

Section IV: Marine Environments

Middle Eastern Marine Environments: An Overview of Anthropogenic Impacts

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ABSTRACT

The seas that surround the lands of the Middle East have been significantly affected over the last century by human activities, including fishing, coastal engineering projects, and pollution from municipal, industrial, agricultural, and shipping sources. The impacts of these activities are only likely to increase in the future. Without coordinated, cooperative efforts by the nations involved, the seas of the Middle East are threatened with catastrophic change.

INTRODUCTION

The marine areas of the Middle East include four major basins: the Levant Basin (i.e., the Southeast Mediterranean); the Red Sea; the Gulf of Aden, the Arabian Sea, and the Gulf of Oman (which are more or less contiguous); and the Persian Gulf. Problems associated with anthropogenic change have increasingly affected the marine environments of the Middle East just as they have the world's other seas, but Middle Eastern seas also have to contend with problems and issues that are peculiar to, or especially acute in, the region.

Among these features are:

- the Suez Canal, with its dense ship traffic and the huge amounts of crude oil, fuels, and petro-chemicals that are transported through all Middle East marine areas;
- biological issues specific to the two semi-enclosed basins of the region (i.e., the Red Sea and the Persian Gulf) including such special tropical biotopes as coral reefs; and
- inadequate regional and sub-regional cooperation in environmental matters, due to historical, political, and cultural reasons.

Numerous studies describe the changes in marine environments that have occurred throughout the Middle East during the past few decades (Ben-Tuvia 1985; Ben-Yami and Glaser 1974; Caddy 1993b; Caddy and Oliver 1996; Golik and Goldsmith 1986; Inman and Jenkins 1984; Nir 1989; Vadiya and Shenuda 1985). These changes include pollution and eutrophication as well as the side effects of certain engineering projects.

The main environmental problems in Middle Eastern marine environments today are:

- Pollution originating from municipal, industrial, and agricultural sources in densely populated areas with high population growth rates, e.g., in the southeastern Mediterranean;

- Coastal erosion and other effects of engineering projects;
- The question of fisheries sustainability;
- Conservation of marine and coastal biotopes and endangered species, as well as biota migration through the Suez Canal;
- Oil spills;
- Pollution due to shipping.

MUNICIPAL, INDUSTRIAL, AND AGRICULTURAL EFFLUENTS

These effluents, which are the most common and significant sources of marine pollution, often contain a wide variety of nutrients, untreated bio-wastes including bacteria and viruses, and pesticides and other toxins including heavy metals and assorted chemicals. They are on occasion abnormally acidic or basic relative to the marine environment that they enter. These effluents may trigger physical and/or chemical processes, including both those inherent in the existing marine ecosystem as well as those that can only happen in the presence of pollution. For example, certain effluents may result in the synergistic creation or transformation of poisonous materials and/or the re-accumulation of contaminants, with unpredictable and accumulative consequences, to which some species may be more sensitive than others (Patin 1992).

Areas particularly affected by this sort of pollution can be found along the coasts of Israel and Gaza, the Nile Delta, the Gulfs of Aqaba and Oman, and the Persian Gulf. The situation is exacerbated by the fact that certain industrial interests, both from within the region and without, are often looking for locales where anti-pollution legislation is either weak or un-enforced in order to establish production facilities that would not be permitted under more stringent anti-pollution regimes (or would face high-cost investment in environment-friendly technology).

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MARINE AND COASTAL FISH FARMING

Coastal and marine fish farms produce primarily organic waste, which can be especially detrimental to the ecosystems of semi-enclosed bays and inlets. Coastal fish farm effluents are mainly nutrients, but may also include misapplied chemicals (Berg and Lavilla-Pitogo 1996). Marine cage farms also produce effluents, although these are more readily dispersed because of their offshore location. In addition to waste feed and fish feces, marine cage farms may also introduce such undesirable elements as residual antibiotics and chemicals from disease and parasite treatments. Marine fish

farming development in the Red Sea (Shehadeh and Feidi 1996) may lead to environmental damage, especially of coral reefs, if sites and culture practices are not chosen with care.

