

Intertidal Treasure Khowr-e Mussa - Unraised

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Sources of Knowledge

There are people saying that the Iranian coast is one of the most unknown coastal stretches of the world. And even if Iranian scientists have explored it, the results of the exploration are hardly accessible. Up to about 10 years ago, this was the general opinion concerning most of the Gulf coast, and the classical books of Purser (The Persian Gulf, 1973) and Basson et al., (Biotopes of the Western Arabian Gulf, 1977) were the only sources for a long time - up to the first (Iraq-Iran) and second Gulf War (Iraq-Kuwait) both of which had the terrible result of a deliberate, or at least, approved release of tremendous amounts of crude oil into the marine ecosystem. While in the first case, the continuing war prevented a scientific assessment of the damages, the second case triggered a rush of intense research causing the authors to meet and to experience the still poor characterization of the outstanding intertidal area Khowr-e Mussa.

Official and generally available sources like sea charts (German 332, Iranian 1296) and handbooks (BSH, Handbuch für das Rote Meer und den Persischen Golf, 1993) present surprisingly unprecise and antiquated information and are, as usual, restricted to navigation interests, nevertheless leaving to the discerning reader the idea of an extremely interesting area of sea-land transition. On available maps, large areas are marked as "unsurveyed", or the map design allows the conclusions that details are not known.

Geographical and Hydrographical Setting

The depth of the Persian Gulf decreases from South to North. The northern coast is fringed by an intertidal zone of a width of up to 15 km (Figure 1). The length is appr. 200 km from the western head of the Bay of Kuwait to Ras (Cape) Barkan (Iran). This intertidal zone includes the Bay of Kuwait, 40 % of which runs dry, the channels surrounding Bubiyan Island (Kuwait), the vast areas of the outer Khowr-e Mussa system (Iran), and the inner Khowr-e Mussa, which is the subject of this treatise (Figure 2). The commonly best known component is the Shatt al Arab (west bank: Iraq, east bank: Iran) which, however, is much less conspicuous than the other inlets. This coastal strip is a trilateral area; unfortunately trilateral not in the sense of



border-transgressing cooperation but in the sense of a present impossibility of scientific work in the border-near zones.

Tidal amplitudes are in the range of 2 - 3 m along the coast, increasing to 5 m and more in the Khowr-e Musa deep channel and inner basin. Tidal currents attain 4.5 knots in the channel. While the (undredged) depth of the outer channel is only around 2 - 3 m, a situation unique for the northern half of the Persian Gulf is found around the knee where Khowr-e Musa turns from north-south to west-east direction: There, the natural water depth is 89 m! This makes clear the enormous water masses which pass the deep channel during every tide. The inner basin has the approximate size of the Jadebusen, but with just that difference which merits the attention given

— A mudkipper colony occupies a small depression of the upper intertidal zone in the Khowr-e Mussa area.

Each fish maintains and defends a territory of about one square meter which offers the epiphytobenthic food (Bandar-e Khomeini Nov. 24, 1994).

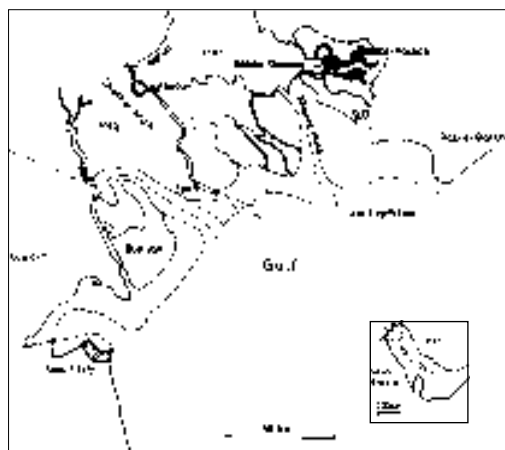


Figure 1
The location of intertidal areas along the northwestern coast of the Persian Gulf from Kuwait to cape Ras-e Barkhan (Iran). Stippled: the inner Khowr-e Mussa basin.

