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جامعة حيفا

HMS
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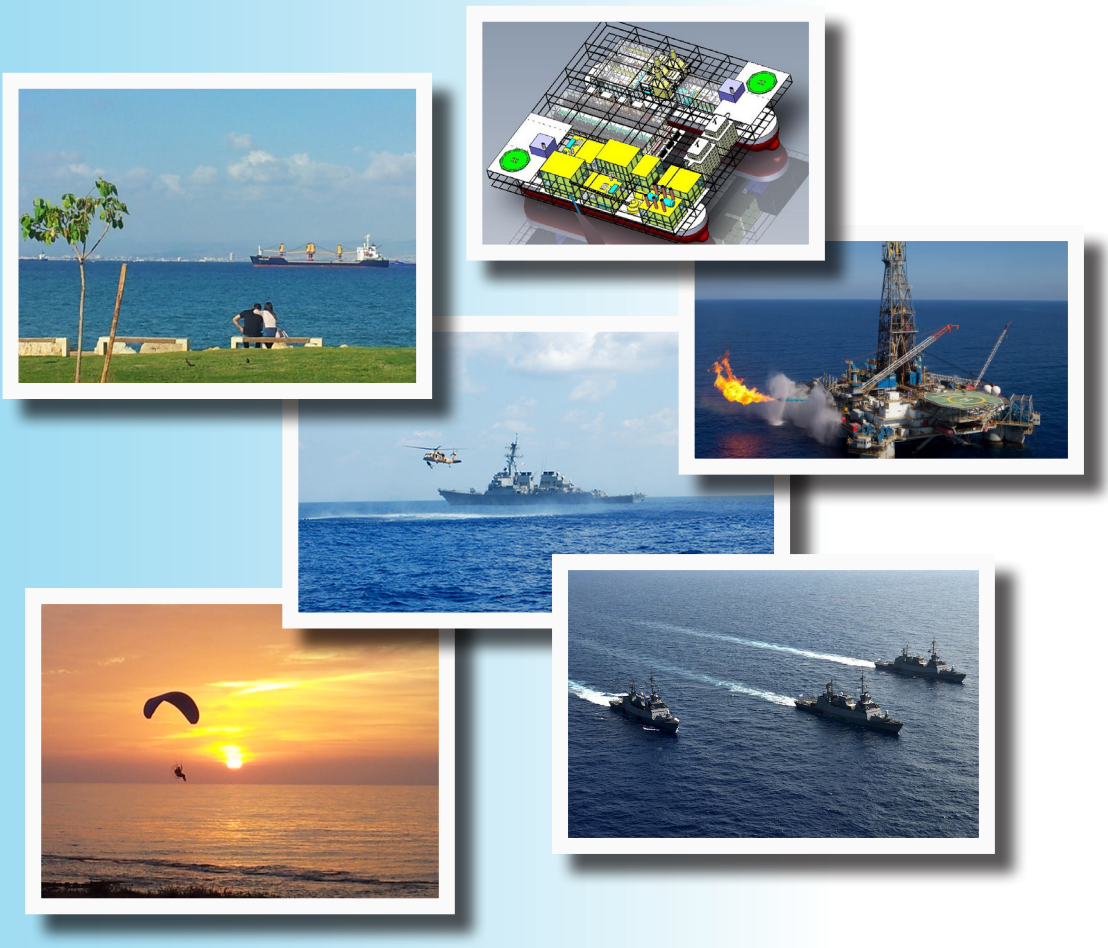
MARITIME STRATEGIC EVALUATION FOR ISRAEL 2016

Chief editor: **Prof. Shaul Chorev**
Edited and produced by: **Ehud Gonen**



Chapter 14: Israeli marine ecosystems: interactions between humans and marine biota – state of the sea 2016

Dror Angel

There are numerous human activities that take place in Israeli coastal and offshore waters and all of these interact with the resident biota. The ecosystem interactions include physical, chemical and biological components and the following review will focus on how human activities affect the marine environment by changing or impacting these components.

Israeli eastern Mediterranean (Levant) and Red Sea waters are considered "oligotrophic" (low in the nutrients that drive marine productivity) and one of the characteristics of such waters is the low biomass and fairly high diversity of the resident biota. Changes in the physical and chemical properties of oligotrophic waters will, by default, generally lead to changes in the biological communities, often expressed as a shift in the species composition and in relative abundances of these species. There is a delicate balance between the inanimate properties of the marine environment and the biota, which evolved over millennia, forming a highly diverse assemblage of benthic and pelagic organisms. Marine ecologists generally agree that diversity begets stability and resilience, and biodiversity (and changes in biodiversity) is often used as the major indicator of a healthy or an unbalanced marine ecosystem.

