mud flats. [4] 153,000 ha	~37°50'N 118°50'E	Estuary (Delta)	Internationally important as staging site for migratory waders and shorebirds.	Continental, semi-humid sub-tropics.	No
North Korea						No
65 Korea Bay	134,000 ha intertidal mudflats	~39°00'N 125°00'E	Estuary and bay.	Internationally important as staging site for migratory waders and shorebirds.	Continental, humid sub-tropics.	No
66 Yellow Sea coast	93,200 ha intertidal mudflats	~37°50'N 126°00'E	Estuaies, bays, open mud flats and back barrier islands.	Internationally important as staging site for migratory waders and shorebirds.	Continental, humid sub-tropics.	No
South Korea						Yes
67 Coast of the Yellow Sea W and SW-Korea	290,000 ha intertidal mudflats. [2, 10] ?	~36°00'N 127°00'E	Estuaies, bays, open mud flats and back barrier islands.	Internationally important as staging site for migratory waders and shorebirds.	Continental, humid sub-tropics.	Yes

South East Asia

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Thailand						Yes
68 Gulf of Thailand	~40,000 ha	13°20'N	Estuary and bay.		Semi-humid warm-tropics.	No
69 Pattani Bay	5,000 ha 1,968 ha intertidal mudflats	06°55'N 101°18'E	Estuaries and bay.	The intertidal mudflats are extremely rich and have been found to support a higher ash-free dry weight of zoo-benthic biomass than any other site in Thailand. Internationally important for migratory shorebirds.	Semi-humid warm-tropics.	Yes
Vietnam						Yes
70 Xuan Thuy Natural Wetland Reserve	[1] 12,000 ha [4] 6,000 ha	20°10'N 106°20'E	Estuary (Delta)	Most important (internationally) wintering and staging area for migratory waterbirds.	Semi-humid warm-tropics.	No

Oceania

State/Site	Size	Coord.	Type	Ecological Importance	Climatic Zone	Contact
Australia						Yes
71 Bowling Green Bay	[1] 35,500 ha [2] ? [11] ?	19°27'S 147°15'E	Estuary and bay.	Important as habitat for some 50% of species listed in the Appendix of both the JAMBA and CAMBA.	Semi-arid warm-tropics.	Yes
72 Corner Inlet	[1] 67,186 ha	38°45'S 146°32'E	Estuaies and back barrier islands.	Important feeding area for waders.	Semi-humid/humid, maritime sub-tropics	Yes
73 Eighty-mile Beach	[1] 125,000 ha	19°29'S 120°35E	Estuary and bays.	Important as landfall for migrating birds. Also important for shorebirds and waders.	Arid warm-tropics.	Yes
74 Moreton Bay	[1, 9] 113,314 ha 23,000 ha mud flats [2, 10] ?	27°20'S 153°10'E	Estuary, bay and back barrier islands.	The Moreton Bay region is an important habitat for many species of birds and is one of four recognized sites to wintering migratory wading birds along the Australian coast.	Semi-humid, maritime sub-tropics.	Yes
75 Roebuck Bay	[1] 55,000 ha	18°07'S 122°16'E	Bay	Northwestern Australia is the most important region for waders on the continent. Staging site.	Arid warm-tropics.	Yes
76 Shoalwater & Corio Bays	[1] 239,100 ha Intertidal area: 25,900 ha [10] ?	22°40'S 150°17'E	Estuaries and bay.	Important as feeding ground for migratory birds.	Semi-arid warm-tropics.	Yes
77 Western Port	[1] 59,297 ha 27,000 ha intertidal mud flats.	38°22'S 145°17'E	Estuaries, bay and back barrier islands..	Western Port is of national zoological significance as a foraging and high tide roosting site for migratory waders.	Semi-humid/humid, maritime sub-tropics	Yes
New Zealand						Yes
78 Farewel Spit	[1] 11,388 ha 9,427 ha intertidal zone [4] ? [10] 11,321 ha	40°32'S 172°50'E	Bay	Internationally important habitat for migratory waders.	Semi-humid, maritime sub-tropics.	Yes
79 Firth of Thames (Miranda)	[1] 8,500 ha 7,000 ha shallow estuarine waters and mudflats [10] ?	37°13'S 175°23'E	Estuary and bay.	The shell banks present in the area are used as high tide roosts by many birds, while adjacent grass flats are used for feeding and as roosts by some species.	Semi-humid, maritime sub-tropics.	Yes

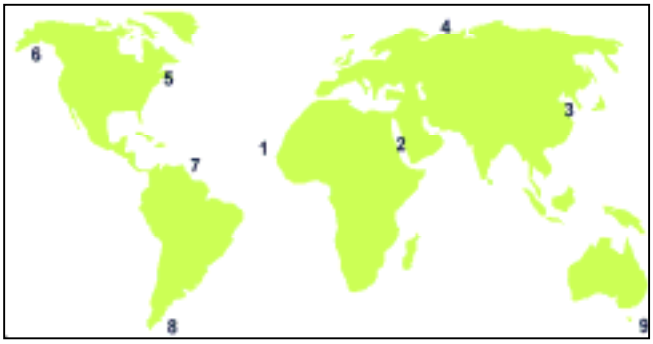
Chapter 5 Comparison of selected sites with the Wadden Sea

In the third step, we want to describe one or two sites per continent and compare them with the cross-border area of the Wadden Sea in Denmark, Germany and The Netherlands. We compare characteristics, common geographical features, like size and position, ecological importance, main uses, main threats and the management concepts. The selection of sites we made depended on size and the information we've got from the sites. One can't compare little sites like 10,000 ha with the Wadden Sea. In contrast to the second step, where we described mostly little separate sites, we tried to put sites together, which are linked areas across borderlines like the Wadden Sea. In some cases we have such sites in Tab 4.1 too, but we always separated by states. Another selection criteria was the kind and quantity of information we got. The sites we described in this step are not conclusively the most important intertidal mud flat areas but possibly the areas we got the most information of. As in the case of chapter 4, the information is heterogeneous, and so in this chapter the description of the regions differ from each other too. In the following, we describe:

1. The coasts of North West Africa,
2. The Persian Gulf,
3. The Yellow Sea,
4. The White Sea,
5. The Atlantic in North America from Georgia to Nova Scotia,
6. The Copper River Delta,
7. The coast of Suriname,
8. Tierra del Fuego and
9. Miranda-Firth of Thames

and compare them with the cross-border area of the Wadden Sea in Denmark, Germany and The Netherlands.

5.1 The Atlantic coast of North West Africa



This area includes the coast from Morocco to Guinea (1). Further south in Sierra Leone and Liberia, we know about intertidal areas but they're mostly covered with a main portion of mangroves. Mud flats are commonly very extensive in lagoons and in other wave-protected situations. The coastline is about 4,000 km long and is dominated by sandy beaches and interrupted in places by river mouths, which often flow through wide estuaries or extensive deltas. The absence of coral reefs along the northwestern coast of Africa is a common feature with the western shores of other continents, such as the Americas. The NW-African coast is influenced by the cold southerly flowing Canary Current. This brings colder water conditions far into the tropics. In addition, cooling of the surface water is added too by the upwelling of colder subsurface water off the Mauretanian coast (centered from 20 to 22°N). The tides on the western coast of Africa are semi-diurnal, and their range is comparatively small, only exceeding 1.8 m at mean high water springs in a few river estuaries where they may attain 3 m (John, D.M., Lawson, G.W., 1991). The climate ranges from sub tropic in Morocco to tropic in Guinea.

Morocco

In Morocco, we know about four lagoons with intertidal mud flats *namely Baie de Khnifiss*, *Merga Zerga*, *Qualidia Lagoons* and *Sidi Moussa Lagoons*. The biggest of them is the *Merja Zerga* or the *Moulay Bou Salham* with an extent of 7,000 ha and has extensive intertidal mud flats, subtidal seegrass beds and fringing marshes. The *Baie de Khnifiss* consists of salt flats, sand flats, mud flats, salt marsh with muddy creeks, dunes, desert and rocky island.

These two sites are important as wintering and stopover site for migratory birds, including waders, and are protected by the Ramsar Convention. The other two sites have probably the same habitats and important functions.
Using the sites for different activities can cause threats. In this case, threats to the sites are growing from tourism, urbanization (new motorway) and overgrazing which causes desertification.

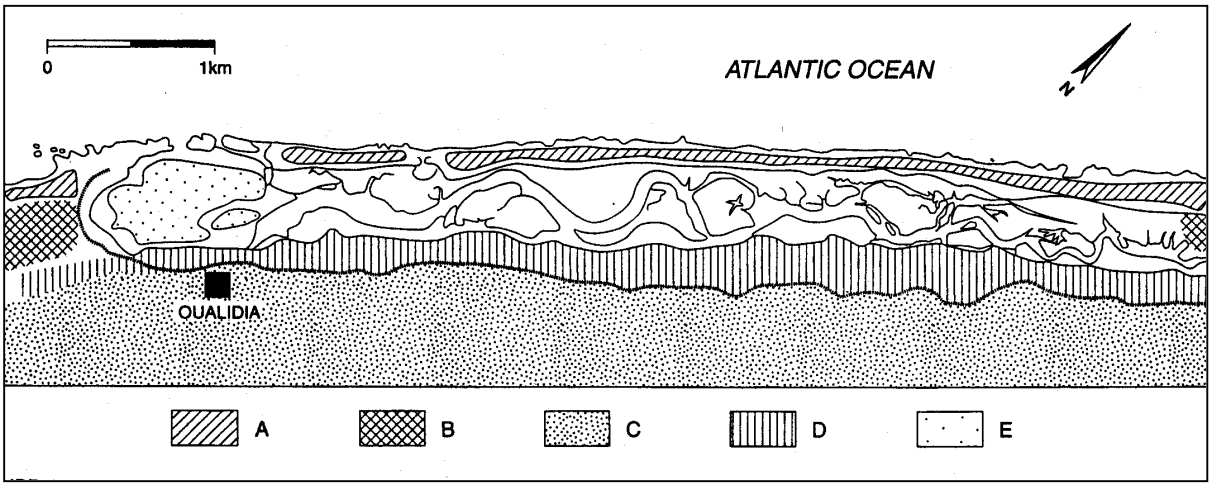


Figure 1: The Qualida lagoon (A = Aeolian soils, B = clayey alluvium, C = red Mediterranean soils, D = lithosols and regosols, E = sand banks of flood tidal delta (in: Eisma 1998).

Since 1980, the sites have been protected by the Ramsar Convention protection and the *Merja Zerga* and the *Baie de Khnifiss* has been a Biological Reserve since 1978 respectively 1962. The management authority of *Baie de Khnifiss* is the Forest Service of the province of Laayoune. A Monitoring-system has been set up, and at *Merja Zerga*, an environmental impact assessment is done to study the potential effects of a motorway (Frasier, S., 1999; Eisma, D., 1998).

Mauritania

The Ramsar site Banc d' Arguin in Guinea Bissau has an extent of 1,173,000 ha, divided into two zones of roughly equal size, one terrestrial and the other marine with 54,000 ha of intertidal flats (Wilson, J.R., Bartner, M.A., 1998), covered with sea grass around a group of 14 islands. Small stands of mangroves occur at this site and are the most northerly stands on the shore of the eastern Atlantic. It is the most important over-wintering site for Palearctic Limikolen and an important nursery

ground for fish. So, the *Banc d'Arguin* is not only important for the local fishery of the indigenous people but also for the national economy as the fish migrates into the open sea where it is caught by traditional or industrial methods. Also little Wales, turtles and monk seals occur at the site.

The site is used for fishing by the tribe Imraguen. Nomads use the site for grazing their camels and goats. The habors are base for a fleet of fishing boats, including factory ships from many nations.

Threats to this site are illegal hunting of gazelles, marine turtles and illegal fishing. Pollution from solid waste is another threat and increasing tourism also destroys the site. Overfishing by international factory fleets may threaten traditional fishing activities of the Imraguen and could cause a decline in numbers of fish-eating birds.

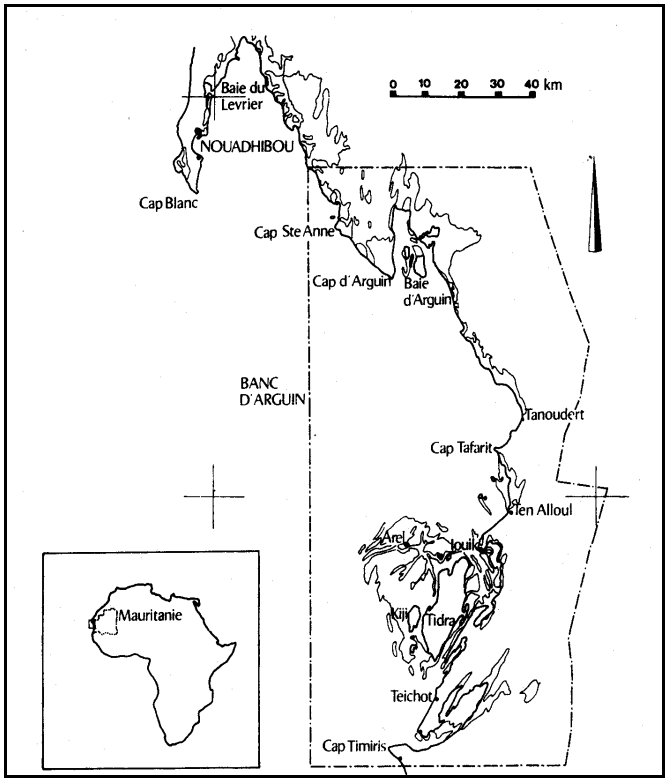


Figure 2: The Banc d'Arguin (in Eisma 1998).

Since 1976, the site has been National Park, since 1982, Ramsar site, and since 1989, World Heritage Site. To protect the National Park, it is tried to implement land- and sea patrols, put up a no-go area, have education campaigns of the public, educate the staff, control recreation and tourism and prohibit hunting. Furthermore, they take an admission fee to finance a good administration of the National Park. Nature tourism can be a chance to get money and control tourism to protect the National Park. Fishing is controlled and in fact only allowed for indigenous communities. Participation of the local people, the Imraguen, takes place. In exchange for the permit to fish and money to maintain their instruments they supervise the site. This work is initiated by the FIBA, the international foundation Banc d'Arguin. The FIBA was founded in 1986 under the chairmanship of the head of the state of Mauretania. Members are Mauretanian Institutes and international organizations which are involved in nature conservation. The goals are to support

and coordinate the nature conservation and research in the National Park (National Park Banc d'Arguin, 1994).

Furthermore, scientific research (also in cooperation with scientists from the Wadden Sea countries) is done to understand the ecosystem, for example, Monitoring of fish, birds and other species, and population biology (Frasier, S., 1999; Eisma, D., 1998).

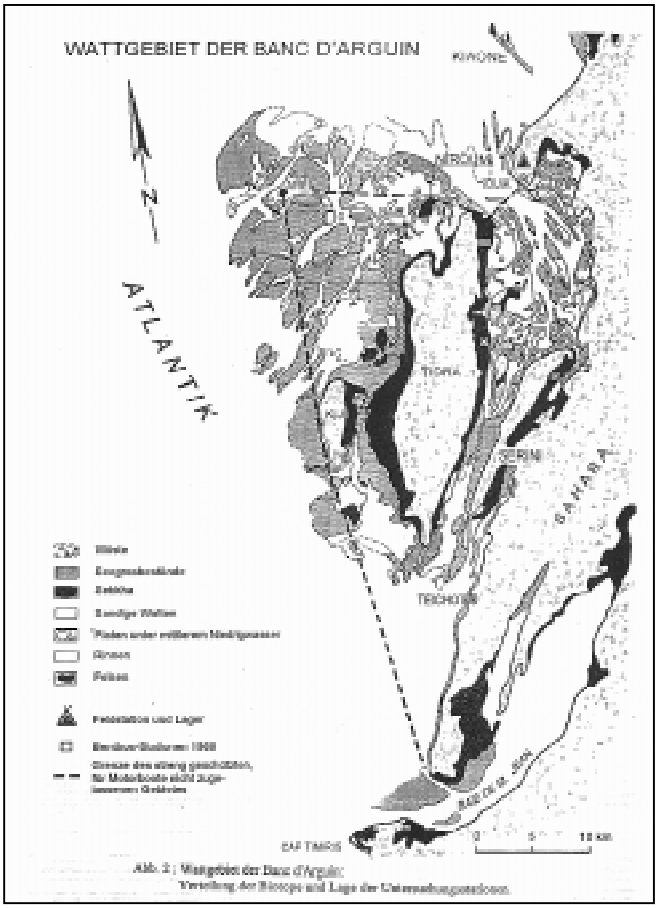


Figure 3: Tidal flats of Banc d'Arguin (Michealis et al., 1997).

Senegal and Gambia

In Senegal and Gambia, intertidal flats occur at several estuaries (*Senegal-, Gambia-, Sine-, Saloum- and Casamance River Mouth*). The flats are usually covered with mangroves only more inland, bare muddy areas called "tanns" occur around high tide level. About the size, no information was available.

The mangrove forest provides an important fish breeding ground and possibly an important habitat for resident and migratory species.

These areas are threatened by reclamation for rice cultivation and dyking for fresh water retention. Human growth and increasing settlements in the surroundings of the sites could have a negative impact on them. Furthermore, recreational activities take place in the Reserve and can disturb the site.

The Baobolon Wetland Reserve (20.000 ha) is the only Ramsar site at the coast of Senegal and Gambia. The valley lies at the northern bank of the River Gambia and just consists of the same mean habitat, tidal flats covered with mangroves, as the other river mouths.

Besides the same threats as at the other sites, another conflict results of the protection, namely the crop damage from wildlife.

The site has been protected since 1996 by the Ramsar Convention, and since 1977 by the Wildlife Conservation Act & Banjul Declaration. The core area of the wetland reserve is under optimal conservation status and environmental, ecological and socio-economic surveys are planned to write an underpinning management plan. Conservation Officers keep the site under surveillance (Frasier, S., 1999; Eisma, D., 1998)

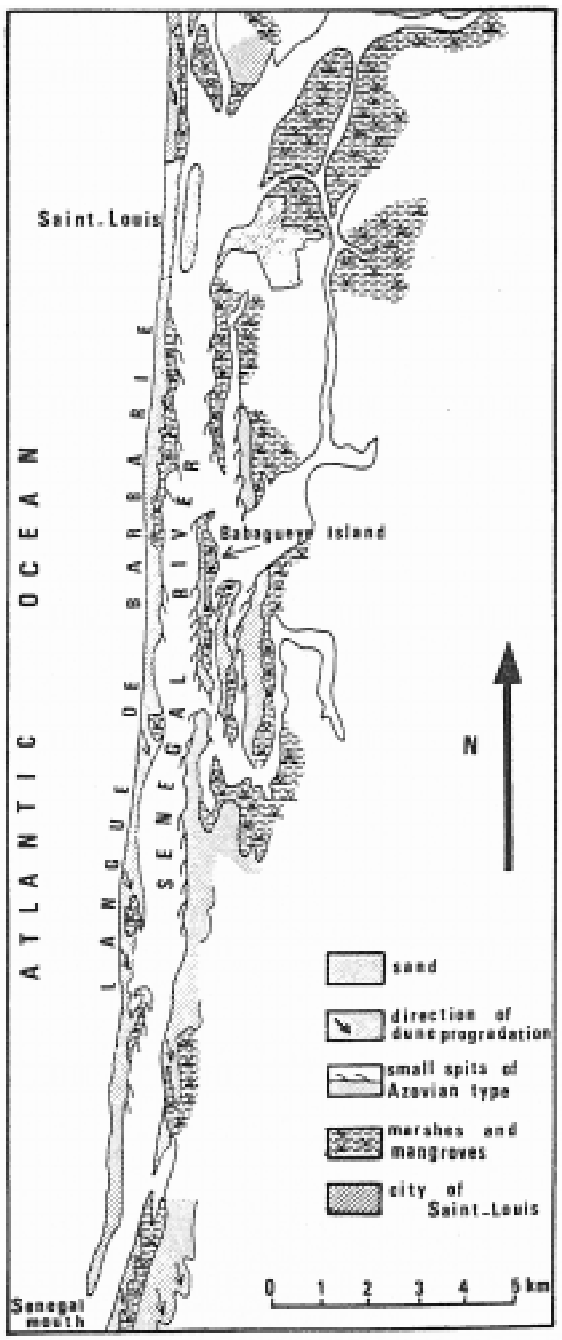


Figure 4: Senegal River mouth (in: Eisma 1998)

Kapverden

The Republic of Kapverden consists of a group of nine inhabited and a few uninhabited island with a total size of, at the most, four times that of Texel. At a few sites, intertidal flats occur behind the beaches which are flooded not much more than once a year. The size of the flats is not larger than a few square kilometers.
The archipelago is used by migratory birds as overwintering site (Koedijk, O.,1989). Information about threats and management was not available.