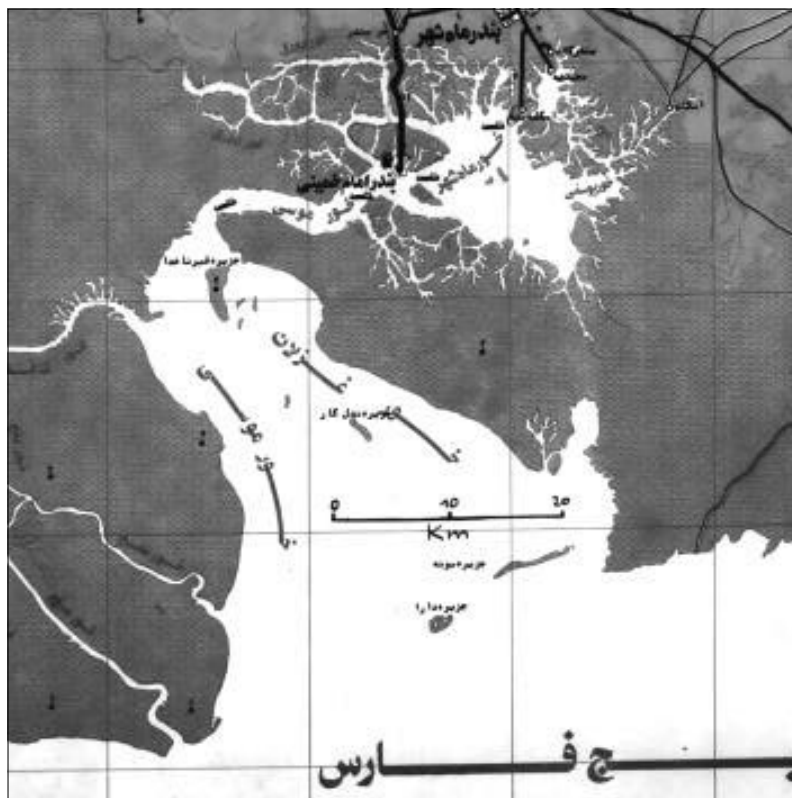


Figure 2
Khowr-e Musa, consisting in an estuary-shaped approach and the inner basin. The two harbour and industrial centers are Bandar-e Khomeini (left) and Bandar-e Mashab (right). The town at the northern edge is Mashab. Source: Iranian traffic map of Khusistan Province.

here: it is surrounded by a corona of numerous tidal channels of various length and width, some of which extend 20 km and more into the flat marshland.

In contrast to the geographical image, Khowr-e Musa is not an estuary. There is almost no fresh-water inflow. The eastern branches of the Shatt el Arab Delta are small or closed. The Karun river which is the largest in discharge circumvents Khowr-e Musa in the North and joins the Shatt near the twin-cities Abadan and Khorramshar. The Jarrahi river oozes away in the huge northern (and salty) bogland from which water enters the intertidal area only on the occasion of extreme floods.

Ecological Features

Khowr-e Musa is a part of the sedimentary system fed by the Iranian mountains and progressing into the Gulf. While the outer part is mainly sandy, fine sand and mud dominate the inner part. The sediments are cohesive and form steep slopes along the channels. This, and the large tidal amplitudes, create a very detailed and diversified surface morphology with -at low tide- surprising differences of level. These impressions are accentuated by macrophytic plant communities covering the ridges between the channels.

The mudflats are subject to intense bioturbation. Wadden Sea experts note immediately that the cohesivity of the sediment, together with the low energy input, allow a much longer lifetime of the species-specific surface characteristics than on Wadden Sea flats. Bioturbation is at least as intense as it is in the Wadden Sea, but the digging community is completely different. We got the impression that two animal groups are of dominant activity: small digging crabs and the mudskippers (cover photograph), although there is still no scientific study to confirm this. There is a variety of crab species forming large and densely settled, apparently monospecies colonies with distinct zonations.

For the Gulf area, mudskipper colonies are reported from the Bay of Kuwait. Each fish digs his own deep burrow where it hides from disturbances and during high tide. Under certain conditions, the single fishes (most probably *Boleophthalmus boddarti*) build polygonal territories of a size of about one m², surrounded by dams, defended against rivals, and large enough to provide food (microphytobenthos). While this scenery is rare even in Kuwait Bay and difficult to be accessed, we found that it is widespread on lower situated mudflats of the Khowr-e Musa area where it covers many km². Even in the higher situated zone, mudskippers contribute decisively to the bioturbation power but do not form territories. Often, they form mixed colonies with digging crabs, e. g. fiddler crabs (*Ucaidae*).