Both the eastern Mediterranean and the Gulf of Aqaba are geologically active areas, which form numerous underwater habitats, including deep sea canyons, kurkar ridges, expansive sand flats, cold seeps, etc. These diverse habitats and the unique underwater conditions (high temperatures and salinity) are believed to have led to the evolution of specialized, unique and diverse biological communities. In addition, there has been an influx of large numbers of exotic species into the Mediterranean and one of the world's hotspots for invasive species is in the Levantine Basin.

Activities that affect the physical integrity of some of the aforementioned habitats, especially the soft bottom (sand and mud) communities, include massive and historical projects such as the Aswan dams and the Suez Canal. More recent activities of this sort, albeit at much smaller scales include the installation and mooring of an assortment of: underwater cables, pipes and gear related to transport of natural gas and oil from the deep sea to shore-based facilities,

etc. Another activity that took place for many years until it was outlawed was the mining of sand and of a variety of hard-substrates, mostly for construction purposes. A related activity which is still ongoing is beach nourishment, whereby eroded sandy beaches are replenished artificially by dumping huge amounts of sand, usually from sea, onto the shore and the shallow sub-tidal region. This takes place both on the Israeli Mediterranean and Red Sea (where it is entirely artificial) shores. Additional activities that have a physical effect on the marine environment include other coastal construction projects, such as the construction of marinas, commercial ports, breakwaters, promenades and other structures. The most heavily populated urban areas in Israel and elsewhere around the world are generally in proximity to the sea, and as a result, one of the limiting factors along the Mediterranean coastline is space. A solution to this problem that has been discussed for several decades is the construction of artificial islands, which will change the current coastline drastically and will probably create a variety of environmental and ecological problems that will need to be addressed.

All of the activities listed above affect the shallow as well as the deep water biological communities that occupy and rely on the habitat that they have evolved into. The recent law forbidding construction in the 100m strip, from the water line to the east, on the Mediterranean coast was passed to help protect both the intertidal and subtidal habitats, as well as the biota that are affected by changes in this region. Although new construction in this narrow strip is rare, lighting of promenades and other facilities is common and conflicts with the natural light-dark cycles of the biota that occur in the coastal zone, adding light-pollution to the already large list of stressors. An activity that has a direct negative effect on some benthic Mediterranean communities is trawl fishing which alters habitats by scraping the seafloor, netting all macrobiota and at times even hard substrates that occur in the epi-benthos.

Another class of physical trauma that marine animals are exposed to is acoustic (noise) pollution caused by coastal and submarine construction, shipping, naval activity, deep sea exploration using a variety of acoustic methods and other commercial activities. The impact or influence on fish and marine invertebrates has not been explored, yet the cause of numerous dolphin and whale strandings on Mediterranean shores as well as internal injuries to sea turtles over the years is probably related to noise-trauma.

There are several large seawater-cooled power plants on the Mediterranean Israeli coast, and the marine area affected by thermal trauma due to these is local and limited. A bigger problem, unrelated to human activities along the Israeli coasts is

climate change which has caused Mediterranean seawater temperatures to rise by >1° C over the past 25 years; several times faster than the global average (EEA 2015). This temperature rise has had wide-scale effects on many taxa, causing some species to become extinct and some to flourish. Future forecasts anticipate additional temperature increase that should facilitate the arrival and colonization of invasive species from the Indo-Pacific region. Additional climate change effects forecast for the next century include a large rise in the frequency and intensity of storms that will wreak havoc on our unprotected coastline, especially the coastal cliff and kurkar ridges and their inhabitants.

Climate change also affects the chemistry of the sea. The continuous rise in the concentration of carbon dioxide in the atmosphere is expressed in the ocean as a decrease in the pH of seawater. Whereas scientists once thought that changes in ambient pH affect only organisms that undergo calcification, such as corals and molluscs, it has become clear that environmental pH values affect the physiology, metabolism and survival of non-calcareous organisms too. Many indigenous species have declined as a result of a combination of competing invaders, changing environmental conditions and damage to habitat. Although the eastern Mediterranean is world-famous for being hyper-oligotrophic, the coastal zone is polluted by land-based activities such as urban sewage, urban and agricultural runoff, industrial effluents, polluted groundwater discharge and atmospheric emissions (industry, transportation, fires, etc.).

Although most marine pollution may be traced to terrestrial sources, there is also marine pollution that is related to maritime activities. Dredging often releases toxins, as does mining for and extraction of hydrocarbons and minerals from the seafloor. Acting under MARPOL, the International Convention for the Prevention of Pollution from Ships, the Israeli Ministry for Environmental Protection has implemented numerous actions to reduce marine pollution at sea, yet limited enforcement and monitoring prevent this source from becoming trivial, though new monitoring technologies show promise.

There is a huge list of chemicals that enter the sea but not all of these are pollutants; only those that cause some form of (mainly biological) damage. Among the classes of pollutants there are the non-toxic organic compounds, e.g. sewage, that cause marine bacteria to multiply and deplete the oxygen in sediments or the water column; the damage is a hypoxic or anoxic area where all aerobic organisms die or migrate from. Such events are still comparably rare in the well oxygenated coastal waters of Israel.