Guinea-Bissau

Figure 5: The coastal area of Guinea-Bissau showing the intertidal flats (hatched) (Salvig & Asbirk 1994).

Coastal Guinea-Bissau is a delta region, providing 157,000 ha of intertidal mud flats within a stretch of only about 220 km. *The Bijagos Archipelago* is situated just offshore and consists of 48 island and islets at the river mouths of the Rio Geba and the Rio Grande de Buba. Between the islands and along the coastline, extensive mudflats are drained by a network of canals and creeks. The tidal amplitude in this area varies from about 3 m at neap tide to about 4.5 m at spring tide and gives rise to huge intertidal flats at low water which are highly productive in terms of prey for waders and other waterbirds. The Archipelago is partly part of the National Park Orango. Most of the intertidal zone in Guinea-Bissau is fringed with mangroves.

Another area with intertidal flats is the *Lagoa de Cufada*. The site has been protected by the Ramsar convention since 1990 and consists of three freshwater lakes, between the lakes lie seasonally flooded marshes. Marshes lie also along 14 km of the south side of the river Rio Corubal.

The Bijagos Archipelago is the second most important area of wintering waders of the East Atlantic Flyway.

In contrast, Cufada is an internationally important nesting site and a dry season refuge for waterbirds especially for Afrotropical species.

Large expanses of vegetation are burned annually for shifting rice cultivation and to facilitate hunting. Also banana and cashew nut production and fishing takes place at the site and can cause problems. Although the area is state owned, local people retain traditional land use rights.

Overfishing of the *Lagoa de Cufada* may be the result.

Monitoring of birds has been done since 1995 within the scope of a joint initiative of Guinea-Bissau and the Trilateral Cooperation on the Protection of the Wadden Sea.

In the future, *the Bijagos Archipelago* could be target of tourism and fishery, which could damage the site. To prevent unintentional damage, because of lack of knowlage about the importance, research is done to point out the most important sites for wintering waders within the Archipelago. The same activities with the scope of the joint initiative named above is done at *Bijagos Archipelago* too. The joint initiative includes tackling important gaps in knowledge of the wildlife and habitats of the tidal areas along the coast of Guinea Bissau, and the linkages to the Wadden Sea; exchanging information on research, management practices and other issues to enable, where possible, a common understanding and approach on international conservation issues; operating and providing finances for exchange visits and fellowships by staff to broaden the work experience, attend seminars, symposia and conferences, and undertake joint projects; providing advice in areas of special experience to the Contracting Parties; and arrange, where appropriate, joint publications relating to the international aspects of the two areas. In 1996, *the Bijagos Archipelago* was accepted by the UNESCO as a Man and Biosphere Reserve (Frasier, S., 1999; Eisma, D., 1998; Günter, K.,1997; CWSS, Asbirk, S., 1997).

Guinea

At the coast of Guinea, three Ramsar sites are situated. Two sites are at river mouths (90,000 ha and 20,000 ha) and one is an island (1 ha) in one of the river mouths. The intertidal flats are partly covered with mangroves but no information is available about their size.

The estuaries are important wintering sites for palearctic migratory birds.

Main uses of the site are fishing and rice cultivation.

Problems at the site include hunting poaching, rice cultivation, disturbance of nesting sites, waste discharge, logging, oil pollution, increasing fishing and tourism.

All sites are state owned and for the two estuaries also a proposed Outline Mangrove Management Plan (SDAM) exists which, as of 1993, has not yet been implemented (Frasier, S., 1999; Eisma, D., 1998).

Discussion

An obvious difference is the geographical position, which causes, in this case, a difference in the climate zone. The Wadden Sea has a temperate climate and NW-Africa a subtropical to tropical climate. Besides the North West African coastline (4,000 km) is much longer than the Wadden Sea coastline (500 km) of the North Sea. But, at the Wadden Sea coast, the intertidal areas are linked together and in Africa the areas are separated from each other. But the size of the hole intertidal area along the North West African coast (at least 211,000 ha) is smaller than the size of the intertidal area of the Wadden Sea (400,000 ha) (Wilson, J.R., Bartner, M.A., 1998). The tidal range is near the same as the Wadden Sea. As we have a look at the morphology of the whole intertidal flats in NW-Africa, we see the same types but not as close to each other as in the Wadden Sea. In NW-Africa also open intertidal mud flat areas, estuaries and back barrier islands occur. Only lagoons are also part of the coastline in NW-Africa which do not occur in the Wadden Sea. Of course, the habitats are not the same because of the different climate zone. The intertidal flats at the NW-African coast are similar to the Wadden Sea but the part of the Wadden Sea which consists of salt marshes consists in NW-Africa mostly of mangroves. Because of the strategic position on the East Atlantic Flyway, the intertidal mud flats are important for migratory waders. The sites at the NW-African coast are overwintering sites in contrast to the Wadden Sea, that is stopover and

breeding site. The Wadden Sea is also an important habitat for seals and a nursery ground for fish. The intertidal zones at the NW-African coast are nursery grounds as well and besides mammals, such as seals and whales, turtles, monkeys and hippopotamus are indigenous species.

In contrast to the Wadden Sea region, the region of NW-Africa is only a scarcely populated area with an unfavorable climatic condition, so there is not much infrastructure and industry. The main uses of the area are traditional fishing and further south rice cultivation. But, there are threats that can cause problems in the future, and first signs are already visible. Through growth in population, the infrastructure and industry will develop and can disturb the sites. Fishery (not only of indigenous people) can lead to overfishing of the coastal waters. Additionally, as more people become interested in getting to know foreign nature areas, tourism can become a great problem in the future. But, the countries at the coast have now still the chance to create plans for sustainable tourism and fishery and let the local people participate. Participation of the local population usually results in public support and understanding of the high value of the site. In the Wadden Sea area, the public support of nature conservation issues for the area in the local coastal population is minor.

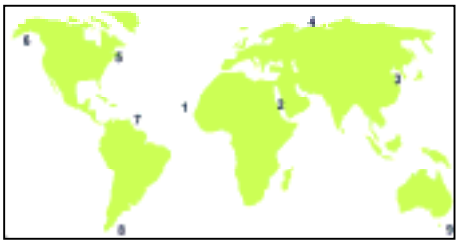
The intertidal flat sites at the coast of NW-Africa are protected by Ramsar, as National Park, National Reserve or Biosphere Reserve. Monitoring activities are in the beginning but management plans are often still missing.

The action plan for West and Central Africa (WACAF) involves all twenty-one countries bordering the Atlantic. Although the WACAF countries adopted the Abidjan Convention for Cooperation in the Protection and Development of the Marine and Coastal Environment of the West and Central African Region in 1981, it had not been ratified until August 1994 (later information not available). In recent years, some bilateral donor agencies, along with the World Bank, have attempted to assist West African nations with the formulation and implementation of coastal zone management plans. But progress is slow since most of the countries lack both a legislative base of supporting regulations and the institutional capacity needed to translate programs on paper into action on the ground. By 1994, only three countries - Guinea-Bissau, Nigeria and Cote d'Ivoire - had initiated coastal area management plans. Only Guinea-Bissau was moving toward the implementation stage in 1996 (Hinrichsen, D., 1998,).

Through cross border cooperation between scientists from the Wadden Sea and Mauritania/Guinea Bissau, monitoring projects and other cooperation projects are set up (A Join Initiative of Guinea-Bissau and the Trilateral Cooperation on the Protection of the Wadden Sea). An end for this cooperation and the implementation of coastal zone management plans was the beginning of the Civil War in 1998.

In the Wadden Sea area, there is more administration and more scientists do research in the area, but the sites at the African coast have better chances for protection in the future, because there has not been much influence from the outside until now, and they can still prevent it for the future by introducing appropriate measures. This is a lot harder in the Wadden Sea area because of disturbances and habitat destruction in the past mainly caused by missing awareness.

5.2 The Persian Gulf



The Persian Golf (2) is a semi-enclosed sea only connected through the narrow Street of Hormoz to the Gulf of Oman and the Indian Ocean. The Gulf is 990 km long and has a mean depth of 31 m. The shallow Gulf is a region of strong evaporation, not much of rainfall and freshwater inflow of rivers, leading to salinity values frequently exceeding 40 ‰ in the northern part. The heavy water sinks down and leaves the Gulf as bottom current. It is replaced by ocean water of about 37 ‰

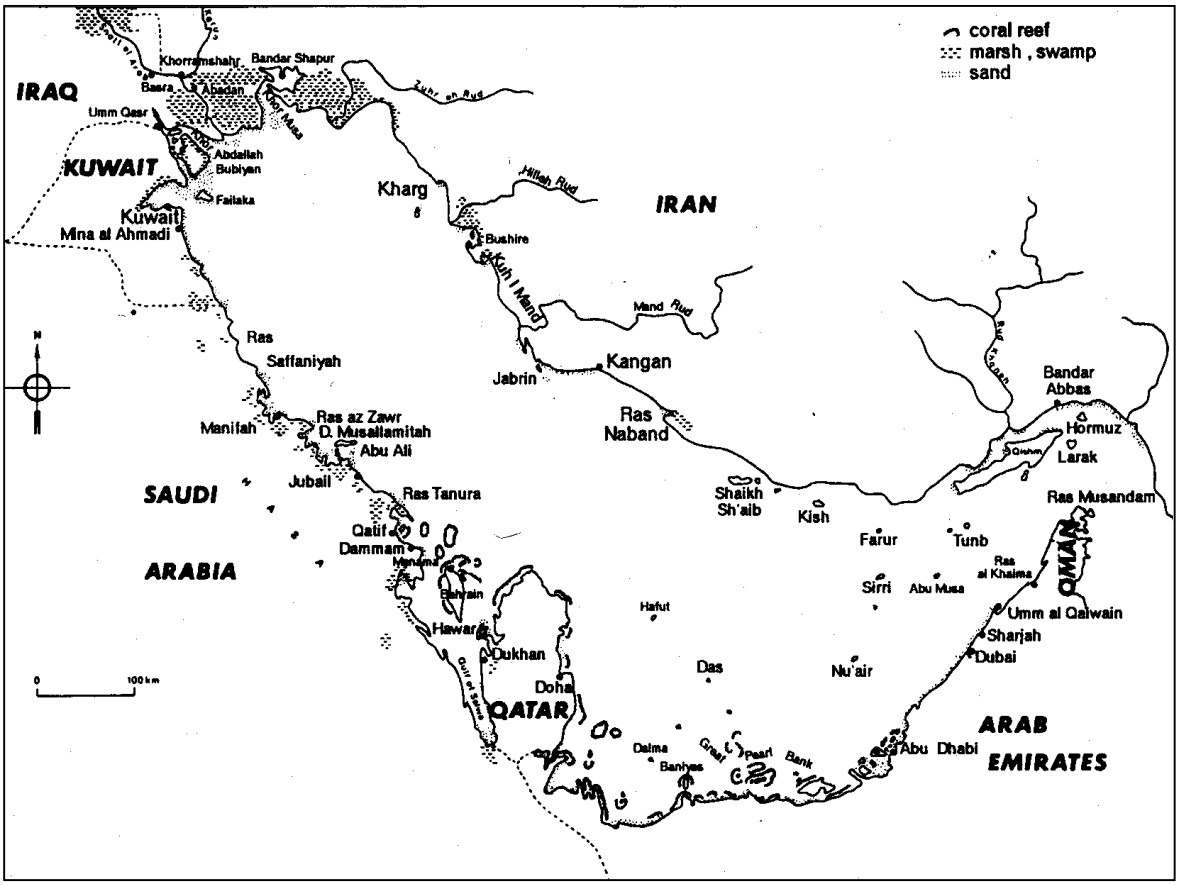


Figure 6: The Persion Gulf (Eisma 1998).

which enters the Gulf as a surface current. The current moves along the Iranian coast while the bottom current runs mainly along the Arabian coast (Hunter, J.R., 1982). So, the water flows counterclockwise in the Gulf. The tides occur in the Gulf diurnal and semi-diurnal with a tidal range of 2 - 4 m at the northern Persian Gulf

and 1-2 m at the rest (Zwarts, L., 1991). The climate is tropical at the eastern Iranian coast and in Qatar and the United Arab Emirates. Along the remaining coast, there is a subtropical climate. In the following, the coastline from the eastern shore of the Street of Hormoz at 57°40' east in Iran to Ras Granada in the United Arab Emirates is described. There are about 300,000 ha of intertidal mud flats.

Iran

In the Street of Hormoz (Iran), three sites with a portion of intertidal mud flats occur, all these sites are protected by the Ramsar convention.

The *Deltas of Rud-e-Gaz and Rud-e-Hara* (15,000 ha) form a continuous strip of coastal wetlands extending for about 40 km from north to south along the eastern shore of the Street of Hormoz. The wetlands comprise a complex of tidal creeks and mudflats, an estimated 900 ha of mangrove swamps, numerous sandbanks and sand bars, and several low-lying muddy islands.

The *Deltas of Rud-e-Shur*, *Rud-e-Shirin and Rud-e-Minab* (11,800 ha), is a large area of intertidal mudflats, mangrove swamps and sandy beaches in the contiguous deltas of three rivers. There are about 300 ha mangroves at the river mouths and along adjacent creeks, and there are long sandy beaches, low sand bars and sand spits.

Also two large shallow bays occur near the mouth of the Rud-e-Minab.

The *Khouran Straits* (100,000 ha) is the largest mangrove-mudflat system in Iran. It is a vast complex of low-lying muddy islands, mangrove swamps, intertidal mudflats and creeks in the shallow straits between the islands of Gheshm and the mainland coast.

All of them are important spawning and nursery grounds for fish and wintering, staging and breeding sites for birds.

Main uses of the sites are fishing (subsistence and commercial), cutting mangrove for charcoal and grazing of domestic livestock.

Threats that can result from the use are disturbance of the areas from fishery boats and cutting mangroves and the exploitation of them. Also there may be some pollution from the nearby port of Bandar Abbas, and oil pollution is an ever present threat.

Only the *Khouran Straits* are legally protected and were once a national park but were downgraded to a protected area in 1980. Since 1975, the site has been protected by the Ramsar Convention and since 1976 it has also been a UNESCO Man and Biosphere Reserve. The other two sites have also been protected by the Ramsar Convention since 1975, but they have now further legal protection.

The *Deltas of Rud-e-Gaz and Rud-e-Hara* have been identified as Important Bird Areas of Birdlife International.

The management activities are restricted to a few surveys of the Ornithology Unit of the Department of Environment. Only at the *Khouran Straits* they have done winter censuses in most years since 1970. There is also a marine research station on the island of Hormoz. (Frasier, S., 1999)

Iran / Iraq / Kuwait

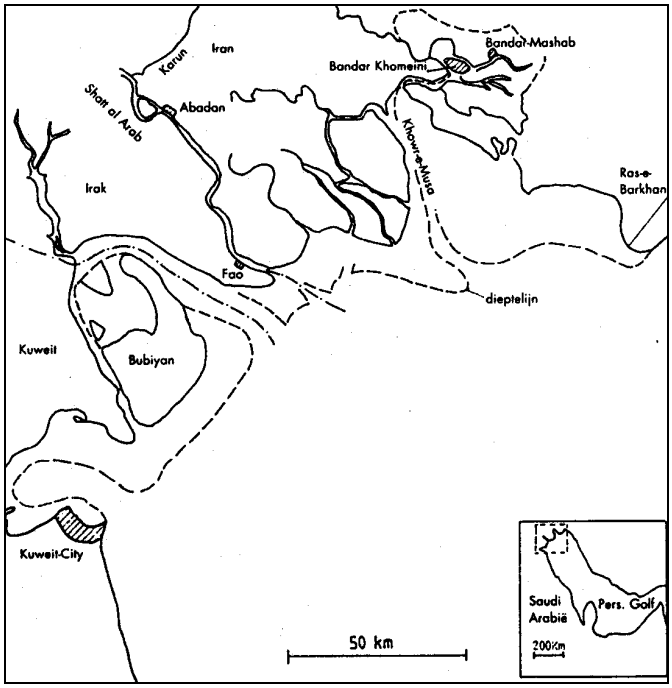


Figure 7: North west coast of the Persion Gulf from Kuwait to Ras-e Barkan (Höpner, 1991)

A large cross-border area of intertidal mud flats occurs between Ras Barkan in Iran and Kuwait. This area includes the *Bay of Kuwait*, the creeks around the *island of Bubiyan*, the *Shat al Arab* and the *Khowr-e Musa* system. The intertidal area is 200 km long and it is 2 to 15 km wide (Höpner, Th., Kazem Maraschi, S.M., 1999). The total intertidal area can have an extent from 40,000 ha to 300,000 ha. At the entrance of the Shat Al Arab, the tidal range is more than 3 m (Eisma, D., 1998).

The *Khowr-e Musa* is a basin with a 50 km long connection to the open ocean. It is not an estuary because it has no freshwater inflow. The tidal range here is 2 to 3 m, but in the 89 m deep connection channel, the range can be up to 5 m.

Together with parts of the *Shat Al Arab,* the Khowr-e Musa forms the Ramsar site *Shadegan Marshes and the mudflats of Khor-al Amaya and Khor Musa* with a size of 400,000 ha. The wetland comprises the southern portion of an extensive floodplain and delta system of the Karun, Dez and several other rivers which rise in the northwest Zagros Mountains of western Iran. Numerous small islands exist, and additional islands are forming as a result of depositions from the Karun river and the *Shat Al Arab*. Besides the importance for wintering and staging migratory birds, the *Khowr-e Musa* basin is important for the whole northwestern coast of the Persian Gulf. The basin provides the further coastline with larves, eggs and organisms which are responsible for the biological richness.

The Ramsar site is used by two industrial ports that are located in the basin. A petrochemical industry is located at the ports. Fishery of indigenous people takes place, and at a research station, aquacultural work is done to cultivate shrimps. Further uses are reed- and rice cultivation and shipping on the *Shat Al Arab*.

The industrial ports and waterways can cause oil pollution from ship traffic , the site may also have suffered from damage as a result of "acid rainfall" during the Gulf War of 1991. Long-term threats to the wetland are diminished water supply as a result of diversion of water for irrigation, pollution of water, and destruction of habitats by water desalination plants.

Since 1971, the Ornithology Unit of the Department of the Environment has undertaken annual mid-winter censuses, and several breeding season surveys on other occasions.

