Consequences for the Natural Heritage and Cultural Significance of the Current Patterns of Development in the Coastal Regions of the Mediterranean Sea

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Abstract

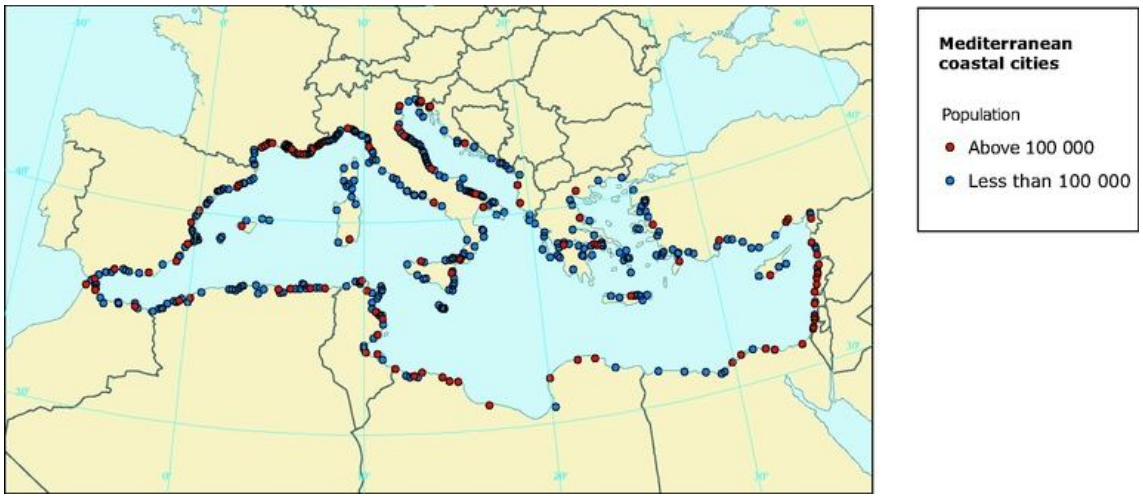
In the recent decades the human activities on the Mediterranean coast have caused a degradation of marine ecosystems and terrestrial ecosystems nearby and have accelerated this process. This is mainly due to the expansion of urban areas, coupled with other problems such as erosion, eutrophication, maritime transport and the exploitation of the fishery resources. This article presents an analysis of the current situation and proposes suggestions of what should be prioritized by the environmental programs in order to prevent the loss of the natural capital.

Keywords: natural heritage, model of development, sustainability, natural capital, environmental degradation.

1. Introduction

According to the European Environment Agency (2008) only 69% of the 601 Mediterranean coastal cities with the population of over 10,000 inhabitants (more than 46 million total resident population) had operative plants of wastewater treatment. The problem exacerbated by the rapid growth of coastal cities, especially in the southern Mediterranean area. We must not forget that coastal and marine ecosystems play a complex and vital role in sustaining economic prosperity and welfare of developing countries. Today, marine resources in general and the Mediterranean Sea, in particular, are threatened by land-based sources of pollution, oil pollution, habitat degradation, overexploitation of some fishery resources, etc.

Figure 1: Mediterranean Coastal Cities



Source: European Environment Agency.

From this perspective, the environmental degradation in the Mediterranean basin has reached serious levels in recent years. There is significant danger of irreversible consequences and, in order to reverse the current trend, it is necessary to study the causes of this degradation and take appropriate action program. Most countries in the Mediterranean region share environmental problems.

Some problems are either common or transnational and require international cooperation. These problems include marine pollution, loss of habitat for migratory birds and endangered species, such as marine mammals and sea turtles, and the abuse of migrating fish. There are also cases of pollution and depletion of sub regional resources that are affecting more than one country. These sub-problems, although still limited in number, are becoming increasingly urgent in its resolution. Other problems separately affect all countries to varying degrees and are likely to have similar solutions that could be implemented in parallel.

2. Analysis and diagnosis of a complex situation

There are four main causes of marine pollution: industrial and municipal wastewater, agricultural runoff, discharges of oil and chemicals from ships, and improper disposal of solid waste, especially plastic. Sewage and agricultural runoff containing nutrients also lead to the eutrophication and the problems associated with it. Many other pollutants of continental origin reaching the Mediterranean Sea through the atmosphere (Tables 1 and 2).

Table 1: Causes of major marine pollutants in the Mediterranean Sea

Type of pollutant	**Main causes**
Organic waste, including pathogens.	Dumping of domestic, agricultural and industrial waste water, untreated or partially treated, into the rivers, the estuaries and the sea.
Excess nutrients including phosphates and nitrates.	Agricultural runoff (fertilizers) and domestic wastewater (detergents) discharged into the rivers, the estuaries and the sea.
Industrial chemicals (heavy metals, organic chemicals and other similar ones).	The dumping of sewage, untreated or partially treated, into the rivers, the estuaries and the sea; plus the contribution of domestic sewage, urban runoff, solid waste and the discharges from boats.
Pesticides and other agricultural chemicals.	Agricultural runoff into the rivers and the estuaries; the rain contribution with volatile chemicals.
Petroleum hydrocarbons.	Discharges from boats and shore facilities; contribution from industrial and urban sources through rivers, urban runoff and direct discharge.
Garbage, including plastics, floating debris and organic materials.	Garbage on the coast, dumping of ships on the shores, local discharges by residents; contribution from the agriculture and the fisheries.
Sludge and mining waste.	Erosion of agricultural soils poorly preserved, treeless hills, mine tailings, and metal saturated soils.

Source: own elaboration.