Five desalination plants along the Mediterranean coast of Israel release large volumes of brine and of other compounds used in the desalination process into the sea. The extent of damage caused by the release into the sea of the byproducts of desalination is debatable. Because of the unique situation in Israel, where there are few sustainable alternatives to a reasonable supply of freshwater desalination is a topic of national security.

Another pollutant that is strongly related to our current lifestyle is plastic. Plastic polymers are the dominant type of solid waste in the sea, ranging in size from macro to micro-particles, commonly known as microplastics. Microplastics are currently found worldwide in all seas, at all depths and are thought to cause a wide array of biological and ecological effects. The effects include smothering, choking, strangulation, starving – all which may cause death to the affected organism, and a wide array of sub-lethal effects, including dietary imbalance, exposure to heavy metals and toxic organic compounds (POPs), endocrine disruptors, etc. Plastics have been found in a huge list of vertebrate and invertebrate animals examined and there is concern that these animals and their predators (as well as humans) are exposed to the pollutants adsorbed onto the plastic particles. Although plastics are recognized as a major form of marine pollution, and numerous programs have been established to address this problem, there are few practical and realistic programs to effectively reduce the abundances of plastics at sea and their constant flux to the marine system. Plastics are also thought to be an important vector for various diseases and for invasive species.

In addition to being one of the most oligotrophic bodies of water, the Levant has some of the highest numbers of marine invasive species. Many exotic species from the world oceans reach the eastern Mediterranean via a long list of transport mechanisms. Most of these do not survive, however those that do and become established may compete with, prey upon and exclude endemic species. The decline in many indigenous Levantine species is probably the result of multiple-stressors acting in concert. Changes in temperature, water chemistry, pH, resources and habitat may all contribute to the survival or extinction of a species.

One of the outstanding examples of a successful invasion in the eastern Mediterranean is the scyphomedusa Rhopilema nomadica. This rhizostome jellyfish was first described in Israeli coastal waters in the 1970s and has been recorded annually since then, generally forming massive swarms every summer. These swarms impact many human interests, including mainly recreation and tourism, and also fishing, power-plant cooling water, and desalination operations. Although they have not been quantified, these jellyfish blooms most likely affect

many ecosystem functions including the composition and abundances of micro and mesoplankton, availability of food for larval and juvenile finfish, etc. On the positive side, the jellyfish also appear to provide important habitat and may even serve as a food source to some commercial finfish species, and entrepreneurs have proposed pharmaceutical and biomedical products that can be produced from this and other jellyfish species.

Several hypotheses have been formulated regarding the apparent success of this species. The warming eastern Mediterranean environment appears to suit this species that was limited to the Levant for several decades, but has migrated westward over the past decade; recorded in Tunisia and Malta is recent years. Several researchers have suggested that overfishing in the eastern Mediterranean exerts strong pressure on finfish - one of the main competitors of the jellyfish – and that placing limits on fishers may balance the situation, thereby increasing completion between finfish and jellyfish. This hypothesis may be tested if fishing moratoria and bans are enforced. Another hypothesis focuses on the success of polyps – the benthic stage in the jellyfish life cycle – which rely heavily on surfaces. This hypothesis states that as the area of artificial submerged marine substrates increases, coincident with massive development and sprawl in the coastal zone and solid waste pollution, the area available for jellyfish larvae to settle on increases and facilitates further blooms. Although they make sense, these hypotheses have yet to be studied and tested, especially with respect to the local situation, in the eastern Mediterranean.

One of the activities that may be impacted by stinging jellyfish is marine aquaculture. In the eastern Mediterranean, mariculture consists mainly of finfish farmed in net cages and there have already been several instances of aquaculture fish-kills related to jellyfish blooms in the western Mediterranean. Aquaculture has traditionally been criticized by environmentalists as an activity that is unsustainable, but it appears that blanket statements are unjustified as local conditions vary radically from site to site and site-specific features are often the major factor determining the sustainability of this sector. In the Israeli coastal zone, classical net-cage farms are scarce due to the extremely exposed nature of this coast and large-scale submersible cage systems using single-point mooring and other anchoring systems are being developed as a viable alternative.

In light of the above, there are several things that may be done to protect, maintain and conserve the marine environment and marine ecosystem services that we are interested in. These include:

- Develop a set of standards to protect the marine and coastal environment, to match ongoing activities as well as anticipated initiatives.
- Create several marine protected areas that protect nature, especially sensitive and unique habitats.
- Empower existing teams of regulators and watchdogs, at the national level, to ensure the marine environment is monitored and protected.
- Establish a plan to develop energy resource exploration and extraction based on environmentally sustainable principles .
- Develop strategies for sustainable fishing, e.g. reduce trawl-fishing and encourage development of pelagic fisheries.
- Establish strategies for sustainable aquaculture in Israeli coastal waters.