A wildlife refuge of 296,000 ha, encompassing all the main wetland areas and the coastal mudflats in the south, was established in 1972. Hunting is prohibited at this refuge. A good possibility to protect the intertidal areas in Iran holds the bilateral governmental agreement with Germany that includes also the environment. Furthermore, the University of Ahwaz (120 km away from Bandar-e Khomeni at the *Khowre-e Musa*) has a cooperation with the ”Institut für Chemie und Biologie des Meeres”, ICBM, of the University of Oldenburg, Germany. (Frasier, S., 1999; Höpner, Th., Kazem Maraschi, S.M., 1999)

The Kuwait Bay has an extent of approximately 80,000 ha and 40 % (32,000 ha) of it is falling dry at low tide. The tidal range is 3.5 to 4.3 m (Eisma, D., 1998). Tidal sand and rock flats in Kuwait, for example, are primary confined to small stretches at Al Jadailiat and Al Doha. The remainder of *Kuwait Bay* including Sulaibikhat consists of wide mud and sandy mud flats (Clayton, D.A., 1986).
In common with the other described intertidal mud flats, *the Kuwait Bay* has its importance for wintering, staging and breeding birds.

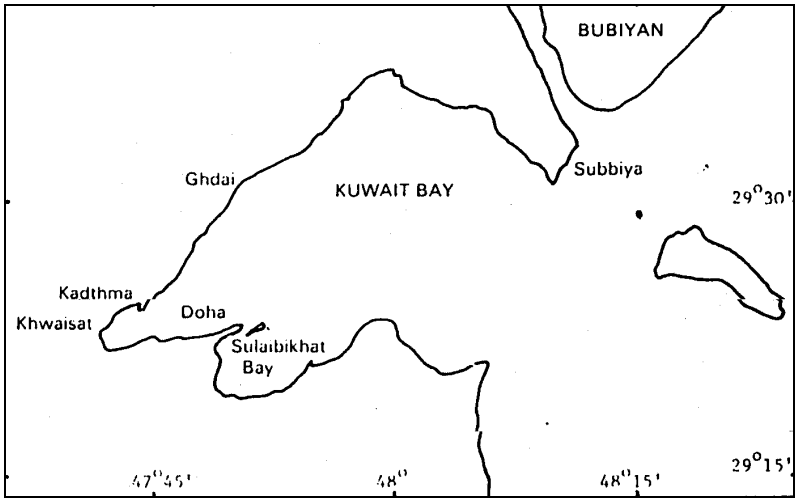


Figure 8: The intertidal mudflats of Kuwait Bay (Clayton 1982/1986).

About uses and threats, only assumptions can be made. The Bay is probably used as waterway to the port of Kuwait City where oil exploitation industry is situated. Shipping traffic and pollution from oil tankers can cause problems. During the Gulf War, the sea was polluted with oil and could have caused damage to intertidal mud flats (Frasier, S., 1999)

Saudi Arabia

Tidal flats are the most important type of intertidal environment, in terms of area, along the Gulf coast of Saudi Arabia. Tidal flats occupy 30 to 40 % of the area of numerous large and small bays along the coastline. Extensive tidal flats also occur on the sheltered southeast side of each of the major headlands or coastal projections. The total area of tidal flats along this coastline can roughly be estimated to between 50,000 ha and 100,000 ha in 1981, today, it is considerably less, approximately 20,000 ha (Zwarts, L., 1991). The greater part of these flats consists

of mud or very fine sand, deposited in bays and other sheltered locations where wave energies are low. Large, flat areas of intertidal sand occur in many locations where wave or current energies are higher than those prevailing in the mud flat areas, but less than found on exposed beaches. For example, extensive tidal sand flats occur on the windward northern side of Tarut Island, while on the leeward side, the tidal flats consist almost entirely of mud. Intertidal rock flats occur extensively along the Saudi Arabian coast, especially in the *Gulf of Salwah* and in other bay areas, where conditions favor the formation of beach rock. Tidal rock flats in form of faroush, a soft greyish limestone made up of broken shells, sand and mud particles cemented together, occupy large areas in *Tarut Bay*. The rock layer is usually 10 to 20 cm thick, and the underlying sediments, which consists of coarse shell and sand with a silt or mud admixture, are often anaerobic. Wide expanses of intertidal rock flats are also found along relatively sheltered sections of open coasts. These rocks are often rougher in texture than the faroush flats in bays, and may be partially covered by thin sheets of sand (Basson, P.W.; Burchard Jr, J.E.; Hardy, J.T.;.Price, A.R.G., 1981).

The Jubail Marine Wildlife Sanctuary is located to the north of the industrial city of Jubail. It covers an area of more than 200,000 ha and includes the two shallow bays of Dawhat ad-Dafi and Dawhat al-Musallamiya, the stretch of the coastline between Abu Ali and Ras az-Zaur and the five coral islands Harqus, Karan, Kurain, Jana and Juraid. The area consists of terrestrial desert habitat, wetland habitat, intertidal habitats with rocky shores, sandy shores, muddy shores, salt marshes and mangroves. Other habitats at the sanctuary are shallow subtidal, open water, offshore coral reefs and islands.

The site is an important fish ground and important for migratory birds as wintering and staging ground. Furthermore, turtles, sharks and dolphins occur at the site.

The area is used for fishing and recreational activities like diving.

Threats may be pollution from the industrial city of Jubail, pollution from oilspills during the Gulf War, and damage from recreational activities. The administration of the sanctuary is probably under the National Commission for Wildlife Conservation and Development from the Kingdom of Saudi Arabia. There are a few regulations to be followed within the site. This includes to avoid making new tracks across the sand, the prohibition of hunting, corals may not be removed from the sea, the prohibition of spearfishing, taking care where drop anchors, the prohibition of removing turtle eggs - hatchlings and adults, to avoid disturbance of nesting birds on the islands and that no garbage may be left behind in the sanctuary (Jones, D.A.; Fleming, R.M.; At-Tayyeb, H.H.).

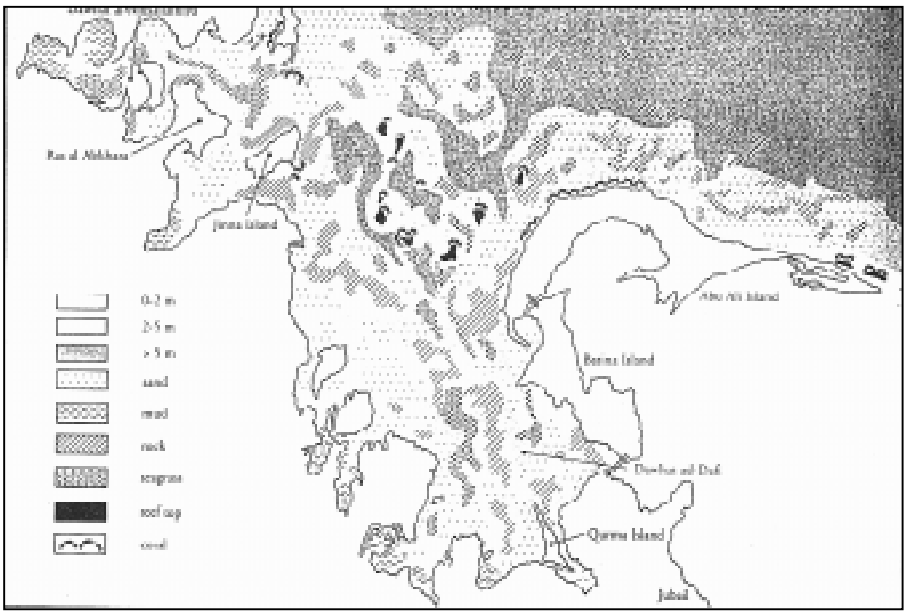


Figure 9: Map of the subtidal habitats of the Jubail Marine Wildlife Sanctuary (Jones 1996)

In the mid-1970s, Saudi Arabia planed to build Jubail, a large industrial community as a major step to economic diversification. From the beginning, the major goal of the Royal Commission of Jubail City has been industrialization with environmental protection. To avoid unpleasant environmental side-effects, they followed specific politics and constant monitoring of industrial activities. After the oilspills in the Gulf War, the Royal Commission, assisted by local business and other agencies, established the Jubail Wildlife Rescue Center (Royal Commission of Jubail and Yanbu).

Other intertidal mud flats along the coast of Saudi Arabia occur at the *Tarut Bay* protected by the landspit Ras Al Tannura. There is also, comment on the presence of many smaller, but similar (unspecified) bays along the Saudi coast. Uses and threats are probably the same as at the other sites (Clayton, D.A., 1982).

Bahrain

In Bahrain, we know about two little sites with intertidal mud flats which are also protected by the Ramsar Convention. The *Huwar Islands* is a 5.3 ha big archipelago in the Gulf of Bahrain. The other Ramsar site is the 1.6 ha big *Gulf of Tubli*.

Qatar

Along the *Qatar Peninsula* coast, small areas of intertidal flats, up to 7 km wide, are present in bays, with chenier beaches and spits in some bays. The flats are accreting and cementation of tidal flat sediment occurs in layers of a few centimeters' thickness beneath the surface or the flats at the level of low tide in the sediment (Eisma, D., 1998).

United Arab Emirates

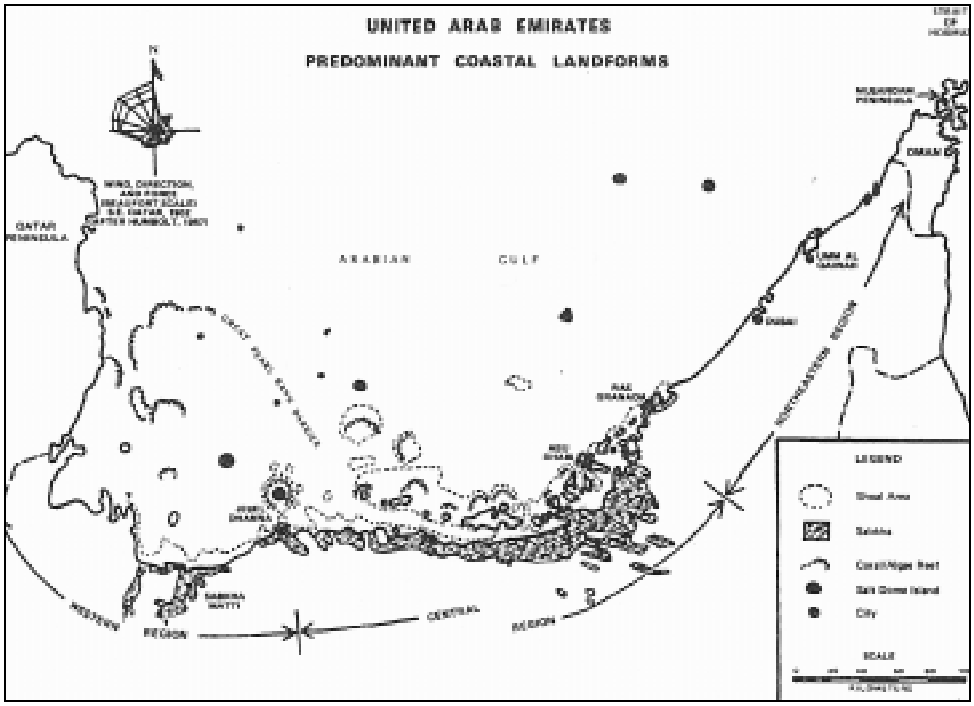


Figure 10: The coast of the Persian Gulf between Qatar and Oman (in: Eisma 1998).

The coast of the United Arab Emirates is in large parts protected by reef barriers, and intertidal flats occur in separate embayments along a zone between the Qatar peninsula and Ras Granada. Most of the coast is dominated by sebkhas (Sebkhas

are vegetation-free with salt encrust areas at the coast, which are situated just above normal high tide level and become submerged only during the higher tides and during storm surges (Barth, H.J., 1998).). Intertidal flats are present seaward of the sebkhas and at the eastern side of the "lagoon terraces" which are seldom flooded by more than 2 m water and often fall dry at low tide. In the lagoons the salinity can raise to a value of 60 ‰ (Eisma, D., 1998).

Discussion

Actually, the Persian Gulf is quite different to the North Sea, much depends on the climatic zone. The Persian Golf is an edge-sea as the North Sea but the latter has wider connections and greater exchanges with the open ocean. The freshwater inflow in the Persian Gulf is little, because the rivers are dry much of the year. Only the Shat Al Arab has greater amounts of inflow into the Gulf. River Mouths, bays, protecting sand-banks and unprotected intertidal mud flats occur in The North Sea and in the Persian Gulf as well. The development of the intertidal mud flats is mainly caused by sediment supply from rivers. The *Shat al Arab* provides the southern coast of the Persian Gulf with sediment. In the most southerly parts of the Persian Coast, coast intertidal mud flats are possibly developed by deposits from the Persian Gulf itself This is similar to the Wadden Sea, where intertidal mud flats developed by river supply or deposits from the North Sea. Also the size of the intertidal mud flats at the Persian Gulf is comparable to the North Sea, but as in the case of the NW-African coast, the area is separated and only the coast from Ras Barkan (Iran) to Kuwait of 200 km forms a related area.

The intertidal mud flats of the Persian Gulf are an important staging and wintering site on the migratory route of many bird species. The Wadden Sea at the North Sea lies on the East/Atlantic Flyway and the Persian Gulf, in contrast, on the West Asia/Africa Flyway. The migratory birds breed in Siberia and stage and winter at the Persian Gulf and some species winter in eastern Africa.

The Gulf is commonly used as waterway for the exploitation of oil, other products and for fishery by the local people. The related threats of these uses are pollution from oilspills, especially during the Gulf War, and reclamation of intertidal mud flats for settlements and coastal development, e.g..

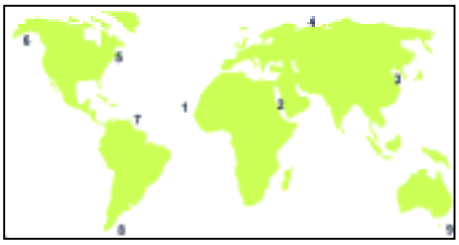
A new, but big problem, is the production of freshwater from seawater in desalination plants at the whole coast of the Persian Gulf. The number of thermal

desalination plants is 277 at this coast. The water taken in must be as poor as possible in suspended matter, which is archived by wide, deep and long channels through which the water flows very slowly and without turbulence. Sometimes the channels are more than 1 km long. In contrast, much less expense is usually spent on the outfall. To save money and to move the processed water as far as possible from the point of intake, natural tidal channels, river mouths, lagoons and mangrove swamps are used to guide the discharged water away from the intake. The purpose is to avoid recirculation effects between the intake and the outlet, which clearly is not so easy when the currents change with the tides and the winds (Höpner, Th., 1998). This and the building itself are coastal morphological impacts that disturb and damage the coastal ecosystems. During the production of freshwater and the production of necessary energy from oil fired power plants, many chemicals are emissioned into the sea like corrosion products (metals), antiscaling additives (polycarbonic acids, polyphosphates), antifouling additives (mainly chlorine and hyperchlorite), halogenated organic compound forms after chlorine addition, antifoaming additives, anticorrosion additives, oxygen scavengers (sodium sulfite), acid. Furthermore, the processed sea water is very concentrated and a lot hotter than the intaken water. These emissions cause damage of the ecosystem through an increase in salinity and temperature of the seawater and the chemicals damage the quality/natural backyard concentration of the water.

Ecological Impact Assessments can serve to solve problems already in the planning time of a desalination plants. EIAs, are a way to avoid pollution in advance, they are gernerally a component of normal environmental law in the Western World, but not so in the countries of the middle East, although they are in process of adopting or have already adopted corresponding environmental laws. EIAs can serve international financing and, additionally, it helps to establish a good reputation outside the country and is a selling promoter of environmentally sensitive export products such as food or chemicals (Höpner, Th.,1998).

The protection of the intertidal mud flats along the coast of the Persian Gulf cannot be compared with the Wadden Sea. Many of them are not legally protected by the country, in some cases only by the Ramsar Convention. This may be because there is no ecological understanding for the high value of the importance of intertidal mud flats. Since the oil spills in the Gulf War, seabirds covered with oil are shown on TV around the world, thus the international awareness and attention is increasing.

5.3 The Yellow Sea (3)



The Yellow Sea and its adjacent Bo Hai Bay lie between China to the east and north and South Korea to the west, covers about 460,000 square kilometers and contains 18,000 cubic kilometers of water. Despite theses figures, both bodies of water are relatively shallow. Their average depth varies from 38 meters in the north to 46 meters in the south (Hinrichsen, D., 1998, pp. 152). The climate is subtropical but has very low temperatures in winter. The seasonal fluctuation in surface water temperature occasionally reaches more than 25°C, nowhere else in the world is the annual fluctuation larger. Another feature of the climate in this region is the prevalence of monsoon winds. The southeast monsoon prevails in summer and the northwest monsoon in winter. The tides are generally semidiurnal, with the exception of the innermost Gulf of Bo Hai, where a diurnal tide occurs and rotates counterclockwise. The tidal range for each region is discussed below (Nishimura, S.,1983). The described coast stretches from the south coast of Korea to the Hangzhou Bay in China and has an extent of intertidal mudflats of at least 1,088,800 ha.

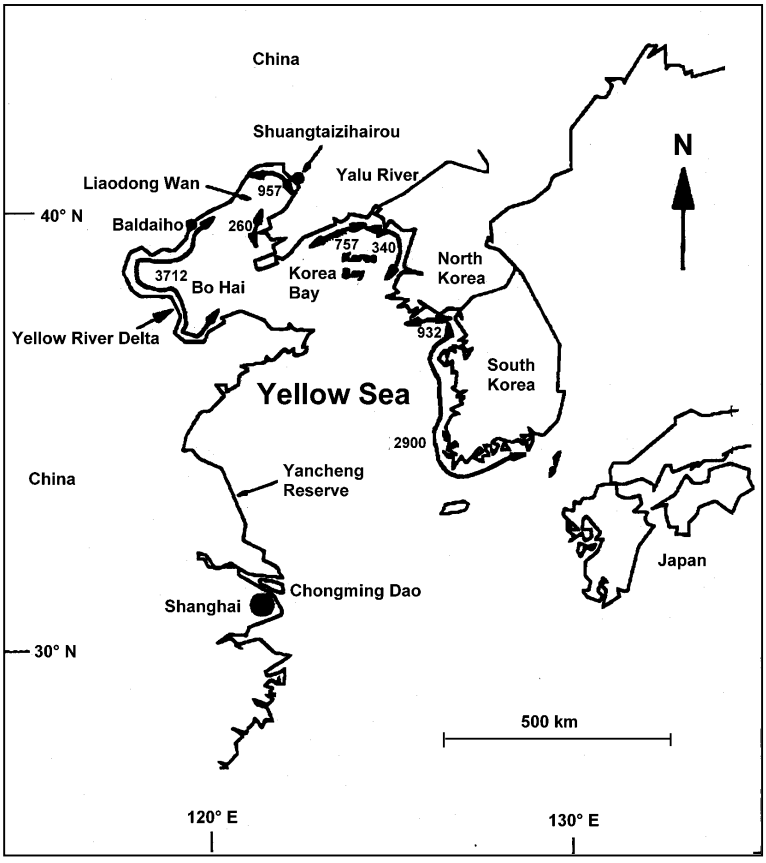


Figure 11: The Yellow Sea region showing the areas of intertidal mudflats (km^2) (Wilson & Barter 1998).