HOSTILITIES

Oil pollution, whether from accidents or hostilities, has so far occurred mainly in the Persian Gulf, where the world's most dramatic oil spill resulted from intentional Iraqi releases during the 1991 Gulf War. The Iraqis spilled an estimated eleven million barrels of crude oil into the Gulf, which spread quickly and affected hundreds of kilometers of coastline, mainly in Saudi Arabia. Cleaning efforts recovered an estimated 13% of the total. Contrary to a number of pessimistic forecasts, the Gulf environment managed to rebound rapidly from this disaster. Experience with this and other spills seems to indicate that warm, tropical marine ecosystems enable more rapid and effective decomposition of oil pollution than more temperate ecosystems, thanks in large part to intense solar radiation and the action of oil-degrading bacteria.

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FISHERIES

Fisheries play an important economic role in the Middle East, especially in the countries of the southern Arabian Peninsula and in Egypt (see Feidi, this volume). Although some of these resources are currently under pressure from excessive fishing and other anthropogenic factors, none of them are currently considered seriously over-exploited (Caddy and Oliver 1996; Feidi 1996; Sanders and Morgan 1989). Since most of the fish stocks straddle the waters of more than one country, international and regional fishery management has an important role to play. In the semi-enclosed Mediterranean, fisheries have increasingly been affected by the combined effect of intensive fishing activities and persisting enrichment (eutrophication) due to runoff of nutrients and other polluting agents. Coastal pollution and the resulting eutrophication are playing a paradoxical role with respect to fisheries in oligotrophic seas (i.e. seas that are poor in nutrients and of low primary production). Although pollution is generally seen as something to avoid, the stable and even growing Mediterranean fish landings can only be explained in terms of man-made enrichment of its waters. This enrichment seems to be compensating for the reduction of nutrients that were once supplied by the Nile River but that were halted after the 1964 construction of the Aswan High Dam. Apparently, anthropogenic eutrophication is the main cause of the increasing landings in Mediterranean fisheries (Caddy 1993b, 1996). The sardine fishery offers a case in point.

Prior to the construction of the Aswan High Dam, this fishery produced 18,000 to 25,000 t/yr off the Nile Delta. After 1964, this fishery collapsed to 550 t in 1966. Since the 1980s, however, sardine and other small pelagic catches in Egypt's Mediterranean waters have rebounded to about 50% of the pre-Aswan period. Catches of some demersal fish have also grown significantly. These and other yield increases appear to be a result of anthropogenic enrichment rather than of the inadequate fisheries management that characterizes the region. Still, the relationship between eutrophication and fisheries should concern all Mediterranean countries, particularly in view of the ecological calamity that befell the Black Sea fisheries in early 1990s, which evidently was triggered and fed by man-made pollution, resulting in eutrophication, combined with a devastating intrusion of an exotic predatory comb-jelly (Zaitsev 1993; Caddy 1993; Ben-Yami 1994).

TOURISM DEVELOPMENT

Expansion of the tourist industry, as in the case of the recent rapid development along the coasts of the Gulf of Aqaba/Eilat, is quite a separate issue. Inadequate planning of tourist infrastructure, especially large hotels, can put severe strains on existing sewage treatment and disposal systems that were originally established to serve much smaller populations.

In semi-enclosed marine basins, all projects involving massive increase of the density of coastal population, whether permanent or transient, should be looked upon as components of one combined system. One way to assess eventual combined damage and at the same time to set limits on proposed tourism development is: (a) to assess the existing contribution to marine pollution in terms of person/day/pollution factors; (b) to assess the maximum sustainable pollution capacity throughout the affected marine area (approximate pollution carrying capacity (GESAMP 1986; Krom and Cohen 1991)); (c) to determine the additional number of person-days that the ecosystem affected can sustain without permanent damage to coral reefs, water clarity, etc., taking into consideration the existing and additional (planned) means of sewage treatment; and (d) upon such determination, to allow additional population in the various projects.