That, along with such a diverse and rich macrofaunal life, the area is also rich in birds is not unexpected. A list of 45 species (Table 1) argues for an avifaunal importance comparable to e. g. the West-African Banc d'Arguin (30 species) and the Saudi-Arabian "Marine Wildlife Sanctuary for the Arabian Gulf" (63 species, the expense of counting, however, and the definition of shoreline birds seems rather different). While most bird species are either identical, or similar to the North Sea Wadden Sea species, the number and activity of some birds of prey (not in Table 1 besides the fish-hawk!) is spectacular. They feed on mudskippers and crabs which both move long enough on the surface to become an easy prey.

While on the one hand, the observer concludes that the benthic and pelagic species diversity is high, experts assume that it is not as high as along the corresponding oceanic coasts. There is a convincing explanation: After the Persian Gulf had merely been a river valley during the ice age, it was resettled by marine organisms which immi-

grated through the Strait of Hormuz. Many organisms, which could live under the more temperate conditions of the northern Gulf, were unable to pass its harsh and hot southern entrance.

Whoever gets the opportunity of doing research in the Khowr-e Musa area will have advance from D. A. Jones' remarkable "Field Guide of Kuwait and the Arabian Gulf" (Univ. of Kuwait, out of print).

Human Use

Even if the flat barrier of the outer Khowr-e Musa requires permanent dredging, the basin and its approach form a splendid natural port. The center is an island which is occupied by the Bandar-e Khomeini port and industrial facilities. It is the main port of the busy Khusistan province, and since Khusistan is an important agricultural area as well as an area of oil and gas mining, Bandar-e Khomeini houses piers for oil, container, general goods, and grain and in addition (petro)chemical industries, and this at the environmental standards typical for the Middle East. Since the occupation of the, at that time, most important Iranian harbor Khorramshar Shatt in 1980, the importance of Bandar-e Khomeini has increased and is still increasing, accompanied by a strong increase in population and industry in the hinterland.

There is a second oil harbor in the eastern part: Bandar-e Mashar, accessible by tankers of 200,000 to 300,000 t (which underlines the size and the tidal power of Khowr-e Musa). From both ports, road links go exclusively to the North. Bandar-e Khomeini has a railway link, too. Both centers are at present restricted to densely utilized and clearly confined areas so that the sharp transition from industrial to natural zones is very conspicuous. Because of the rapid industrial and population development, environmental pollution has increased considerably.

Fishery is carried out by artisan fishermen from slim traditional boats, now equipped with out-borders. Fishery is coordinated by a cooperative (Schilat) located between Bandar-e Khomeini island and the mainland. The cooperative runs a small fishing port as well as a research station which, among others, develops shrimp aquaculture and shrimp hatch for production ponds. Fishermen seem to be the only persons who move inside the extended channel system.

Nature Protection

There has been a long-lasting discussion on environmental protection which, however, has not achieved concrete measures so far. The rapid eco-

Species	m: migrating n: non-migrating b: breeding	+++ frequent ++ common + rare
Alcedo atthis	n	+++
Ardea cinerea	b	+++
Ardea purpurea	m	+
Ardeola grayii	m	++
Ardeola ralloides	b	+++
Botaurus stellaris	m	+++
Branta ruficollis	n	+
Bubulcus ibis	m	+++
Ceryle rudis	n	+++
Charadrius mongolus	m	+++
Chlidonias hybrida	m	+++
Chlidonias niger	m	+++
Ciconia nigra	m	+
Cygnus olor	m	+
Egretta garzetta	m, n	+++
Egretta gularis	n	+++
Fulica atra	n	+++
Gallinago gallinago	n	+++
Gallinula chloropus	n	+++
Gelochelidon nilotica	b, m	+
Haematopus ostralegus	m	+++
Larus argentatus	n	+++
Larus genei	n	+++
Larus ichthyaetus	n	+++
Larus minutus	n	+++
Limicola falcinellus	b, m	+
Nycticorax nycticorax	b, m	+++
Pandion haliaetus	b	+++
Pelecanus crispus	b, m	+++
Pelecanus onocratulus	m	+
Phaethon aethereus	b	+++
Phalacrocorax carbo	b, m	+++
Phalacrocorax pygmaeus	b, m	+++
Phoenicopterus ruber	b, m	+++
Plegadis falcinellus	m	+++
Podiceps ruficollis	b	+++
Porphyrio porphyrio	n	+++
Puffinus assimilis	b	+++
Sterna anaethetus	n	+++
Sterna bergii	n	+++