South Korea

South Korea has a ria coastline with a total area of intertidal mud flats of 285,000 ha (at the beginning of the 1990s) and a width up to about 10 kilometers. The intertidal mud flats fringe almost the whole coastline from southeast to northwest Korea. Many small islands (approximately 3,000) with rocky shores are scattered over the flats while mountains and hills of 150 to 800 meters height border its fringes. The tidal channels are up to 30 meters deep. The development of Korean tidal flats is supposed to be related to the large supply of sediment from the Yellow River in China. The tidal range in spring tides increases from 2.4 m in the southeast to 3.9 m in the south. 4 m in the southwest and 7 m in the central west and 9.3 m at Incheon in the northern west. The air temperature is usually between around - 8.3 °C in December and 38 °C in July. The occurrence of ice in winter is not unusual.

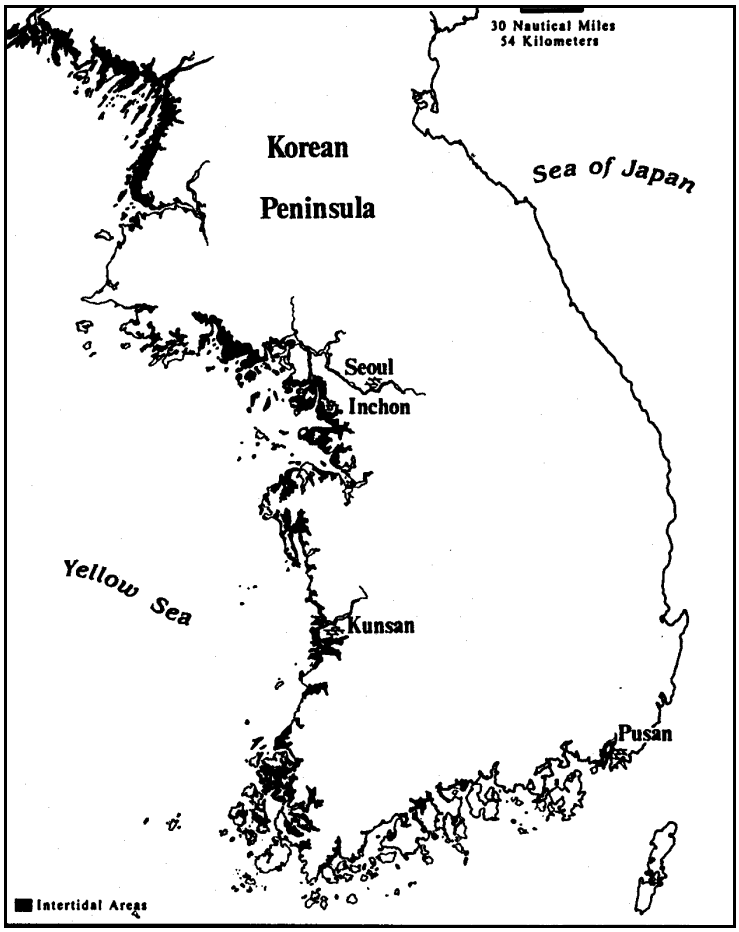


Figure 12: Major tidal flat areas in Korea. Although abundant along the southern coast, intertidal areas are much more prominent along the western coast (Frey et al. 1987)

Due to the high productivity of the mud, mixed and sand flats, this area is an important foodstone for migrating birds along the East-Asian-Australasian Migratory Bird Flyway between the Indonesian Archipelago, Australia and New Zealand, and East Siberia and Alaska. The shallow waters along the coast of Korea are also an important fish ground, especially the Saemankeum as a major regional fish hatching and nursery area.

For this reasons, the tidal flats of South Korea support considerable fisheries on bivalves, crustaceans and fish, and are also the basis for aquaculture of shrimp and algae. Fisheries play an important role in the Korean economic. The fishing is carried out mostly by small vessels and probably by international fleets in the Yellow Sea but also by walking out with beach seines or by hand collections. Furthermore, the coastal zone is utilized by agriculture, that is predominately rice fields. Tourism and recreation is centered in a few places near large urban areas because in many regions infrastructure is poorly developed.

There are, however, increasing threats to the Korean intertidal mud flats from land reclamation. Embankments of tidal areas were already started in the first decades of this century. Intensive reclamation went hand in hand with the unprecedented growth of the Korean economy in the sixties and seventies, when a total of 40,000 ha was embanked for agriculture and industrial plants. A second intensive phase was initiated in the nineties and is still in progress. The total area of reclamation, proceeding today, is 76,400 ha. The reclamation of intertidal mud flats destroyed the resting sites for migratory birds and fish grounds. There is already a decrease in numbers of migratory birds and in shell fish catches. Some lakes that are formed by the reclamation through a dyke are considered seriously polluted because of very limited water exchange and industrial discharges from surrounding areas.

In contrast to the mountain region of Korea, at the coast no protected areas have been established. The only way to preserve intertidal mud flats is to enact laws and support them administratively. A "Law for Wetland Preservation" is still pending and the "Management Law for Coastal Areas" recently had a public hearing. But the Korean Ministry for Fishery and Maritime Affairs is currently considering an option to establish a National Park in smaller or larger parts of the intertidal area. Probably this is due to the forming of nature protection NGOs which came out of the human rights movement and puts pressure on this subject. KFEM (*Korean Federation for*

Environmental Movement) is one of them and they are connected under the umbrella organization *Korean Wetland Alliance*, which has been established at the Brisbane Ramsar Conference in 1996. The NGOs have raised awareness of local people with regard to the international importance of their area. Several plans for land reclamation could be stopped by pressure from local groups and communities. Another aim of the Korean Wetland Alliance is to nominate the intertidal mud flats as Ramsar areas. But to prove the internationally importance of the intertidal mud flats, there was only few information about ecological value and scale of the threats. Therefore, the Korean Wetlands Alliance undertook a wetlands and waterfowl survey, conducted in six circuits along the south and west coast. The survey had the aim to identify the wetlands supporting internationally important concentrations of waterfowl - especially shorebirds and endemic species in the Yellow Sea, the identification of threats, if any, to the ecological character and integrity of such sites and the creation of a network of environmentalists, who, through being provided with data and basic training, could participate in surveys and involve their groups at the local and national level in wetland conservation activities. The product, a report, the South Korean List of Internationally Important Wetlands for Waterfowl: The 1999 Shadow List (Wilson, J.R., Barter, M.A., 1998; Korean Wetlands Alliance, 1999; Moores, N., 1998; Koh, C.-H., 1999).

There are contacts between the Seoul National University, the National Park Authority of Korea and the National Park Office Schleswig-Holstein Wadden Sea to promote scientific exchange on common topics of Wadden Sea research and understanding of ecosystems dynamics and to elaborate the best suitable ways and means for efficient protection of tidal flats in South Korea (Kellermann, A., Koh, C.-H., 1999).

North Korea

The intertidal mud flats of North Korea have an extent of 227,200 ha (Wilson, J.R., Barter, M.A., 1998). There was no detailed information about ecology and management.

Peoples Republic of China

At the Yellow Sea coast of China, intertidal mud flats occur in the *Korea Bay*, at *Liaodong Wan*, in the *Bo Hai Bay*, at the *Jiangsu coast*, at the *Chang Jiang River*

Mouth and in the *Hangzhou Bay*. The *Korea Bay* intertidal mud flats have an extent of 75,700 ha and the flats at *Liaodong Wan* 124,700 ha and the sediment is supplied by the Yellow River, there was no further information about this sites (Wilson, J.R., Barter, M.A., 1998).

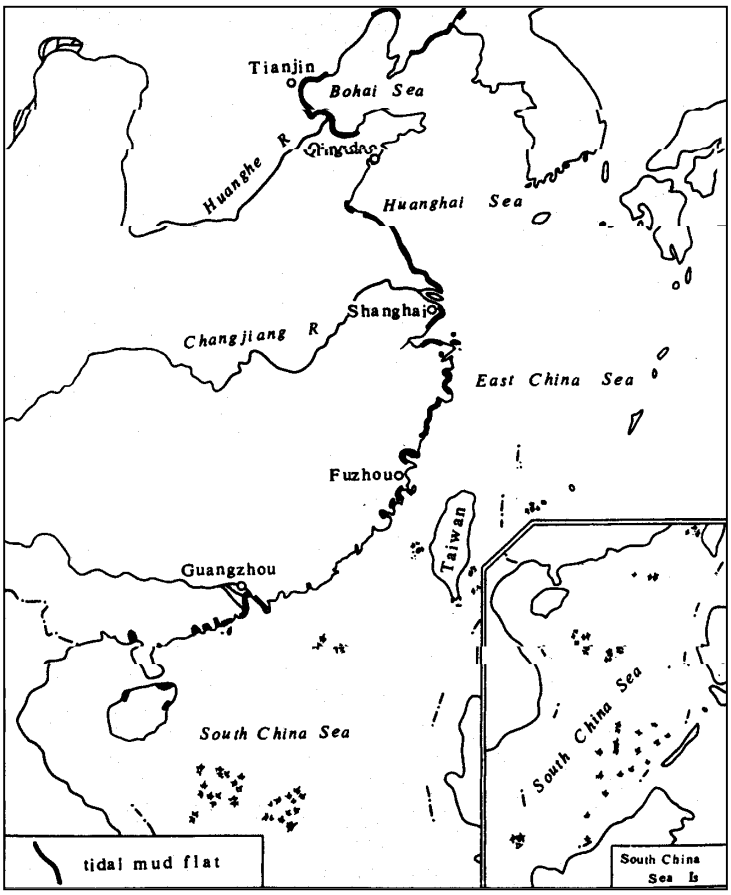


Figure 13: Distribution of mud flats along the Chinese coast (in: Eisma 1998).

Intertidal flats occur at the coastline of the province of Jiangsu from 35° to 32° N at the abandoned river mouth of the Yellow River at Feihuanghekou and also along approximately 30 kilometers of the coast around Lusi in the south. While elsewhere along the Jiangsu coast the mean tidal range is 2.5 to 4 meter, it increases at the coast near Jianggang to more than 4 meters up to 7 meters. The sediment along the Jiangsu coast has been supplied by the Yellow River, which, for almost 700 years up to 1855, had its mouth on the *Jiangsu coast* at Feihuanghekou. After this mouth was abandoned for the present one in *Bo Hai Bay*, erosion of the former river mouth produced the sediment that has been, and still is, deposited on the mud flats south of the Sheyang River (Eisma, D.,1998). There was no further information about this site.

Intertidal flats occur in the *Chang Jiang River Mouth* and to the south around *Hangzhou Bay* at about 31°30' N to 30° N. The maximum tidal range in the *Chang Jiang River Mouth* is 6 to 6.8 meters, and in the *Hangzhou Bay*, 4.9 meters at the entrance, increasing to 8.9 meters inside. Both in the *Chang Jiang River Mouth* and *Hangzhou Bay*, the sediment comes from the Chang Jiang River; only in the innermost part of the *Hangzhou Bay* can sediment from the Qiantangjiang, the largest river that flows into *Hangzhou Bay*, be recognized.. Considerable areas of

intertidal flats are present at the Chang Jiang estuary along Chongming Island and the islands Changxin and Hengsa, around Nanhui coast (a headland between the southern part of the Chang Jiang estuary and the north shore of *Hangzhou Bay*), and along the north and south shores of *Hangzhou Bay*. The intertidal flats along the eastern side of Chongming Island are up to 7 kilometers wide and the Nanhui intertidal flats have a seaward extent over a maximum distance of about 20 kilometers (Eisma, D., 1998).

At the *Bo Hai Bay* intertidal mud flats occur with an extent of 371,200 ha (Wilson, J.R., Barter, M.A., 1998). The tidal range in *Bo Hai Bay* and around the Yellow River Delta is about 1 meter but increases northward toward the Liao He River Mouth to more than 4 meters (Eisma, D., 1998). The tidal flats are developed by sediments of the Yellow River. This site includes the *Yellow River Delta National Nature Reserve*. The total area of the reserve is 153,000 ha, where the current Yellow River Mouth is included, however, most parts of the delta are excluded. The reserve consists of mainly marine and coastal wetlands, including 31,314 ha marine waters, 38,534 ha intertidal mudflats, 32,772 ha intertidal reed marshes and 7,966 ha inland or man-made wetlands, including permanent rivers and streams, fresh water ponds and reservoirs are dispersed in the terrestrial area. Six kinds of habitats can be identified in the Reserve, including farmland and reed ditches, forest, reed and meadow wetlands, salt bush marshes, water areas and Seepweed mudflat.

The area provides an excellent habitat for waterfowl. In the Sino-Japanese Agreement on the Protection of Migratory Birds and their habitats, the Yellow River Delta Nature Reserve is home to 152 species, constituting 67% of the total of 227 species. In the Sino-Australia Agreement, 51 species have been found in the Reserve accounting to 63% of the total of 81 species. The area is part of a region with a high population that can destroy the reserve with their activities. Large scale and irrational reclamation has been carried out since the end of the 1950s. The oil industry (Shengli Oil Fields) is the main source of pollution in this region. Eutrophication and red tides have begun to occur in the river mouth, which are harmful to the aquatic ecosystems and decrease food production for waterfowls.

The newly established Dongying Municipality paid great attention to nature conservation. On the basis of sufficient survey and demonstration, the Yellow River Delta Municipal Nature Reserve was set up in December 1990, then in November 1991, it was promoted into Dongying Yellow River Delta Provincial Nature Reserve,

and in October 1992, it was further promoted into *Shandong Yellow River Delta National Nature Reserve*. The Administrative Bureau of the Reserve was set up in December of 1992, with three management stations Huanghekou, Yiqianer and Dawenliu. The reserve is mainly to protect newly-formed coastal wetland ecosystems and rare, endangered birds, with 79,200 ha core area, 10,600 ha buffer zone and 63,200 ha experimental zone. The core area should be strictly protected, only opened for scientific observation and research. The experimental zone can be used for scientific experiments, practice teaching and tourism etc.. There are still many human activities (fishery, rice cultivation) in the buffer zone due to historic reasons. Shandong Yellow River Delta National Reserve Administration Bureau exercises total managing authority over the reserve. The local communities can continue to conduct their traditional activities (e.g. agriculture, fishing, apiculture, fuel wood collection and oil extraction) under agreement with the reserve Administration Bureau. In most cases when there is a sharp conflict, the government will decide the outcome. The Bureau often holds joint meetings with local stakeholders to reach consensus on wetland management issues and achieve understanding and assistance from local people.

For the same reason, Dongying Municipal Government decided to install the Shandong Yellow River Delta National Nature Reserve United Conservation Committee in June 1997, which consists of the member of relevant authorities.

Although the Yellow River Delta has a very successful wetland management system, some elements still need to be strengthened: Firstly local awareness should be improved through different training courses and public awareness campaigns. Secondly the reserve administrative bureau should be enhanced as the government authority which is responsible for the wetland management and relevant co-ordination between different agencies. This enhancement should comprise the capacity to build the nature reserve itself, and gain more power from municipal government. Thirdly the current management system should strengthen its abilities to solve some specific conflicts, e.g. between Shengli Oil Field and the Reserve Bureau, which is a difficult task needing more coordination and high awareness (Kelin, C., Jun, Y,).

Discussion

The intertidal mud flats at the Yellow Sea (1,088,800 ha) have a greater extent than the Wadden Sea (400,000 ha) (Wilson, J.R., Barter, M.A., 1998), but they have similar comparable aspects. Like the Wadden Sea, the intertidal mud flats in North and South Korea are fringed by islands but the further coastline in China has not this character. The landward coast of China has similar shallow waters as the landward coastline of the Wadden Sea, but in North and South Korea mountains and hills of 150 to 800 meters height border its fringes. The climate at the Yellow Sea is also comparable besides the more extreme temperatures and the monsoon. The tidal range and regime are nearly the same with the exception of the *innermost Bo Hai Bay*. The development of the intertidal mud flats at the Yellow Sea is caused by the large amounts of sediment of the Yellow River and other rivers whereas the Wadden Sea is mainly a sedimentation area of the North Sea. Also, the intertidal mud flats occur across borders without separation as in the Wadden Sea. The west and south coast of the Korean peninsular and the Chinese coast of Korea Bay have 592,900 ha of intertidal area which, when treated as one complex, rates as the largest intertidal area in the world (Wilson, J.R., Barter, M.A., 1998).

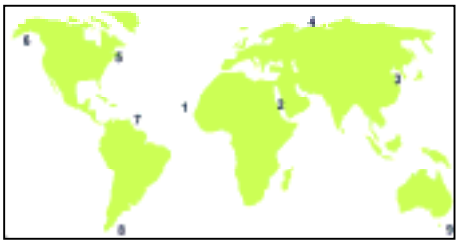
Both sites serve the function as internationally important stop over and resting site of a hemispheric flyway.

The Wadden Sea and the intertidal mud flats at the coast of the Yellow Sea are both influenced by agriculture and industry. Reclamation of intertidal mud flats is the biggest threat to the Asian site. Since the European Wadden Sea has been under protection, reclamation in the European Wadden Sea is no present threat anymore. The problem of reclamation that exists now in the Yellow Sea was in Europe a problem in 20/30th due to creation of agriculture ground and in the 70th due to build offshore ports.

The management is only comparable in the case of the *Shandong Yellow River Delta National Nature Reserve*, where an administrative organ is set up. The other sites are not legally protected and are endangered by reclamation, although a powerful environmental movement exists in South Korea. A chance for the future is a cooperation between the Wadden Sea and the states fringing the Yellow Sea. A contact already exists between the Regional Office of the Wadden Sea National Park of Schleswig-Holstein in Tönning and the NGOs in South Korea. Both sites

could benefit from such a cooperation. The Asian sites could get technical support, examples for an administrative organ and political protection, and the European site could get examples to create public awareness and public participation.

5.4 White Sea



The White Sea (4) is a semi-enclosed sea in the northwestern part of Russia connected to the Barents Sea and fringed by the Kola Peninsula, the coast of the Republic of Karelia and Arkhangeelsk Oblast in the Russion Federation.

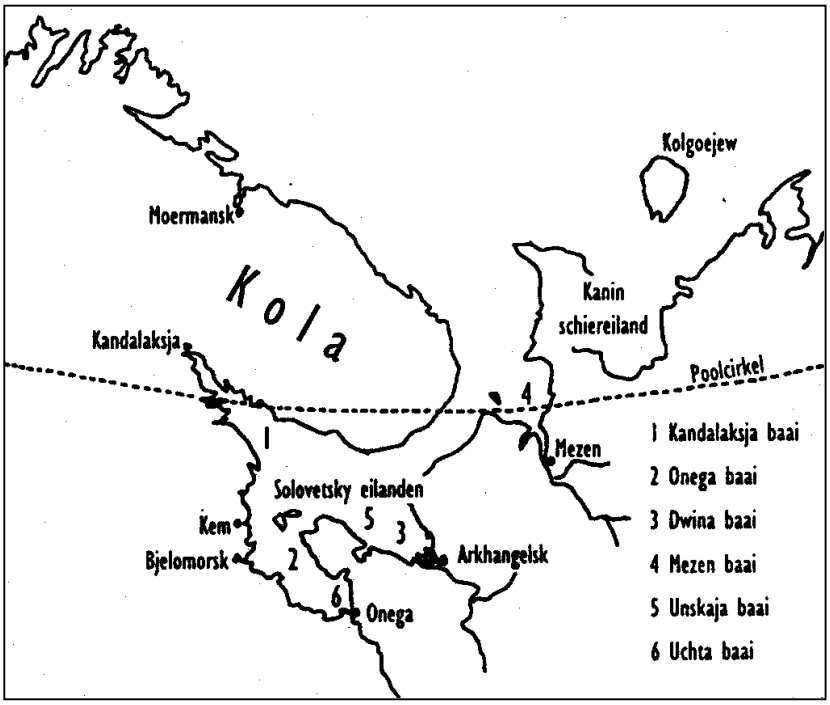


Figure 14: The White Sea (Poot 1993).