In areas such as the Gulf of Aqaba, this integrated approach would call for international cooperation, which has, of course, not always been easy for Israel, Jordan, and Saudi Arabia.

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CORALS

In the Middle East marine environment, corals still abound and thrive. Coral reefs are sensitive biotopes, vulnerable not only to anthropogenic but also to natural stressors. Pollution (of any kind) and coral piracy can bring about, directly or indirectly, the degradation or death of a reef. Dead coral reefs are often found covered with sponge growth or algal turf, while multi-species bleaching of coral reefs, recently reported from the southern Persian Gulf (Dr. Roger Uwate—private communication), is the result of breakdown of the symbiosis between the corals and Zooxanthellae algae. Coral bleaching has been ascribed to several factors, most often to warming of the sea water. Seasonal floods carrying sediment that deposits on coral reefs are another natural cause for reef degradation. It remains to be seen whether proposed marine reserves will serve as an effective means for saving coral reefs (Russ 1996).

POSSIBLE EFFECTS OF MARINE POLLUTION

In seas with low natural productivity, such as the Red Sea and the Mediterranean, eutrophication may initially enhance marine organism populations, but it may also later lead to major environmental damage and even to collapse of whole ecosystems. Pollution may reduce biodiversity and cause harmful genetic changes, especially in the sensitive ecosystems of coral reefs in the Red Sea/Indian Ocean system and the brackish and hypersaline lagoons in Egypt. Algal and medusae blooms linked to pollution may reduce water clarity and threaten other marine organisms as well as the tourist and recreational industry in coastal areas, such as the Levant Basin and along the shores of the Sinai Peninsula. Another danger from pollution is the concentration of heavy metals or other toxic substances in seafood. Special attention must be paid to the presence of such contaminants as mercury and cadmium in the run-off from existing and developing industries in the region (Enserink *et al.* 1991; Simpson 1981; Talbot 1989; Nogawa 1984). Countries of the Middle East have a joint interest in protecting their waters from pollution, in particular from non-biodegradable contaminants. Cooperative regulation and enforcement on the part of the littoral states would benefit the environmental health of the Middle East's marine basins (i.e., eastern Mediterranean; Red Sea; Gulf of Aden, Arabian Sea and Gulf of Oman; and the Persian Gulf). The Persian Gulf in particular is ecologically vulnerable to the actions of its littoral states as well as the riparians of the Tigris-Euphrates river basin whose waters flow into the Gulf.

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MIGRATION, BIODIVERSITY, AND EXOTIC SPECIES

In some areas of the Middle East, native marine life faces not only exposure to pollution and destruction of feeding and breeding habitats, but also the added risks of competition due to intentional or accidental introductions of exotic organisms. Examples of this include diseases and their carriers, such as the new Noda virus which is the cause of viral encephalopathy in seabass, a fish cultured in the area, or the viruses that have been plaguing shrimp farms in southern Asia. Introductions and immigrations of exotic wild and farmed species may affect biodiversity in the marine ecosystem. Indeed, this phenomenon has long been an issue in the Mediterranean, where numerous migrants from the Red Sea have been continually settling in the Levant Basin in niches occupied by native species (Golani, this volume; Ben-Tuvia 1978, 1985; Ben-Yami and Glaser 1974; Golani and Ben-Tuvia 1989). More recently, for example, in the Gulf of Aqaba, the Mediterranean gilthead seabream raised by Israeli cage farmers in Eilat have already found their way into the wild.

COASTAL CONSTRUCTION

Coastal and other marine construction is often detrimental to the coastline, low delta areas, and in-shore biotopes, both in biological and physical terms. Too often the damage done by such construction could easily have been predicted and avoided. Unfortunately, steadily increasing real estate values in heavily populated coastal areas have often led developers to disregard the environmental costs of their work.

Additionally, engineering projects influencing the flow of major rivers may lead to ecological damage of the marine environment downstream, as in the Nile Delta-Suez Canal area and below the Shatt al-Arab (Inman and Jenkins 1984; Vadiya and Shenuda 1985). Especially conspicuous has been the coastal erosion in Egypt in the wake of the Aswan High Dam construction.