Table 1
List of seabirds observed in the Khowr-e Musa intertidal zone. From Dept. of the Environment, I. R. Iran: The birds of Iran

nomie development requires a substantial acceleration. The crucial point is the definition of a general protection goal. Partial goals are obvious:

- Analysis and evaluation of all data which are able to realize and describe negative ecological effects which means geographic, oceanographic, meteorologic, hydrologic, sedimentologic, physical, chemical and ecological examinations.
- Identification of the origins of harmful impacts.
- Measures to reduce harmful activities.
- Preparation and realization of precautionary measures.
- Erection of protected areas or of one uniform sanctuary, e. g. according to the Ramsar Convention.
- National and international control of the observation of environmental laws.

Especially the last two goals require intensive information and environmental education of a population, which, so far, has developed only a low environmental consciousness.

To achieve general and comprehensive results, these goals must be organized in an integrated project, and a cooperation on a national and international level is necessary. This would allow to bring in international experience and standards. Based on a governmental bilateral agreement (of Oct. 2, 1992) between Iran and Germany, which includes environmental protection, an Iranian/German cooperation is obvious. We could imagine that it profits from the German Wadden Sea ecosystem research.

Challenges

The Khowr-e Musa system is an ecologically unknown area. Nevertheless, to explore a hitherto unknown area is not a sufficient reason for research and the era of the discoverers is over. There should be more reasons to set a focal point of ecological research. I want to propose two:

One reason for research is the question: which role does Khowr-e Musa's play for the ecology of the Kuwaiti and Saudi-Arabian Gulf coast? These are much less diverse, less sheltered, and more exposed to dryness, heat and irradiation. There are, however, the Tanajib and Musallamiya Bay systems, but these do by no means exhibit the productivity and diversity of Khowr-e Musa. Nevertheless, this coast shows a species diversity (even in the intertidal zone) which does not seem to be explicable by the prevailing conditions.

There is a link between this coastal stretch and the Khowr-e Musa: It is the general counterclockwise Gulf current. Some people assume that the Khowr-e Musa (and the other comparable subsystems) continuously serves the adjacent coast with eggs, larvae and organisms thereby maintaining a biological inventory which otherwise would not be so rich. This hypothesis would mean that Khowr-e Musa is a key biotope of the northwestern Gulf which merits special protection in the future.

The second reason for research refers to one of the results of the Ecosystem Research Wadden Sea. It was stressed that the still existing "Wadden Sea" is only a part of which it could be, since the dikes have cut off its former landward part. If we compare the Jadebusen with the central Khowr-e

Musa basin, we recognize, for the latter, the complete absence of any dikes and the manifold links between the marine and the terrestrial parts, provided by the large number of tidal channels. Therefore, Khowr-e Musa offers aspects of a reference system for the monitoring of the Wadden Sea.

If this is not enough of a challenge: a second intertidal system of comparable size bears still more secrets. It is the northwestern part of the uninhabited Bubiyan island (Kuwait) which is unknown even to Kuwaiti scientists. The area has been closed since the Iraqi invasion.

Acknowledgements

A Dutch version appeared in Wadden Bulletin (Harlingen) 34(1), pp 34-35 (1999); a German shorter one in Wattenmeer International 16(3), pp 5-6 (1998). Ahwaz University, Khusistan, Iran, is located about 120 km north of Bandar-e Khomeini. There is a cooperation agreement between its Faculty of Oceanography and the Institute of Chemistry and Biology of the Marine Environment (ICBM), University of Oldenburg. The agreement is about comparative intertidal research in the sense of the article above. Due to the long-term political and diplomatic irritations the present results are still very limited.

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