Four bays are part of the White Sea. The *Kandalaksha Bay* at the northwestern side, the *Onega Bay* and the *Dwina Bay* at the southeastern side and at the northeastern side, the *Mezen Bay*. Except for the *Kandalaksha Bay*, the bays have the name of the river, which flows into the bay. The tidal range is at the *Kandalaksha Bay* between 2 and 4 m, at the *Onega Bay* 1,5 m and at the *Mezen Bay* up to 9-12 m (Eisma, D., 1998; Poot, M., 1993). There is a difference in climate between the south and north side of the White Sea. In the north, the area is under influence of the sea climate of the Barents Sea. The southern part is under the influence of the land climate of the continent.

The White Sea is an internationally important resting and stopover site for migrating waterfowl and waders on the East Atlantic Flyway.

The site is mainly used by local people to harvest red algae (Chaepteria plumosa) and eggs of gulls and collect wash-ashore wood.

Since the political upheaval and the resulting economy crisis, unemployment has been growing and more people settle at the coast to harvest the resources of the White Sea, like fish, algae,eggs and wood. The pressure on the site through a growing population is increasing. Other threats to the ecosystem White Sea are dumping of radioactive waste, overfishing, pollution from the chemical industry and eutrophication from the wood-processing industry (Poot, M., 1993).

There is one site protected at the White Sea we know about. The *Kandalaksha Bay* (208,000) has been Ramsar Site since 1976. 54,255 ha of the site have been protected since 1932 as the *Kandalaksha Strict Nature Reserve*. The Bay is located 2 km south of the town Kandalaksha, in the district of Mumansk.

The Niva River flowing into the bay carries industrial pollutants and communal wastes from the cities and reservoirs located in the catchment area of the river. Furthermore, a number of industrial enterprises are located in the coastal zone and the village of Beloye More is an oil transshipping point. Additionally, the *Kandalaksha Bay* is an important waterway used for transportation of oil, timber and other cargoes. Threats are pollution from the industry and, all in all, the same threats as for the whole White Sea mentioned above. Future threats are a highway to Finland, which is being built near the site. When completed, the overall traffic and the cargo turnover of the Kandalaksha Seaport will increase considerably.

Practical protection of the reserve is carried out by a staff of 29 guards and rangers. Special permission of the reserve's administration is required to visit the area. Outside the *Kandalaksha Nature Reserve*, the protection of the Ramsar wetland is conducted by the local Fishery Inspection Office (six people). Research has been conducted since the early 1800s. Researchers of the *Kandalaksha Nature Reserve* are in charge of the ecosystem monitoring in the area and regular research on the regional fauna is also conducted at the biological stations, established in the area by the Zoological Research Institute, Russian Academy of Science, Moscow University and Saint Petersburg University (Frasier, S., 1999).

Discussion

The White Sea is not comparable with the Wadden Sea. The White Sea is a small semi enclosed sea with probably less intertidal mud flats than the Wadden Sea which has diverse morphology types. The tidal range is nearly the same, only one

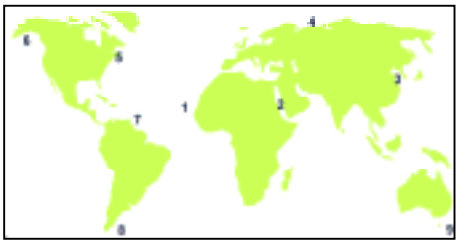
estuary in the bay has a much larger range. The tidal regime is the same, but the climate is cold to arctic, much cooler than the Wadden Sea.

The ecological value of the White Sea is high because it has the same function as the Wadden Sea. Both are important staging sites for migratory waterbirds especially geese. The White Sea is also an important nesting site.

The White Sea area is used similar to the Wadden Sea. At both sites, rivers are entering the sea which carry pollutants into the seas. They are also both influenced by shipping, industry and human settlements.

The management is, in the case of the *Kandalaksha Bay*, comparable to the Wadden Sea. Probably the practical protection by rangers is more efficient than in the Wadden Sea. But, there is, in fact, not much information available and the real situation cannot be described.

5.5 Atlantic coast of North America from Georgia to Nova Scotia



The large bays with intertidal mud flats at the Atlantic coast of North America (5) (*Bay of Fundy, Delaware Bay and Chesapeake Bay*) are well-known for their international importance as staging site for migrating shorebirds. But, at the coast from Georgia (USA) to Nova Scotia (Canada) also other intertidal mud flats exist.
The Georgia coast consists of a series of eight large barrier islands separated by tidal inlets. At the back lies a very flat coastal plain with tidal bays and large tidal embayments flanked up to 12 km wide salt marshes and tidal flats. The tides are semidiurnal with a spring tide range of 2 to 3 m, a mean range of more than 2 m, and a storm range of up to 3.4 m. The inlets are estuarine or purely tidal; the tidal estuaries are more numerous and dominated by sea water with some freshwater coming from rainfall on the marshes and from groundwater runoff from the islands. The fluvial estuaries are fed by rivers coming from the coastal plain or the Piedmont Mountains farther inland (Eisma, D., 1998).

Along the adjacent coast of South Carolina, the river estuaries become wider and the barrier islands smaller and more irregular (Eisma, D., 1998).

From northern South Carolina to Massachusetts, between about 33°N and 42°N, the coast consists of sandy barriers or barrier beaches with inlets, estuaries and lagoons, and of numerous small and several very large embayments and smaller intertidal flats (*Chesapeake Bay and Delaware Bay*) (Eisma, D., 1998).
The intertidal mud flats at this part of the coast have probably also as a high ecological value as the bays.

In this described area lies the WHSRN (Western Hemispheric Shorebird Reserve Network) site *Barrier Islands: Maryland - Virginia, International Reserve*. The site consists of 176 km of barrier islands that are extremely important to migratory

shorebirds during both spring and fall migration. The intertidal mud flats probably lie on the landward site of the islands.

Recreational activities are the main uses of the site and threats are human disturbance and tropical storms.

The site is owned by the Nature Conservancy, U.S. Fish and Wildlife Service, National Park Service, NASA, Commonwealth of Virginia and State of Maryland. The overall management strategy combines census and monitoring strategies, habitat characterization, active management in the form of restrictive signage and fencing, and public education (WHSRN, Barrier Islands: Maryland-Virginia International Reserve, WHSRN-USA, http://www.wetlands.ca/wi-a/whsrn/barrier.html .).

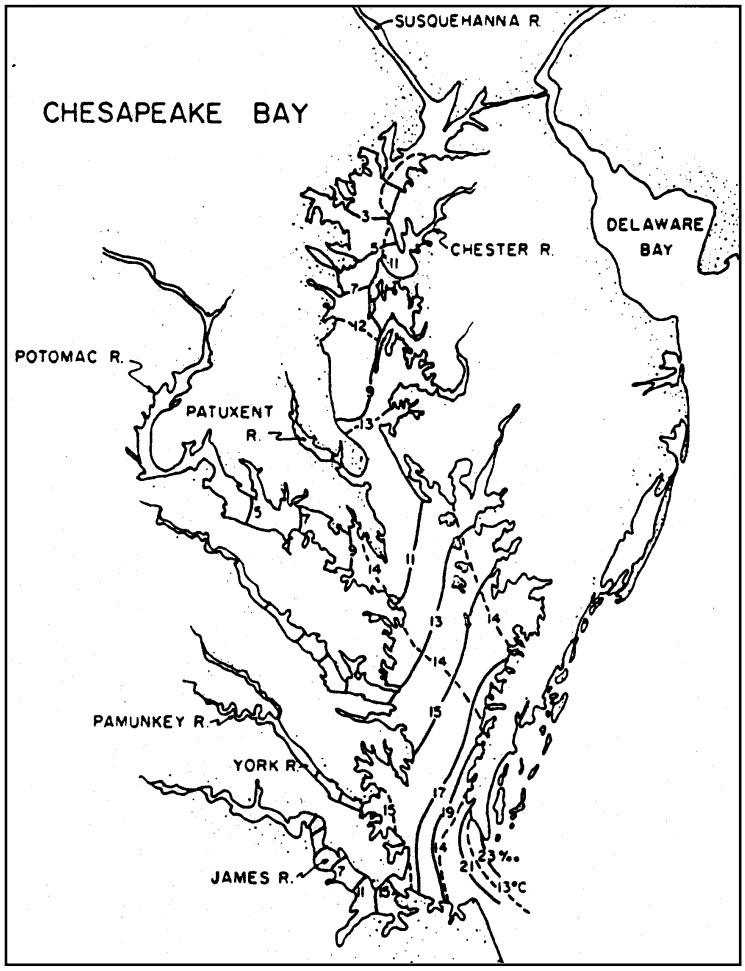


Figure 15: The Chesapeake Bay (Miller).

Further north the *Chesapeake Bay* is located between the cities of Baltimore and Norfolk, in the states of Maryland and Virginia. The site is a vast, shallow, estuarine complex with many major tributaries including wetland types like estuarine waters, shallow marine waters, subtidal aquatic beds, intertidal mud, sand or salt flats, intertidal marshes and some inland wetlands. The cities of Washington D.C. and Richmond, Virginia are located on two of the bay's major tributaries, the Potomac and the James River, respectively. Further major tributaries entering the system are the Susequehanna, Patuxent, Rappahannock and York on the western side of the Bay and the Chester, Choptank, Nanticoke and Pocomoke on the eastern side (Frasier, S., 1999). The *Chesapeake Bay* is about 300 km long from the mouth of the Susequehanna River in the north to the Cape Charles-Cape

Henry entrance in the south. It ranges in width from 5 to 56 km, the widest point, being in Tangier Sound in the Southern Bay, with an average width of about 40 km. The shoreline of the Bay is extremely irregular, totaling 12,900 km in length. With an average depth of only 8 to 10 m, the Bay is very shallow compared to its width. The deepest part of the Bay is the incised main channel of the former Susequehanna River which runs the entire length of the Bay, with depths over 50 m Wray, R.D., Leatherman, S.P., Nicholls, R.J., 1995). The tidal range at the entrance of the Bay is 1.2 m which decreases inward to about 50 cm or less (Eisma, D., 1998).

Information about the extent of intertidal mud flats was not available. The climate is warm to subtropical.

The *Chesapeake Bay* is the largest estuary and one of the most important wetland areas in the United States. It is of importance for very large numbers of staging and wintering waterbirds.

Due to its biological importance, the site is used for commercial fishery, including crap and mollusk fishery. The Bay is also used for seagoing transport, industry, agriculture and recreational activities like boating, hunting and sport fishing. The main threat for the area is the urbanization, which causes wetland loss for urban developments like human and industrial settlements, additionally, the rivers carry pollutants into the Bay.

45,000 ha of the *Chesapeake Bay* has been Ramsar Site since 1987. Multiple, physically separated areas are protected in the Bay, managed by Federal State and local authorities. Management practices for those areas including within the site are generally directed towards protecting and improving wetland habitats for waterbirds and other fauna and flora, especially rare and endangered species. Environmental education, conservation-oriented recreation and scientific research are also primary management objectives. Hunting and trapping of waterbirds and fur-bearing mammals are strictly controlled in accordance with Federal State regulations. A management plan for the site was implemented in 1998 (Frasier, S., 1999).

In 1983, a local partnership finished the Chesapeake Bay Program. The main issue is the restoration and improvement of the Bay's living resources. Examples of specific actions initiated by the Bay Program include a watershed-wide phosphate detergent ban, the introduction of agricultural best management practices, biological nutrient removal at wastewater plants, and a public education campaign emphasizing the role each of the watershed's 15 million residents play in the

restoration (The Chesapeake Bay Program: An Overview, www.chesapeakebay. net/ overview.htm).

Along the ocean coast of the Delmarva Peninsula, that forms the eastern margin of the *Chesapeake Bay* in Virginia, a 3 to 12 km wide belt of tidal flats, marshes and channels lies behind a 100 km long chain of barrier islands, ranging from the *Chesapeake Bay* entrance to beyond the Maryland border (Eisma, D., 1998).

North to the Delmarve Peninsula, the *Delaware Bay* is located at the mouth of the Delaware River, downstream of the cities of Wilmington and Camden, in the states of Delaware and New Jersey. The site is a large complex of estuarine wetlands including nearly the same habitats as in the *Chesapeake Bay*, around a shallow wide bay that extends north/northwest up the valley of the Delaware River for approximately 200 km. Water depth in the estuary averages 5 m, with a maximum of 38 m. Information about the extent of the intertidal mud flats and also other habitats was not available.

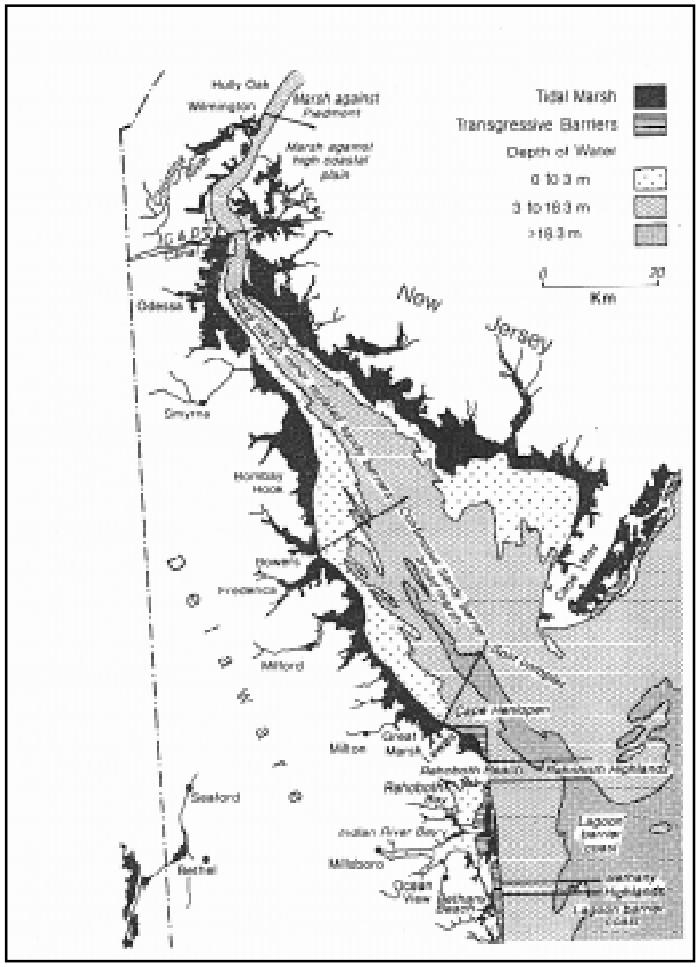


Figure 16: The Delaware Bay (in: Eisma 1998).

The lower *Delaware Bay* complex is used as staging area for migratory shorebirds and is one of the two most important staging areas on the Atlantic coast of North America (Frasier, S., 1999). The bay is the largest port of transport on the east coast of North America and heavily used for oil transport. Other functions of the area are recreation, industry and fishery. Threats for the area are transportation of oil, pollution from industrial facilities, including a nuclear power plant and human disturbance by recreational activities mainly during peak migration.

51,252 ha of the *Chesapeake Bay* has been Ramsar Site since 1992, composed by more than seventy, separate, protected wetland areas in federal, state, county or private ownership. The Bay is also Western Hemispheric Shorebird Reserve.

The state of Delaware has drafted a comprehensive management plan for tidal wetlands (including recommendations for shorebird habitat) and a draft plan to protect shorebird habitat on the *Delaware Bay* was prepared by the New Jersey Division of Fish, Game, and Wildlife (NJDFGW) in 1989. The NJDFGW also developed a report on findings of all research and management activities and a five-year Shorebird Management Plan with comments from regular agencies, state land management agencies and the public. Research activities in the bay are shorebird surveys, shorebird studies to estimate abundance of shorebirds using marshes, shorebird banding with international help, a study to determine levels of human use along the bay and a computer based oil spill trajectory model to predict the most likely landfall of a spill in the bay. Cross border cooperation occurs in the case of the shorebird surveys with Canada. Other activities are education to minimize human disturbance of shorebirds.

The *Bay of Fundy* is located on the coast of Canada at about 45°N and is open to the southeast. It has an approximately rectangular shape with a depth of about 50 m at the entrance, and it ends in the northeast in two smaller bays with less than 12 m water depth: *Chignecto Bay* in the north and the *Minas Basin* with the *Cobequid Bay* in the south. The tides are semi-diurnal with a mean tidal range of 3.5 m

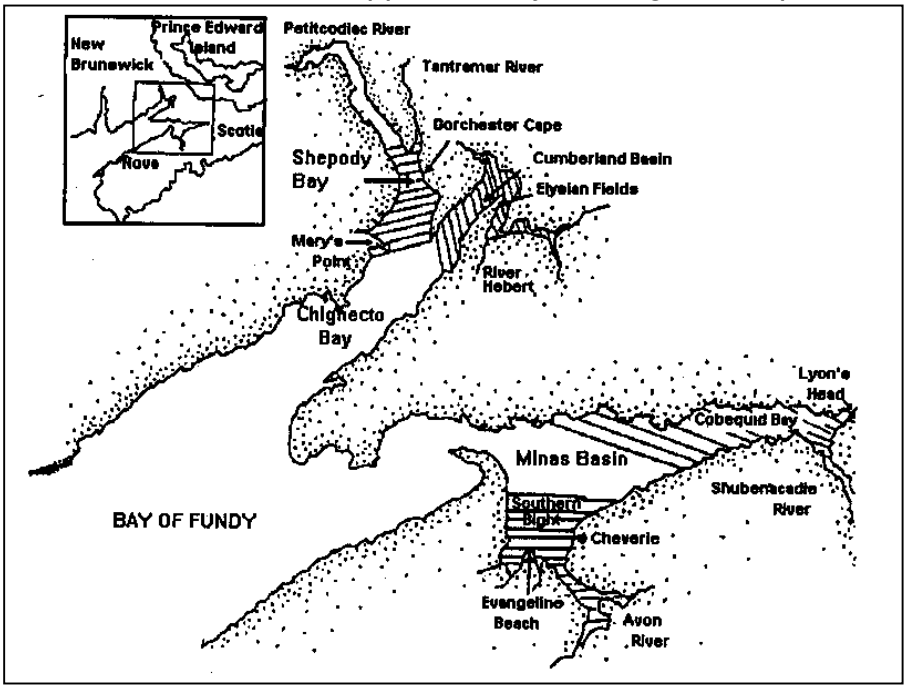


Figure 17: The Bay of Fundy WHSRN Sites

at the entrance of the bay, they increase in range to more than 10 m in *Chignecto Bay*, and to more than 12 m in *Cobequid Bay* with a maximum of 16.3 m (Eisma, D.,1998). The whole bay has a volume of 880 billion kubicmeters (Officer, C.B., 1983). The climate is temperate. There are at least 13,000 ha of intertidal mud and sand flats.

The Bay is of special importance as staging site for migrating shorebirds, because of a high density of the amphipod, *Corophium volutator*, which, in North America, occurs only in the *Bay of Fundy*, the principal food source of the shorebirds.

The bay is mainly used for fishing, fish bait harvesting and recreation including bird watching tourism. Surrounding areas are mostly privately owned with farms, cottages and rural homes.

The bay is threatened by establishment of a tidal power barrage, unregulated harvesting fish bait and increasing recreational pressure through development of housing and cottages in the surrounding, and increasing birdwatch tourism.

In the bay, four sites are dedicated as Ramsar sites: the *Shepody Bay* (12,000 ha), *Southern Bright - Minas Basin* (26,800 ha), *Mary's Point* (1,200) and *Chignecto Bay* (1,020 ha). *Chignecto Bay* has no intertidal mud flats and is therefore not further described.