Poorly planned harbors, marinas, and similar projects, both already completed and still in the planning stage, have become or may yet become ecological calamities. In Israel, these include the Ashdod harbor and the marina at Herzlia. Also, the coast of Gaza is already heavily eroded due to the rather small structures existing there (Golik and Goldsmith 1986). Any major construction, such as a deepwater harbor, especially if based on sea walls or breakwaters protruding seawards, would certainly substantially accelerate the coastal erosion, endangering not just the beaches, but also coastal roads and residential areas (Nir 1989). Such at-risk sites may in fact be developed by innovative, alternative solutions, such as offshore harbors connected with the coast by bridges allowing free flow of water.

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SHIPPING

Pollution generated by shipping, notably oil tankers, (particularly along the shipping lines leading to and from the Suez Canal, the Straits of Bab al-Mandab, the Gulf of Oman, and Shatt al-Arab) contaminates both the sea and coastlines. This pollution is partly caused by the flushing of ships' bilges and oil and fuel tanks at sea, and partly by jettisoned waste and litter, some of which is practically indestructible plastic (Golik and Gertner 1989). Much of this pollution arrives at beaches in the form of tar-like products and as ordinary garbage. Frequently, marine animals may swallow plastic bags and other containers or fasteners, while others may become entangled in this waste with potentially fatal consequences. The Suez Canal alone carries some 20,000 vessels that transport about 14 % of the world's trade. This includes 2,500 oil tankers. The average amount of crude oil passing daily through the Suez Canal is approximately 800,000 barrels. The Canal has been deepened recently to 17.5 meters, which makes it navigable by all but the largest oil tankers. The load of the oil traffic on the Canal seems, however, to be subsiding owing to increased use of the Suez-Mediterranean Pipeline (SUMED) and to a lesser degree the Trans-Israel Pipeline (TIP). Because the oil to and from these pipelines is carried by ships, the transfer of oil into and out of the pipelines may in fact increase the risk of spills.

Apart from Persian Gulf oil, the crude-oil load of the Suez Canal also derives from local production which is centered on the Gulf of Suez basin. Further development of oil refineries and petro-chemical industries has been projected in Egypt.

FUTURE RESEARCH NEEDS AND COASTAL ZONE MANAGEMENT

In all areas, but especially in enclosed and semi-enclosed bays, gulfs, and lagoons, there is a need for "preventive" research and surveys. One objective for research is the assessment of their capacity to absorb waste originating from human activities (GESAMP 1986), with special attention to heavy metals and other toxic substances. This research should include the water at all levels, the sediments, and the flora and fauna (Caddy 1993). Routine monitoring and regular scientific research represent an essential condition for rational decision-making and should be introduced in all marine areas to prevent unpleasant surprises, including environmental effects due to global warming (Everett 1995) and ozone depletion (Baker 1991) on especially sensitive ecosystems.

At the same time we should bear in mind the widely discussed limitations of environmental sciences, both in terms of the reliability

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of environmental capacity assessments (Krom and Cohen 1991) and forecasting of the influence of natural and man-caused changes on whole ecosystems and their separate components.

Undoubtedly, the world-wide movement toward integrated coastal zones management (ICZM), which appears increasingly essential in view of the multiple users of coastal waters, beaches, and related resources, will also arrive in the Middle East. Coastal development and protection are largely a national issue related to environmental degradation of shores, including coastal lakes and lagoons, mangrove areas, beaches, and coral reefs. This issue may become international where major coastal construction projects in one country may cause beach degradation in another, or where pollution originating in one country is contaminating beaches and inshore waters of its neighbors.

CONCLUSION

In view of the high rate of population growth, industrial and tourism development, and crude oil production and transportation, problems in the marine environment of the Middle East will increasingly require national attention and international cooperation among neighboring countries. In some areas, such as the Persian Gulf, the Gulf of Aqaba, and the southeastern Mediterranean, whole marine ecosystems may collapse without such cooperation. Efforts toward the establishment or reinforcement of such cooperation must continue despite the often tense political situations in many of these regions.

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