The *Shepody Bay* site is principally open water, intertidal mud flat and exposed beach and is, thus, undeeded and under jurisdiction of the Province of New Brunswick and under the authority of the Government of the Province of New Brunswick. The site is unprotected. However, it does abut on the *Mary's Point Unit Shepody National Wildlife Area*, which is protected under federal jurisdiction. A management plan for the site, which will recommends protection for a number of key habitats, is being drafted. With the *Southern Bright - Minas Basin* and *Mary' Point*, the *Shepody Bay* forms the *Bay of Fundy New Brunswick - Nova Scotia, Canada Hemispheric Reserve*. A protection plan for the WHSR and Ramsar Wetland of International Importance at the Grande Anse (Johnson's Mills) Section of the *Shepody Bay* was released in draft form in mid 1994. In the 80s, many shorebirds were banded at the site. No information center is situated at the site but lectures and trips are conducted annually in association with the Mount Allison University.

The majority of *Southern Bright - Minas Basin* is intertidal or subtidal and is thus undeeded. Boot Island, a small island at the site, is the only protected portion, as a

National Wilflife Area, controlled by the Wildlife Area Regulations under the Canada Wildlife Act of 1973. The island is owned by the Government of Canada. The Southern Bright - Minas Basin Management Plan was drafted in 1994. It recommends the declaration of the site as a Wildlife Habitat Area, designation of specific beaches, securements protection of key habitat areas and, possibly, regulation of the bait worm industry. The shorebird distribution and feeding ecology have been studied by the Arcadia University at Wolfsville.

The Government of Canada owns 107 ha of *Mary's Point*, which includes the most critical sites used by the large roosting flocks of shorebird during high tide. Most of the 150 ha salt marsh remains under private ownership as poor land titles have prevented purchase by the federal government. The remaining 940 ha (approximately) of intertidal mud flats are undeeded but under the jurisdiction of the province of New Brunswick. The most critical adjacent parcels next to the end of the beach are owned by avid conservationists. 107 ha owned by the federal government have been declared a unit of the *Shepody National Wildlife Area*, and is scheduled under and controlled by the National Wildlife Area Regulations under the Canada Wildlife Act. The portion of the Ramsar Site within *Shepody National Wildlife Area* is managed under the Shepody National Wildlife Area Management Plan which was released in 1988. A small visitor center and display area was constructed at the site in 1992 and seasonal naturalists provided by the New Brunswick Federation of Naturalists offer interpretive services during July and August.

In 1989, a twinning is established between the sites *Wia Wia, Coppename and Bigi Pan* in Suriname and the *Bay of Fundy* (Frasier, S., 1999, Canadian Ramsar Site Mary's Point, New Brunswick, www.wetlands.ca/wetcentre/wetcanada/ramsar/ cdnsites/ maryspnt.html , Canadian Ramsar Shepody Bay, New Brunswick, www.wetlands.ca/wetcentre/wetcanada/ramsar/cdnsites/shepody.html, Canadian Ramsar Site Southern Bright-Minas Basin, Nova Scotia, www.wetlands.ca/ wetcentre/wetcanada/ramsar/cdnsites/sthbight.html).

Discussion

The Atlantic coast of North America and its intertidal mud flats are not comparable with those of the coast of Denmark, Germany and the Netherlands. The coastline of North America is much longer than the coastline of the Wadden Sea in Europe but the intertidal areas are much smaller in America and not adjacent to each other. The

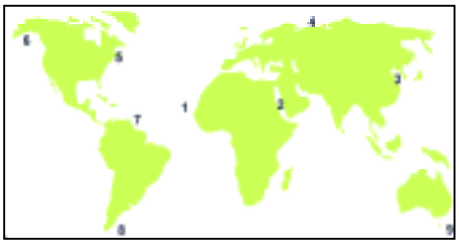
morphology has some similar types like Back barrier beaches and islands and estuaries. The climate is nearly the same at both sites, only the southern part of the described coast in America is different. The tidal regime is the same but tidal ranges in average higher in North America.

Both intertidal mud flat areas have the same function as internationally important staging sites for migratory shorebirds, only the flyway is different. In the case of the east coast of North America, it is the West Atlantic Flyway.

As we look at the whole described coast of North America, the uses and threats are the same as in the Wadden Sea. Both sites are used for fishery, shipping and recreation. Threats are overfishing, pollution by shipping and human disturbance.

Much of the sites in America are legally protected but in contrast to the Wadden Sea mostly in the way of many small separate areas. Management authorities are federal state departments as at the Wadden Sea, but in America there are no special departments for a protected site like a National Park Administration. Management activities are nearly the same as in the Wadden Sea. But monitoring of birds, research of birdlife and education takes probably place in a lesser range in America. Also, cross-border cooperation between the USA and Canada takes place but not in the range of a trilateral cooperation as in the Wadden Sea area. About the twinning between *The Bay of Fundy* and the sites in Suriname there was no detailed information available.

5.6 The Copper River Delta



The *Copper River Delta* (6) is located at the south coast of Alaska near the city of Cordoba. The site is comprises a large portion of tidal and submerged lands in the Orca inlet, near Cordoba and extensive intertidal and freshwater wetlands and the barrier islands near the mouth of the Copper River.

The site has a cold temperate climate. The tidal range is 4 to 6 m and the regime is mixed (Eisma, D., 1998).

The area has probably the most important shorebird concentration site in the world due to the highly productive mud flats. Migratory shorebirds on the Pacific Coast stage here each year before flying north to their breeding grounds. Important too are the upland marsh wetlands for other shorebird species breeding here.

The area is used for fishing and the adjacent sea for shipping. The site is threatened by oil spill, excessive local air traffic, heavy repeated ATV use and concentrated food traffic on the mud flats.

The Copper River Delta Cooperative Agreement was signed in 1962. In 1978, the State of Alaska legislature designated much of the tidal, submerged and adjacent uplands as the *Copper River Delta Critical Habitat Area*. This designation requires the Alaska Department of Fish and Game to protect and preserve habitat areas, especially, crucial perpetuation of fish and wildlife, and to restrict all other uses not compatible with the primary purpose. The Alaska National Interest Lands Conservation Act, Public Law 96 - 487 was also passed in 1980. A five party MOU, signed in 1986, established the *Copper River Delta Fish and Wildlife Management Area*, enlarging the former agreement. 151,256 ha of the area is the *Copper River Delta Shorebird Unit (CRDSU)*. Its attention focuses on the Delta as a key staging area for shorebirds and represents the combined concerns of public agencies, private corporate land managers, and local city government. Cordoba Ranger District staff members and a broad base of cooperators conduct plant association

and ecology work, management studies and fish and wildlife habitat improvement projects over broad areas of the Delta. Since 1991, the Copper River Delta Institute (USDA Forest Service) has conducted migratory shorebird research. The Copper River Delta Shorebirds Festival has been a highlight each spring since 1990. The Festival includes workshops taught by Alaskan ornithologists familiar with shorebird biology and identification as well as many other activities (WHSRN, Copper River Delta: Alasca-USA Hemispheric Reserve, WHSRN-USA, www.wetlands.ca/wi-a/whsrn/crdelta.html).

Discussion

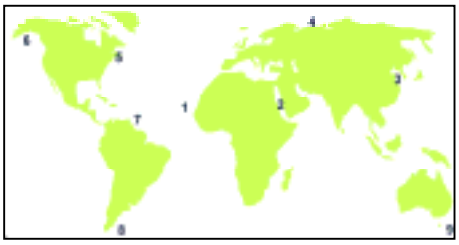
Actually, the *Copper River Delta* is difficult to compare with the Wadden Sea. The site in Alaska has similar geomorphological features like barrier islands but the whole system is a delta, in contrast, the Wadden Sea is more diverse. Climate and tidal regime are also different to the Wadden Sea.

The function as staging site for migratory shorebirds have both sites, but for different flyways.

Uses and threats are also comparable due to the adjacent shipping routes at both sites. Human pressure and pollution from industry is probably smaller in Alaska because of a small population.

The area at the *Copper River Delta* is managed by cooperation of five parties including governmental institutions and NGOs. This is comparable to the Wadden Sea. Management activities like monitoring and research of shorebirds is done in both places.

5.7 Suriname



The Coast of Suriname (7), which is situated at about 6°N and between 54° and 57°W, has a intertidal zone that consists of a series of mud flats in accretion, with a width of several hundred to a few thousand meters. These flats alternate in space and time with sections in erosion. The parts of the mud flats above mean high tide level, are covered with black mangroves. Therefore, almost the entire intertidal zone is bare. Under the influence of the Guiana current and the waves generated by the NE trade wind, the mud flats are abraded on the east side and silted up on the west side. This results in a westward movement of the flats with a speed of about 1 km per year (Swennen, C., Duiven, P., Spaans, A.L., 1982). Along the Surinam coast, the maximum spring tidal range is 3 m and a mean tidal range of 1.8 m (Eisma, D., 1998). The site has a tropical climate.

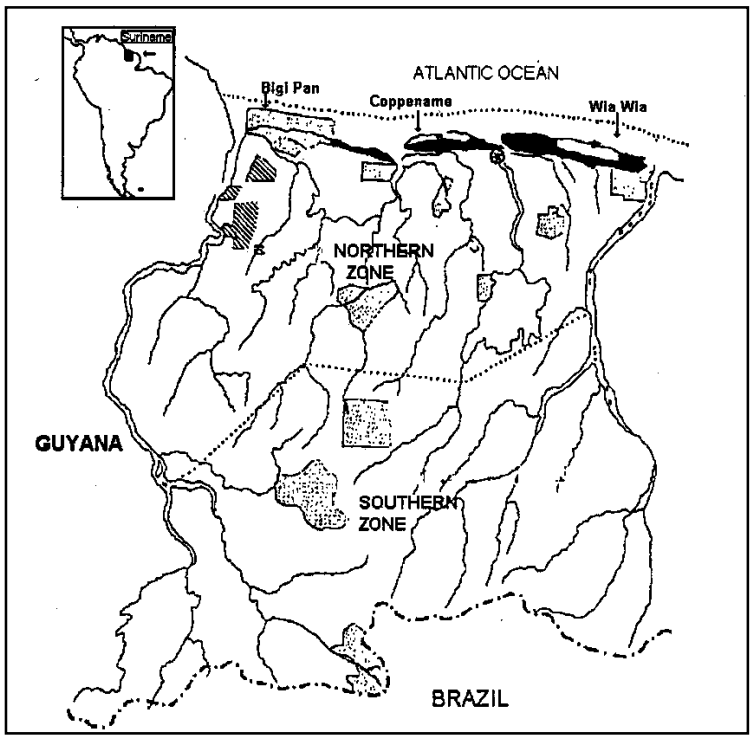


Figure 18: Suriname WHSRN Sites.

The coast is an important staging site for migratory shorebirds and breeding ground for waterbirds. Furthermore, parts of the coast are fish and shrimp nursery grounds.

In Suriname are three WHSRN sites at the coast: *Bigi Pan, Coppenamemonding and Wia Wia*.

Bigi Pan has an extent of 68,320 ha and stretches in the estuarine zone from east of the Nickerie River mouth, to north of Wageningen, and west of Burnside in the Nickerie and Coronie District. The landscape is flat and is dominated by extensive mud flats and areas of standing water, including a mud flat up to three kilometers wide that extends along much of the area. The extensive wetland areas consist of marine swamp clays dissected by sand and shell ridges. It contains bare mud flats, several creeks, mangroves and ridge forests, grass swamps and open swamps.
The site is internationally important for migratory shorebirds as staging site, as an important area for breeding, migration and wintering of waterfowl of a wide variety of species and as an important nursery ground for fish (fresh and brackish water species) and shrimp.
Bigi Pan is used by 200 fishermen and for agriculture, mainly rice farms in the adjacent areas. Threats can be caused by the expansion of rice farms.
The Suriname Government owns approximately 22,300 ha managed as *a Multiple Use Management Area* by the Surinam Forest Service. The remainder of the land is owned by private landowners (mainly rice farmers). The Suriname Ministry on Natural Resources, in cooperation with the Canadian Wildlife Service, developed a Bigi Pan Multiple Use Management Plan in 1990. Efforts are currently underway to implement this plan. The site is twinned with the *Bay of Fundy* (WHSRN, Bigi Pan Suriname Hemispheric Reserve, WHSRN-Suriname. http://www.wetland.ca/wi-a/whsrn/bigi_pan.html).

The *Coppename Rivermouth*: *The Suriname Hemispheric Reserve* consists of approximately 100 km of coast between the estuaries of the Coppename and Suriname Rivers in the Saramacca District and has an extent of 100,000 ha. The area comprises broad intertidal mud flats and fringing mangrove swamps, areas of seasonally flooded savanna and swamp forest.
The site is internationally important as staging site for migratory shorebirds and the coastal fringe constitutes an important nursery ground for many fish and crustaceans.
Hunting, small-scale commercial fisheries, grazing of livestock and rice-growing are the main livelihoods of people living in the rural portion of the coast. There is also limited ecotourism. Fishing is practiced mainly in the estuarine zone, and more intensive fishing takes place offshore. The suburbs of Paramaribo adjoin the eastern

extremity of the swamps. Urbanization and the expansion of agricultural activities are the principal threats. There is some illegal hunting and pesticide contamination. Furthermore, drilling for oil may pose management problems.

The area is mainly state-owned, with some private holdings. Internationally, the area is designated as a *WHSR*. The western part (12,000 ha) included in the *Coppename Mouth Nature Reserve* established in 1966, is protected and managed by the Ministry of Natural Resources, and the Suriname Forest Service. This area has also been designated as a Wetland of International Importance since 1985.

Current research activities consist of waterfowl studies and the collection of data for the preparation of a management plan for the reserve. As of June 1998, a Management Plan is being prepared for the *Coppenamemonding Nature Reserve*. At the same time, a feasibility study, and a Management Plan for the North Saramacca area (around the Coppenamemonding Nature Reserve), are being prepared to establish this area as a Multiple-use Management Area.

The Suriname Forest Service is committed to maintain guarding forces in the protected area, but enforcement of protective legislation has been greatly hampered by a lack of equipment, particularly outboard motors and jeeps.

The "Conservation Action Plan for Suriname" considers the *Coppenamemonding Reserve* as one of the top priority sites in the coastal ecosystems conservation; that would benefit greatly from a carefully prepared management plan.

Just as in the case of *Bigi Pan*, the site is twinned with the *Bay of Fundy* (WHSRN, Coppename Rivermouth: Suriname Hemispheric Reserve, WHSRN-Suriname http://www.wetland.ca/wi-a/whsrn/copename.html).

The *WHSR site Wia Wia* is located east of the mouth of the Suriname River and north of the lower Commenwijne River, Commenwijne District. The area consists of the estuary of the Commonwijne River and approximately 80 km of coast to the west. The reserve has an extent of 90,000 ha. The landscape is characterized by broad intertidal mud flats and fringing mangrove swamps; bordered inland by a belt of shallow fresh to hypersaline lagoons and swamps, areas of seasonally flooded savanna and swamp forests.

The area is important as staging site for migratory shorebirds. This is also an important area for breeding, migration, and wintering of waterfowl of a wide variety of species. The beaches are especially important nesting areas for sea turtles.

Agriculture, animal husbandry and coastal fishery (small-scale commercial fisheries), are the main means of support for the people living in the rural portions of the coastal area, with fishing being practiced largely in the estuarine zone. There is no knowledge available about threats to the area .

The *Wia Wia* is owned by the Government of Suriname. The area is protected and managed by the Ministry of Natural Resources, Surinam Forest Service, as a National Park (IUCN classification). The reserve has an administration building and a guard force. But, as in the case of the *Coppenamemonding Reserve*, there are problems because of lack of equipment.

The "Conservation Action Plan for Suriname" considers the *Wia Wia Reserve* as one of the top priority sites in the coastal ecosystems conservation; that would benefit greatly from a carefully prepared management plan.

Just as in the case of the other two WHSR sites, the *Wia Wia Reserve* is twinned with the *Bay of Fundy* (WHSRN, Wia Wia: Suriname Hemispheric Reserve, WHSRN-Suriname, http://www.wetland.ca/wi-a/whsrn/wia_wia.html).

Discussion

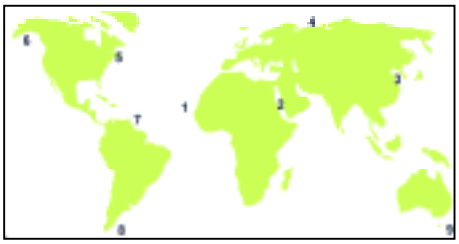
The coast of Suriname is in many cases different to the coast of the Wadden Sea but some characteristics are well comparable. The coastline of it is about 350 km in Suriname and at the Wadden Sea about 500 km. There was no information about the extent available but the difference between the two coastlines is not great so that the intertidal mud flats of Suriname have probably also a great extent. Suriname's coast is located in the tropic climate zone and due to this fact, the area above mean high tide level is mainly covered with mangroves. In the Wadden Sea, these parts are the salt marshes. Similar to the Wadden Sea the intertidal mud flats of Suriname have mixed morphological types only barrier islands do not occur in Suriname. The tidal range at the coast of Suriname has a similar tidal range and regime as in the Wadden Sea.

Besides, the two sites have the same ecological function for migrating shorebirds as staging site on their flyway. Of course, the flyway is different.

Both sites are used for fishery and agriculture but in Suriname in a less intensive way.In the Wadden Sea area, tourism is a growing factor and threats the area. In Suriname only little ecotourism occurs. The threats to both sites may be explained

by expansion of agriculture and urbanization. Industry in Suriname is, according to information, no problem.Some parts of the coast and the intertidal zone of Suriname are national and international protected in contrast to the Wadden Sea where almost the entire coast is protected by mational parks and a Trilateral Wadden Sea Cooperation. There was no information available about cross-border cooperation with possible intertidal mud flat sites in the adjacent states of Suriname. Although there is a twinning of the WHSR in Suriname with the Bay *of Fundy,* in Canada. What this twinning contains is not known, but probably scientific exchange and financial and material assistance.

5.8 Tierra de Fuego



Intertidal mud flats exist in Argentina on the Atlantic coast of northeastern Isl*a Grande de Tierra del Fuego, i*n the Province of Tierra del Fuego (8). In the Bah*ia San Sebastian,* there are broad intertidal mud flats with an extent of 16,000 ha (Frasier, S., 1999). The Bay is open to the east and exposed to waves from that direction but access from the Atlantic Ocean is restricted by a gravel spit (the Paramo Spit). One river, the San Martin, enters the Bay from the west (Eisma, D., 1998). South of San Sebastian, the coast is nearly all shingle beach, with an intertidal zone consisting of sand flats. Between Cabo Domingo and Cabo San Diego the coastline is rocky, and there are extensive areas of restinga (flat area of tidal pools) along much of the coast. Tides are up to 10 m and the intertidal areas between 2-6 km wide (WHSRN-Argentina). The tidal regime is semidiurnal and during winter, the flats are covered with ice and snow (Eisma, D., 1999).The site is an internationally important wintering area for migratory shorebirds. Some neotropical shorebirds also breed in the area.The area is used forfor recreation at the beach, excavation of shores for sand and gravel, shellfish collection and oil exploration. Usage and threats are closely connected. The major threats are coming from the oil exploitation. Pollution can negatively influence the area but also the infrastructure required for the oil exploration has impact on the site. Furthermore, the oil tankers which are filled in the area can cause an oil spill. Another threat is the discharge

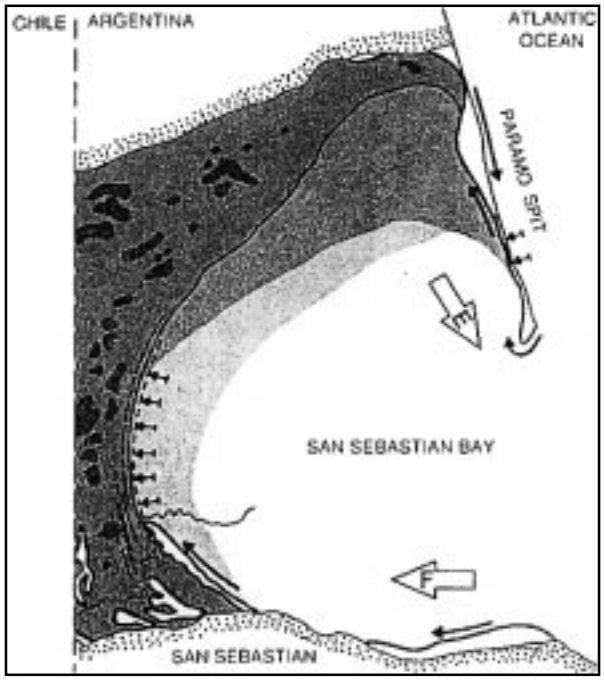


Figure 19: San Sebastian Bay (in: Eisma 1998).

from sewage without treatment into the sea of the city of Rio Grande. More small-scale problems are stray dogs and ranching activities.
28,600 ha of the coastal area has been Ramsar site under the name *Reserva Atlantica de Tierra del Fuego* since 1995. Most of the reserve is owned by eight landowners, who have signed an agreement with the provincial government to ensure the conservation of the site. In 1992, it was declared *Provincial Nature Reserve*. The first stage of a management plan for the reserve (inventory and monitoring aspects) was being developed (as of August 1995). Preliminary studies of birds, mammals, fishing and tourism have been conducted in the area. The provincial government has made preliminary contacts with its counterparts in the crossborder jurisdiction that includes the *Bahia Lomas* site in Chile, to promote bilateral management of the region. The site is also *WHSR site* (WHSRN, Tierra del Fuego-Argentina-Hemispheric Reserve, WHSRN-Argentina.
http://www.wetlands.ca/wi-a/whsrn/tdfuego.html.).

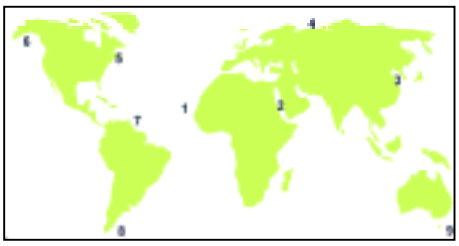
Discussion

The intertidal mud flats at *Tierra del Fuego* are not comparable with the Wadden Sea's intertidal mud flats because they are much smaller, but concerning ecological importance both areas are nearly the same.
Due to the similar latitude, the *Tierra del Fuego* and the Wadden Sea have the same climate (Westermann Kartographie, 1992). The Morphology in South America is different to the Wadden Sea. In contrast to the Wadden Sea, at *Tierra del Fuego* no back barrier islands exist only an estuarine bay and beach to an open coast. Another feature of *Tierra Del Fuego* is that the area is located at an ocean and the Wadden Sea at a fringe sea. Tides are much higher at the site in Argentina but the tidal regime is the same at both sites.
The sites are located both at a flyway and are important for migratory birds. The site in South America is preliminary a wintering site and the European site a staging site for birds on their migration route.
The usiage of both sites is similar, oil exploitation does not take place in the Wadden Sea but gas exploitation in the netherlands part and as looked at the adjoining area, this area is used as important shipping route including oil tankers. Therefore the threats are similar. The Wadden Sea can be a victim of oil spills too. Industry is no

threat at *Tierra del Fuego* in contrast to the Wadden Sea but in South America human settlements are also a threat to the area.

The *Tierra del Fuego* is only protected as *Provincial Nature Reserve* in contrast to the Wadden Sea, which is nationally protected in all three countries. But, similar to the Wadden Sea, the intertidal area is closely connected to intertidal areas in the Chilean part of *Tierra del Fuego*. And like the trilateral cooperation in Europe, the two South American countries try to promote a bilateral management of the region.

5.9 The coast of Miranda - Firth of Thames



The *Firth of Thames* (9) is located approximately 52 km southeast of Auckland on the North Island of New Zealand. The Bay lies in the northern part of the Hauraki graben bounded by fault lines along the Hunua and Coromandel ranges. The Waikato River originally flowed through the Hauraki graben and emptied into the Firth, bringing with it much of the fertile alluvium of the region. Today, the Waihou, Piako and the Waitakaruru Rivers flow into the Firth from the south. The shallow tidal flats of the site, exposed at ebb tide, cover approximately 8,500 ha and can be divided into four main wetland types: shallow estuarine water and mudflats (7,000 ha); shell banks (40 ha); grass flats (30 ha); and mangrove forest, salt marshes and swamp (730 ha) (IUCN, A Directory of Wetlands in New Zealand). The tides are semidiurnal with a spring tide range of 2.8 m and a neap tide range of 2 m (Eisma, 1998). The climate is sub-tropical (Westermann Kartographie, 1992).

The *Firth of Thames* is an internationally important feeding area for waterfowl, most of which are migratory shorebirds which use the site as wintering site. The Firth also supports an important fishery of local significance

Protection of wildlife, bird-watching and photography are the predominant activities at the site. Grazing occurs in a small-scale way. The surrounding area is primarily used for pastoral farming and the Firth is used for fishing, both commercial and recreational, and game-bird hunting takes place during the hunting season.

The wetland is less than 80 km away from two major centers of population, Auckland and Hamilton. The urban area is expanding and a lot of subdivision activity is proposed along the western shores of the *Firth of Thames* that can threat the site. In the past, much of the surrounding land has been cleared of forest, resulting in sediment deposition and loss of some habitat in the Firth. Livestock grazing is a threat to the mangrove area and further decrease in water quality of the rivers Waihou and Piako can result from unsuitable farming practices in the catchment, and have impact on the Firth.

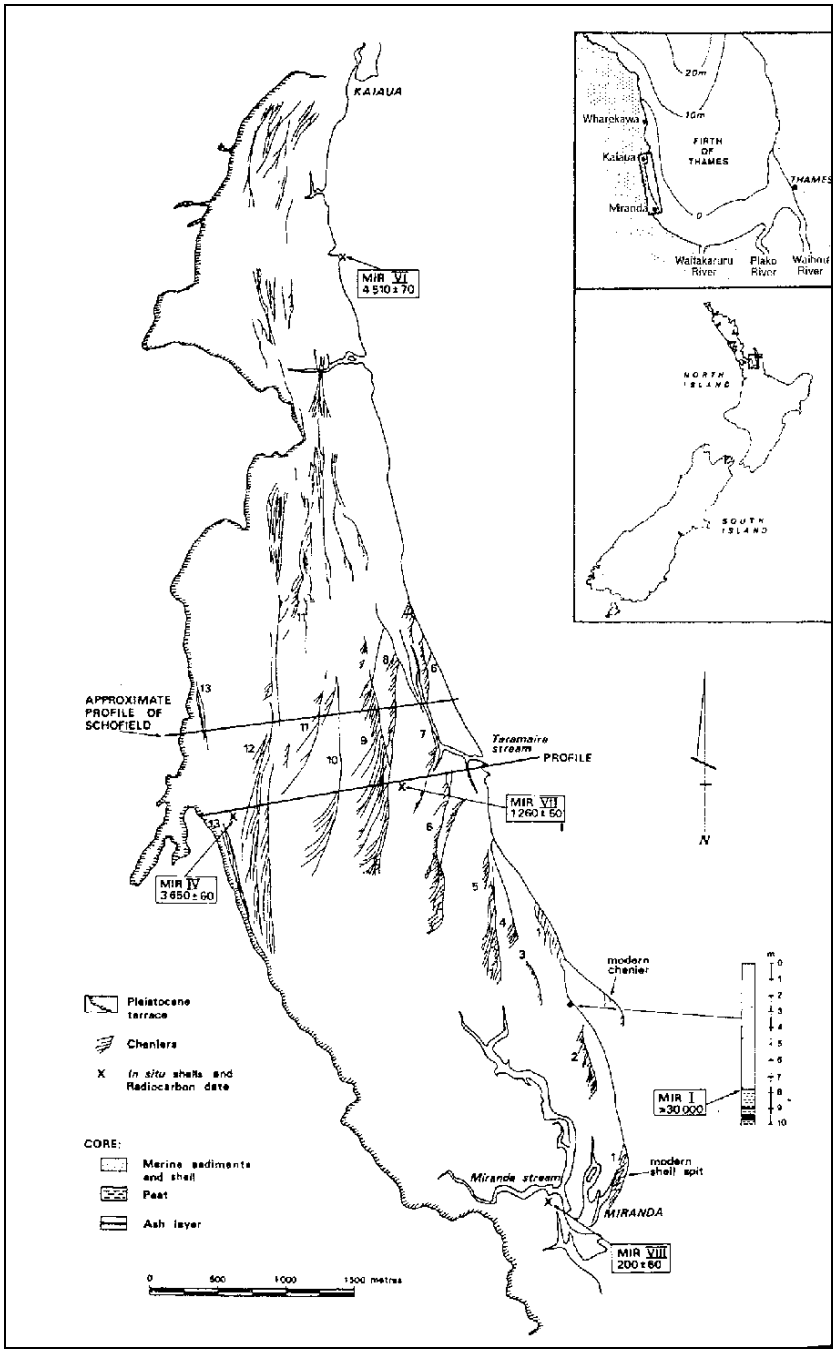


Figure 20: Chenier plain along the western side of the Firth of Thames (in: Eisma 1998).

7,800 ha of the wetland were listed as a Wetland of International Importance under the Ramsar Convention, which is Crown land area. The Department of Conservation (Waikato Conservancy) has responsibility for management of Crown land and wildlife. The majority of land adjoining the site is in private ownership. A 30 ha *Coastal Reserve* (Crown land, managed by the Department of Conservation) has been included as part of the Ramsar Site. Privately owned land adjoining the site lies under several territorial authorities, and protection status varies accordingly. One of

the primary aims in the future is to place some form of coastal planning zone, which provides protection/reservation for the area from the seaward margin to the terrestrial margin. A Joint Management Plan exists between the Miranda Naturalists' Trust and the Department of Conservation and is only now beginning to be implemented (status summer 1999) (Keith Woodley verbal, 1999).
The wildlife of the area has been monitored since the 1940s, with regular bird counts and studies undertaken by the Miranda Naturalists Trust (The Trust operates its own center at Miranda which is used for educational purposes and promotion of research) and Ornithological Society of New Zealand. Work on the botany and the entomology of the salt marsh and mangrove areas has also been undertaken. There is considerable scope for more research in the future.

Discussion

The *Firth of Thames* is different to the Wadden Sea concerning almost all characteristics. The intertidal mud flats at the Firth are much smaller than those in the Wadden Sea and they also have a different morphology. In contrast to the Wadden Sea, the intertidal mud flats are located in an estuarine bay. Bays occur in the Wadden Sea too but the whole site consists of diverse types of morphology. The tidal regime is the same at both sites and the tidal range of the *Firth of Thames* can be compared with parts of the Wadden Sea (near the German Bight). The climate is totally different and causes a different vegetation.
A shared characteristic is the ecological value of both sites. As the Wadden Sea the *Firth of Thames* is an important site on the migration route of waterbirds especially shorebirds. The site in New Zealand is primarilyy wintering site and the Wadden Sea staging site.
The *Firth of Thames* is used on a smaller scale than the Wadden Sea. The last mentioned is used similar as the Firth of Thames but on a greater-scale. Due to this fact, the impact on the site caused by usage is higher. Although the site in New Zealand is accessible to one third of the population of this country, the human impact on the Wadden Sea is higher. Probably a fact of a smaller population density than the Wadden Sea and better recognizing the site as area with high value from local authorities and the residential population. Finally, the Wadden Sea is much larger and more influenced by the surrounded area.

In contrast to the Wadden Sea, the Firth is not protected by national law besides a 30 ha big *Coastal Reserve*. But due to its much smaller extend than the Wadden Sea the management activities of the Firth of Thames like monitoring and education are high and can be compared with the Wadden Sea.

Chapter 6 Summary

350 different intertidal mud flat sites from all over the world have been compiled and 79 of them have been described in more detail. Nine regions with 28 sites (of the 79) have been compared with the Wadden Sea.
Intertidal mud flats exist at almost all coastlines. Most of them are important staging, wintering and breeding areas for migrating birds like waders, shore- and waterbirds.

All of the aims, described in chapter 2, have been accomplished but, as mentioned before, because of lack of time the information is sometimes not complete. Especially, information about the management at the sites was scarce and difficult to compile. This is because that most of the sites are not legally protected under national law. Even if an area is a Ramsar Site, this means not in all cases that there is an effective management or protection in place. Particularly in the so-called developing countries of Africa and Asia, important intertidal mud flat areas are not protected by national law or by international treaties. And there are also countries we know almost nothing about their important ecosystems. For example we know less about intertidal mud flats in China and North Korea because of the political situation in the countries. Also, knowledge about areas in the former USSR is limited or difficult to find.

To improve the situation with regard to site protection and management, more financial and scientific support from the industrial countries in Europe and America is necessary. The ”more developed” counties can in this way help to protect protection intertidal mud flats but also other important ecosystems in countries that are ”less developed”.

But industrial countries can also learn from developing countries. For example, after the political change in South Korea, civil rights movement also create awareness for the environment and huge intertidal mud flats at the coast from South Korea. Local people are involved in monitoring- and education programs and through this even large land reclamation projects could stopped. In the more industrial countries the population actually knows about the importance of special ecosystems and they are

also legally protected, but the awareness is sometimes low which makes an effective protection more difficult.
Furthermore, an effective protection is sometimes easier in developing countries. If important ecosystems in an area occur where no industry, a low population density or no larger infrastructure exist, like at the coast of Mauretania (and other developing countries), almost nobody wants to have claim on the area. If there are no interest conflicts a protection is easier to realize. In Europe and North America the coastline has a densely populated and is influenced by industry and other functions. Here, many interest conflicts exist which leaves only limited room for protection and conservation.

This study shows, that the Wadden Sea in Denmark, Germany and the Netherlands is, in many aspects, not as unique as we have thought for many years. Many characteristics, like the importance as feeding, nursery and resting area, can be found in many other areas all over the world. However the Wadden Sea is one of the most important wetlands worldwide regarding the ecological importance, the size of the area and the interconnections with the adjacent area. The Wadden Sea is not single but unique regarding its specific characteristics.

By learning more about other intertidal mud flat areas on earth concerning functioning, threats and importance we will be able to learn more about the specific values of the Wadden Sea and how to come to a more effective protection of that area. On the other hand, a lot of experience concerning management, research and international cooperation have been gathered during 20 year of the trilateral Wadden Sea Cooperation which are valuable or even applicable also for other geographical regions.

This study doesn’t claim to give a complete overview about the existence of all intertidal mudflats worldwide because of the above explained technical limitations. The report should serve as a basis for future work in this field and additional information is greatly welcomed.

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WHSRN, Estero Rio Colorado Sonora/Baja California-Mexico International Reserve, WHSRN-Mexico
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http://www.wetlands.ca/wi-a/whsrn/bolivar.html .

WHSRN, Brazoria Refuge Complex Texas-USA International Reserve, WHSRN-USA
http://www.wetlands.ca/wi-a/whsrn/brazoria.html .

WHSRN, Copper River Delta: Alasca-USA Hemispheric Reserve, WHSRN-USA
http://www.wetlands.ca/wi-a/whsrn/crdelta.html .

WHSRN, Delaware Bay Delaware-New Jersey-USA Hemispheric Reserve, WHSRN-USA

http://www.wetlands.ca/wi-a/whsrn/delabay.html .

WHSRN, Gray's Harbor Washington-USA Hemispheric Reserve, WHSRN-USA
http://www.wetlands.ca/wi-a/whsrn/grayhrbr.html .

WHSRN, Kachemak Bay: Alasca-USA International Reserve, WHSRN-USA
http://www.wetlands.ca/wi-a/whsrn/kachemak.html .

WHSRN, San Francisco Bay California-USA Hemispheric Reserve, WHSRN-USA
http://www.wetlands.ca/wi-a/whsrn/sanfran.html .

Wice Use Resource Centre Ramsar, The Canadian Federal Government Policy on Wetland Conservation, http://www.ramsar.org/wurc_policy_canada.htm .

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Annex 1 Contact Addresses

[1] responsible national ministery
[2] responsible administration
[3] responsible regional administration
[4] NGO
[5] educational or scientific institutions

SiteNr.	Name of the site	Contact Addresses
	Denmark	[1]National Forest and Nature Agency, Ministry of the Environment, Haraldsgade 53, DK-2100 Copenhagen, Denmark, Tel +45 3947 2000, Fax +45 3927 9899, E-mail puj@sns.dk or sns@sns.dk .
1	Vadehavet	[1]Miljo- og Energiministeriet, Skov- og Naturstyrelsen, Hendrik Wichmann, Haraldsgade 53, DK-2100 Copenhagen, Denmark, Tel +45 3947 2268, Fax +45 3947 2304, E-mail hew@sns.dk . [2]Amternes Vadehavssamarbejde, Inter-regional Wadden Sea Cooperation, John Frederiksen, Sorsigvej 35, 6760 Ribe, Denmark, Tel +45 75 424200 ext. 7120, Fax +45 75 424795, E-mail jf@ribeamt.dk .
2	Aqajarua-Sllorsuaq (Greenland)	[5]University of Copenhagen, Faculty of science, Arctic Station Qeqertarsuaq, Gitte Hendriksen, Oster Volgade 3, 1350 Copenhagen, Denmark, Tel +45 35324 256, Fax +45 35324 220, E-mail gin@adm.ku.dk .
3	Qinnquata Marra-Kuussuaq (Greenland)	
	France	[1]Direction de la Nature et des Paysages, Ministere de l'Amenagement du Territoire et de l'Environnement, Avenue de Segur 20, 75302 Paris 07 SP, France, Tel +33 1 4219 1900, Fax +33 1 4219 1977, E-mail dnp-dir@environnement.gouv.fr .
4	Baie du Mont Saint-Michel	
5	Golfe du Morbihan	
	Germany	[1]Abteilung Naturschutz, Umwelt und Gesundheit, Bundesministerium fur Umwelt, Naturschutz und Reaktorsicherheit, Postfach 120629, D-53048 Bonn, Germany, Tel +49 228 305 2605, Fax +49 228 305 2697.
6	Wattenmeer	[1]BMU, Referat -NI2-, Lothar Fiedler, Postfach 120629, 53048 Bonn, Germany, Tel +49 228 305 2621, Fax +49 228 305 2697, E-mail fiedler.lothar@bmu.de . [2]Umweltbehörde Freie u. Hansestadt Hamburg -Naturschutzamt, Nationalparkverwaltung, Klaus Janke, Billstraße 84, 20539 Hamburg, Germany, Tel +49 40 42845 3945, Fax +49 40 42845 2579, E-mail klaus.janke@ub.hamburg.de . [2]Nationalpark Niedersächsisches Wattenmeer, Nationalparkverwaltung, Virchowstraße 1, 26382 Wilhelmshaven, Germany, Tel +49 4421 9110, E-mail klaus.wonneberger@nlpv.terramare.de . [2]Landesamt für den Nationalpark Schleswig Holsteinisches Wattenmeer, Schloßgarten 1, 25832 Tönning, Germany, Tel +49 4861 616 0, Fax +49 4861 459, E-mail npa.zentrale@t-online.de .

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	The Netherlands	[1]Division for International Affairs, Departement for Nature Management, Ministry foe Agriculture, Natuer Management and Fisheries, Bezuidenhoutseweg 73, Postbus 20401, NL-2500 EK 'S-Gravenhage, Netherlands, Tel +31 70 378 5591, Fax +31 70 378 6146,
7	Oosterschelde	[4]Natuurmonumenten, Noordereinde 60, 1243 JJ 'S Graveland, The Netherlands, Tel +31 35 6559933 or +31 35 655955, Fax +31 35 6563174. [4]Staatsbosbeheer,Centrale Organisatie, Princenhof Park 1, 3972 NG Driebergen, The Netherlands, Tel +31 30 6926111, Fax +31 30 6922978.
8	Waddenzee	[1]Min. Landbouw Natuurbeheer en Visserij, Dir. Natuurbeheer, Henri Kool, Postbus 20401, 2500 EX Den Haag, The Netherlands, Tel +31 70 378 5660, Fax +31 70 378 6145, E-mail h.kool@n.agro.nl . [4]Stuurgroep Waddenprovincies, Hein Tromp, postbus 20120, 8900 HM Leeuwarden, The Netherlands, Tel +31 58 2925825/826, Fax +31 58 2925220, E-mail waddswp@fryslan.nl . [4]Landelijke vereniging tot behoud van de Waddenzee, Voorstraat 18, 8861 BK Harlingen, The Netherlands, Tel +31 517 415541, Fax +31 517 417977, E-mail lvbw@noord.bart.nl . [4]Natuurmonumenten, Noordereinde 60, 1243 JJ 'S Graveland, The Netherlands, Tel +31 35 6559933 or +31 35 655955, Fax +31 35 6563174. [4]Staatsbosbeheer,Centrale Organisatie, Princenhof Park 1, 3972 NG Driebergen, The Netherlands, Tel +31 30 6926111, Fax +31 30 6922978. [4]Stichting Het Groninger Landschap, Ossenmarkt 9, 9712 NZ Groningen, The Netherlands, Tel +31 50 3135901, Fax +31 50 3138979. [4]Vereniging It Fryske Gea, Van Harinxmaweg 17, Olterterp, Postbus 3, 9244 ZN Beetsterzwaag, The Netherlands, Tel +31 512 381448, Fax +31 512 382973.
	Portugal	[1]Instituto da Conservacao da Natureza, Ministerio do Ambiente e Recursos Naturais, Rua Lapa 73, P-1200 Lisboa, Portugal, Tel +351 1 395 9464, Fax +351 1 601 048, E-mail pres.icn@icn.pt or Luis Costa, E-mail costal@icn.pt .
9	Estuario do Tejo	
10	Estuario do Sado	[2]Reserva Natural do Estuario do Sado, Praca da Republica, 2900 Setubal, Portugal, Tel +351 65 524032, Fax +351 65 37256.
11	Ria Formosa	[2]Parque natural da Ria Formosa, Quinta do Marim, Quelfes, 8700 Olhao, Portugal, Tel +351 89 704134, Fax +351 89 704165. Dr. Martin Sprung, CCMAR-UCTRA, Universidade do Algarve, Campus de Gambelas, 8000 Faro, Portugal, E-mail msprung@ualg.pt . [5]Wattenmeerstation Sylt, Hafenstraße 43, 25992 List, Ragnhild Asmus, Tel +49 4651 956 101, Fax +49 4651 956 200, E-mail rasmus@awi-bremerhaven.de .

SiteNr.	Name of the site	Contact Addresses
	Russion Federation (European part)	[1]Department of international Cooperation, State Committee of the Russian Federation on Environmental Protection, B. Gruzinskaya ul. 4/6, RU-123812 Moscow, Russion Federation, Tel +7 095 254 6733, Fax +7 095 254 8283. [5]Valentin Ilyashenko, Department for Biodiversity Protection, E-mail zapchin@glas.arc.org . [4]WWF - Russian Programme, Account WWF 232, Box 289 Weybridge, Surrey kt13 8wj, UK, Victor Nikiforov E-mail nikiforov@wwfrus.glasnet.ru .
12	Berezovye Island in the Gulf of Finnland	
13	13 White Sea (Kandalaksja Bay, Onega Bay, Dwina Bay, Mezen Bay)	[2]Kandalaksha State Nature Reserve, Tel +007 81533 22250, Fax +007 81533 23250, E-mail kand_reserve@dionis.mels.ru . [5]Prof. Pörtner, Alfred-Wegener-Institut, Columbusstrasse, 27568 Bremerhaven, Germany, E-mail hpoertnet@awi-bremerhaven.de . [4]WWF - International artic programme, Kristian Augusts Gata 7A, Box 6784, St. Olavs Plass, N-0130 Oslo, Norway, Tel +47 22 03 65 17, Fax +47 22 20 06 66, Peter Prokosch E-mail wwfap@online.no .
	Spain	[1]Direccion General para la Conservacion de la Naturaleza, Ministerio de Medio Ambiente, Gran Via San Francisco 4, ES-28005 Madrid, Spain, Tel +34 1 597 5532 or +34 1 597 5522, Fax +34 1 597 6301, E-mail anfernan@iies.es .
14	Delta del Ebro	[5]Institut de Cienncies del Mar (CSIC), Albert Palanques, Passeig Joan de Borbo s/n, E-08039 Barcelona, Spain, Tel +34 3 2216416, Fax +34 3 221 73 40, E-mail albertp@icm.csic.es .
	UK	[1]Department of the Environment, Transport and the Regions, Europen Wildlife Division, Tollgate House, Room 907, Houlton Street, Bristol BS2 9DJ, United Kingdom, Tel +44 117 987 8233, Fax +44 117 987 8182, E-mail european.wildlife.doe@gtnet.gov.uk . [4,5]David Stroud, UK Joint Nature Conservation Committee, Monkstone House, City Road, Petersborough PE1 1JY, UK, Tel +44 1733 562 626, Fax +44 1733 555 948, E-mail stroud_d@jncc.gov.uk .
15	Morecambe Bay	
16	Severn Estuary	
17	The Wash	
18	Upper Solway Flats & Marshes	
	Guinea-Bissau	
19	Archipelago dos Bissagos (Orango-NP)	[1,2]CWSS, Virchowstraße 1, 26382 Wilhelmshaven, Germany, Tel +49 4421 9108 0, Fax +49 4421 9108 30, E-mail polanski@cwss.whv.net .

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	Mauretanien	[1]Direction de l'Environnement, Ministere du Developpement Rural et de l'Environnement, Boite postale 170, Nouakchott, Republique islamique de Mauritanie, Tel +222 2 59183, Fax +222 2 556 16 or +222 2 556 17.
20	Banc d'Arguin	[2]Parc National du Banc d'Arguin, BP 124, Nouadhibou, Republique Islamique de Mauritanie.
	Morocco	[1]Service de la Protection de la Nature, Administration des Eaux et Forets, Ministere de l'Agriculture, Boite postale 605, Rabat-Chellah, Maroc, Tel +212 7 76 2694, Fax +212 7 76 4446.
21	Baie de Khniffis	
22	Merja Zerga (Moulay Bou Salham)	
	Namibia	[1]Minitry of Environment and Tourism, Private bag 13306, Windhoek, Namibia, tel +264 61 26 3131, Fax +264 61 26 3195 or +264 61 259 101, E-mail plat anna@hotmail.com .
23	Sandwich Harbour	[5]Dr. Rob Simmons, harrier@iafrica.com.na .
24	Walvis Bay Wetland	[5]Dr. Rob Simmons, harrier@iafrica.com.na .
	South Africa	[1]Department of Environmental Affairs and Tourism, Chief Directorate, Environmental Conservation, 315 Pretorius Street, Private Bag X 447, Pretoria 0001, South Africa, Tel +27 12 310 3701 or +27 12 310 3514, Fax +27 12 322 6287, E-mail Nat geof@ozone.pwv.gov.za .
25	Langebaan	[1]South African Wetlands Conservation Programme, John Dini nat jd@ozone.pwv.gov.za .
	Tunesia	[1]Direction generale des Forets, Ministere de l'Agriculture, 30 rue Alain Savary, 1002 Tunis, Tunisie, Tel +216 1 891 497, Fax +216 1 794 107 or +219 1 801 922.
26	Golf of Gabes	
	Mozambique	[1]Venancio Massingue, CITUEM, Eduardo Mondlane University, Campus Univeritario, P.O. Box 257, Maputo, Mozambique, Tel +258 1 492 601, Fax +258 1 491 557, E-mail venancio@bandl.uem.mz .
27	Between Save and Buzi River (South of Beira), Maputo Bay	[5]University Witwatersrand, Private Bag 3, WITS, 2050, South Africa, Tel +27 11 716 1111, Fax +27 11 339 7620, E-mail 086wits@atlas.wits.ac.za . (Maputo Bay)
	South Africa	See above
28	St. Lucia System	
	Argentina	[1]Secretaria de Recursos Naturales y Desarollo Sustenable, San Martin 459-Piso 1,1004 Buenos Aires, Argentina, Tel +54 11 4348 8200, Fax +54 11 4348 8288, E-mail secrnah@wamani.apc.org. or lna@ina.gov.ar . [4]Dagny Gingrich, Programm Assistent, Wetlands International - The Americas, 7 Hinton Avenue North, Suite 200, Ottawa, Ontario, Canada K1Y 4P1, Tel +, Fax +, E-mail dgingrich@wetlands.org .

SiteNr.	Name of the site	Contact Addresses
29	Bahia Blanca	
30	Bahia de Samborombon	
31	Reserva Costa Atlantica de Tierra del Fuego (Bahia San Sebastian)	
32	San Antonio Oeste Rio Negro	
	Canada	[1]Water & Habitat Conservation Branch, Canadian Wildlife Service, Environment Canada, 3rd floor, Place Vincent Massey, Ottawa, Ontario K1A 0H3, Canada, Tel +1 819 997 1303, Fax +1 819 994 4445, E-mail clay.rubec@ec.gc.ca . [4]Dagny Gingrich, Programm Assistent, Wetlands International - The Americas, 7 Hinton Avenue North, Suite 200, Ottawa, Ontario, Canada K1Y 4P1, Tel +, Fax +, E-mail dgingrich@wetlands.org .
33	Dewey Soper Migratoryy Bird Sanctuary	
34	Polar Bear Provincial Park (Hudson Bay)	
35	Queen Maud Gulf	
36	Bay of Fundy: -Mary's Point -Shepody Bay -Southern Bright-Minas Bassin	
37	Southern James Bay (Hudson Bay)	
38	Ungave Bay Leaf Bassin	
	Suriname	[1]Suriname Forest Servive, Nature Conservation Division, Ministry of Natural Resources, P.O. Box 436, Paramaribo, Suriname, Tel +597 47 9431 or +597 47 5845, Fax +597 41 0256, E-mail lbbnb@sr.net . [4]Dagny Gingrich, Programm Assistent, Wetlands International - The Americas, 7 Hinton Avenue North, Suite 200, Ottawa, Ontario, Canada K1Y 4P1, Tel +, Fax +, E-mail dgingrich@wetlands.org .
39	Bigi Pan	
40	Coppename-moding	

SiteNr.	Name of the site	Contact Addresses
41	Wia Wia	
	USA	[1]Office of International Affairs, US Fish and Wildlife Service, Department of the Interior, Room 3245, 1849 C Street NW, Washington, D:C: 20240, USA, Tel +1 202 208 6393, Fax +1 202 208 4674, E-mail kimberly mcclurg@fws.gov . [4]Dagny Gingrich, Programm Assistent, Wetlands International - The Americas, 7 Hinton Avenue North, Suite 200, Ottawa, Ontario, Canada K1Y 4P1, Tel +1 613 792 1561, Fax +1 613 722 3318, E-mail dgingrich@wetlands.org .
42	Chesapeak Bay	
43	Delaware Bay Estuary	
	Mexico	[1]Secretaria de Medio Ambiente, Recusos Naturales y Pesca (Semarnap), Periferico Sur 4209, nivel 38, Fraccionamiento Jardines de la Montana, C.P. 1410 Mexico D.F., Mexico, Tel +52 5 628 0600 0r +52 5 628 0601, Fax +52 5 628 0643 or +52 5 628 0644, E-mail jcarabias@buzon.semarnap.gob.mx . [4]Dagny Gingrich, Programm Assistent, Wetlands International - The Americas, 7 Hinton Avenue North, Suite 200, Ottawa, Ontario, Canada K1Y 4P1, Tel +, Fax +, E-mail dgingrich@wetlands.org . [1]Sandra Cruz Mondragon, Departamento de Cooperacion Internacional Regional, Av rervolucion #1425, Nivel 19, Col. San Angel Tlacopac CP. 01040, Mexico, DF, Tel +52 5 624 36604, Fax +52 5 624 3588, E-mail scruz@ine.gob.mx or lortiz@buzon.semarnap.gob.mx .
44	Humedales del Delta del Rio Colorado	[2]Baja California Biosphere Reserve: E-mail barrera@cideson.mx .
	USA	See above
45	Copper River Delta	
46	San Francisco Bay California	
	Iraq	
47	Shatt el Arab (Abadan and Fao)	
	Iran	[1]Department of the International Economic Affairs, Ministry or Foreign Affairs, Kushkmessri St., Building West 8, Teheran, Iran, Tel +98 21 321 2675, Fax +98 21 67 4176.
48	Deltas of Rud-e-Gaz and Rud-e-Hara	
49	Deltas of Rud-e-Shur, Rud-e-Shirin and Rud-e-Minab	

SiteNr.	Name of the site	Contact Addresses
50	Khuran Straits	
51	Shadegan Marshes & mudflats of Khor-al Amaya & Khor Musa (Bandar Khomeyni and Bandar Mashar)	[5]Thomas Hoepner, ICBM University Oldenburg, E-mail hoepner@uni-oldenburg.de .
	Kuwait:	
52	Kuwait Bay	
	Saudi Arabia	
53	Along the Persian Gulfcoast (Tarut Bay)	
	United Arabian Emirates	
54	Along the coast of the Persian Gulf (Bas Al Khaymas)	
	India	[1]Departement of Environment, Forest and Wildlife, Ministry of Environment and Forest, Paryavaran Bhawan, C.G.O. Complex, Lodi Road, New Delhi - 110003, India, Tel +91 11 436 0492, Fax +91 11 436 0009 or +91 11 436 2281. [4]WWF-India, Freshwater and Wetland division, Pirojsha Godrej national Conservation Centre, 172-E, Max Mueller Marg, Lodi Estate, New Delhi - 3.
55	Gulf of Khambhat	
56	Gulf of Kachchh	
	Pakistan	[1]National Council for Conservation of Wildlife, Ministry of Environment, Local Government and Rural Development, 79-E, Al-Rehman Chamber, 3rd Floor, Blue Area, Islamabad, Pakistan, Tel +92 51 82 9756, Fax +92 51 22 1246.
57	Indus River Delta	
	Japan	[1]Wildlife Protection Division, Nature Conservation Bureau, Environment Agency, Kasumigaseki 1-2-2, Chidoya-ku, Tokyo 100-8975, Japan, Tel +81 3 3581 1709, Fax +81 3 3595 1716, E-mail wildlife@eanet.go.jp . [4]WWF Japan, Shiba 3-1-14, Minato-Ku,Tokyo, Japan, Wetland Officer, Tobai Sadayosi, E-mail tobai.sadayosi@nifty.ne.jp .
58	Hakata Bay (Imanzu tidal flat and Wajiro tidal flat)	
59	Isahaya Bay	

SiteNr.	Name of the site	Contact Addresses
	Russion Federation (Asian part)	See above
60	Thamir Peninsula	
61	Karaginsky Island, Bering Sea	
	China	[1]State Forestry Administration, No. 18 Hepingli East Street, Beijing 100714, People's Republic of China, Tel +86 10 8423 8719, Fax +86 10 6421 9149, E-mail nrgef@mail.ied.ac.cn or chdnr@pcux.ied.ac.cn . [1]Department of the Wildlife Conservation/Ministry of Forestry, E-mail gefpo@public.bta.net.cn . [4]Wetlands International-China, E-mail chenkl@sun.ihep.ac.cn .
62	Korea Bay	
63	Liaodong Wan	
64	Yellow river delta	
	North Korea	
65	Korea Bay	
66	Yellow Sea coast	
	South Korea	[1]Ministry of Environment, 1 Joongang-Dong, Kwacheon, Kyunggi-Do 427 760, Republic of Korea, Tel +82 2 504 9284, Fax +82 2 504 9206 or +82 2 507 7654, E-mail eco729@chollian.dacom.co.kr .
67	Coast of the Yellow Sea W and SW-Korea	[4]Korean Federation for Environmental Movement (KFEM), 251 Nooha-dong Chongo-gu Seoul 110-042, South Korea, tel: +82-2-735-7000 fax:+82-2-730-1240, Tidal flat conservation coordinator Jang, Ji Young, E-mail jangij@ecoserve.kfem.or.kr
	Thailand	[1]Office of Environmental Policy and Planning (OEPP), 60/1 Soi Phibun Wattana 7, Rama 4 Road, bangkok 10400, Thailand, Tel +66 2 279 5202 or +66 2 279 8088, Fax +66 2 271 3251 or +66 2 271 5202, E-mail sirikb@samart.co.th .
68	Gulf of Thailand	
69	Pattani Bay	[4]Wetlands International - Thailand Program Paul Erftemeijer epaul@ratree.psu.ac.th Ahmad Somboon Bualuang, Department of Extension and Dissemination Prince of Songkla University, Pattani, Thailand 94000.
	Vietnam	[1]National Environment Agency, Ramsar Convention Section, Ministry of Science, Technology and Environment, Nguyen Du Street 67, Hanoi, Vietnam, Tel +84 4 8242 510 or +84 4 9341 933, Fax +84 4 8242 510 or +84 4 8223 189, E-mail ramsarvn@svrl-han.unep.net or nea@hn.vnn.vn .
70	Xuan Thuy Natural	[4]Wetlands International - Oceania, Doug Watkins,

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	Wetland Reserve	E-mail doug.watkins@ea.gov.au .
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71	Bowling Green Bay	[3]Queensland national Parks and Wildlife Service, 160 Anne Street, Brisbane QLD 4000.
72	Corner Inlet	[3]Port of Melbourne Authority, GPO Box 4721, Melbourne Victoria 3001.
73	Eighty-mile Beach	[3]Department of Land Administration, Central Government Building, Cathedral Avenue, Perth WA 6000.
74	Moreton Bay	[3]Queensland national Parks and Wildlife Service, 160 Anne Street, Brisbane QLD 4000.
75	Roebuck Bay	[3]Queensland national Parks and Wildlife Service, 160 Anne Street, Brisbane QLD 4000.
76	Shoalwater & Corio Bays	[3]Conservation Strategy Branch, Queensland Department of Environment and Heritage, PO Box 155, Brisbane Albert Street, Queensland 4002 Australia.
77	Western Port	[3]Port of Melbourne Authority, GPO Box 4721, Melbourne Victoria 3001.
	New Zealand	[1]Departement of Conservation, Conservation Sciences centre, P.O. Box 10-420, Wellington, New Zealand, Tel +64 4 471 3142, Fax +64 4 471 1082, E-mail hlogan@doc.govt.nz .
78	Farewel Spit	[1]Departement of Conservation, Conservation Sciences centre, P.O. Box 10-420, Wellington, New Zealand, Tel +64 4 471 3142, Fax +64 4 471 1082, Peter Gaze, E-mail pgaze@doc.govt.nz .
79	Firth of Thames (Miranda)	[4]Miranda Naturalists Trust, R D 1 Pokeno, New Zealand, Tel +64 9 232 2781, Fax +?? 9 232 2781, E-mail shorebird@xtra.co.nz .