Table 2: Effects of major pollutants in the Mediterranean Sea

Environmental effects	Effects on living resources
Beaches, coastal waters and contaminated bays, organic sediments in the bays and in the seafloor, including sea grass beds; more turbid water; the reduced oxygen levels in the water; damage to wetlands and submerged vegetation.	Human diseases, including typhoid, skin infections and eye, polio, cholera and hepatitis A; contamination of molluscs.
Eutrophication of lakes, bays and gulfs, which often manifests itself in excessive growth of algae; Red and green tides; dirty beaches due to decaying algae.	Death of aquatic life due to the lack of oxygen in the water, dermatitis acquired by contact with toxic algae. (If properly dispersed, the nutrients may be beneficial to fisheries.)
Locally high concentration in sediments and seawater.	Accumulation in shellfish, fish, marine mammals and birds of mercury (factories and natural sources), cadmium and other metals with persistent organic chemicals; potential hazards to the health of human consumers
Bays and waters polluted near the coast; sediments in the bays and in the seafloor; including sea grass; damage to wetlands and submerged vegetation.	Accumulation of DDT and other prevailing organic pesticides in fish, birds and mammals; which kills the fish and poses a real hazardous danger to human consumers due to the local concentrations of organophosphates.
Oil slicks in the water; traces of tar on the beaches; contaminated seafood.	Tar in the skin of the bathers; damage to fish and marine mammals; death of seabirds.
Floating and suspended debris in the water; unsightly accumulation of garbage on the beaches and in the ports; clogging the pipes of power plants and desalination facilities.	Death of fish, turtles, birds and marine mammals due to being entangled in the trash and also ingesting it
Increased deposition of silt or sand in the bottom of lakes and coastal waters; murkier waters, high levels of mercury and other metals near the mining areas.	Loss of productive deltas in lakes and wetlands: accumulation of mercury in fish, with risks to the health of the consumers of the large amounts of fish.

Source: own elaboration.

A big quantity of municipal wastewater -more than 70% of it - is discharged without any treatment in the coastal areas. Although the levels of marine pollution have not been scientifically controlled during the long periods of time, there are indications that the pollution of the municipal and the domestic origin is increasing in many places. The contamination of waste water is quite common in the coastal areas. The industrial waters that are carried through the drains contain dangerous contaminants which are deposited in the water in a solid or dissolved form without sufficient control. Due to the types of pollutants and damage that these can cause in the municipal systems, these drains pose a significant threat. Most of industrial pollution comes from steel, chemical plants and petrochemical, thermal power plants, oil refineries and factories cellulose and paper.

Today this problem is more acute in the north of the Mediterranean Sea. According to certain calculations, around the 23% of the total pollution in the Mediterranean Sea is found in the northwest of the sea and goes back to its source in France, Italy and Spain. The south of the Mediterranean Sea is currently not as contaminated, but since 90% of the effluents produced by the nations in the south of Europe, does not receive any treatment, the danger of contamination in the near future is quite high.

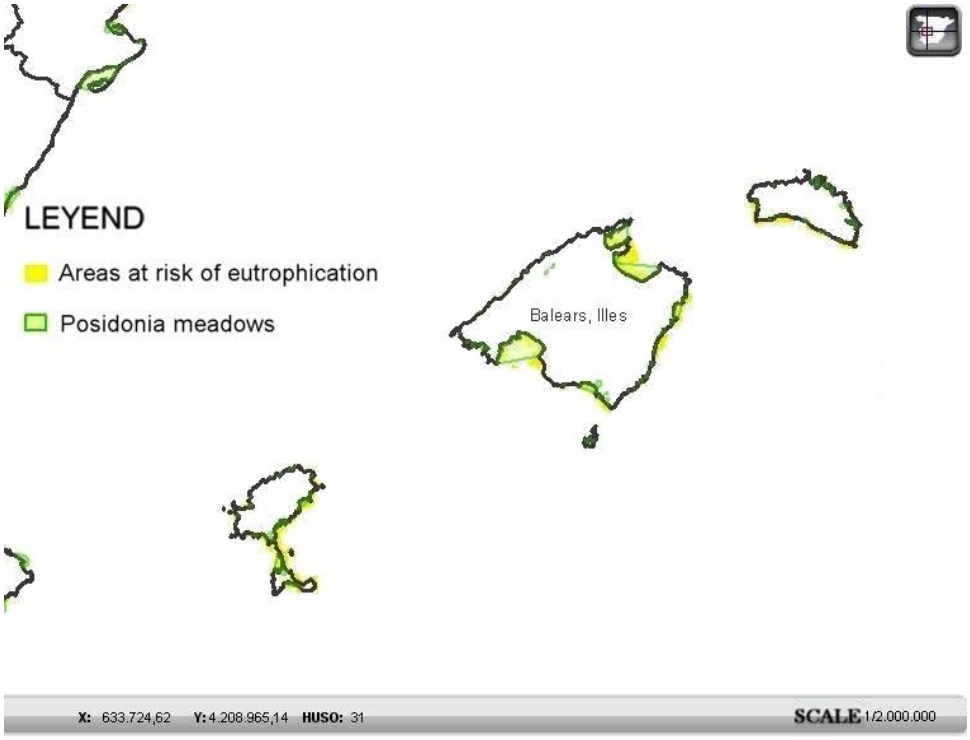
The industrial pollutants compared with marine pollutants that are found in the Mediterranean Sea are generally in the low levels. The marine pollution is reaching significant levels in many coastal areas and it is subsequently affecting health, recreational activities, tourism, wetlands, fisheries and coastal ecosystems. Nevertheless, there have been various successful attempts to control chemical pollution. For example, the French legislation of 1974 to reduce the mercury waste in the electrolytic industry made it possible to detect the mercury concentrations in the animal species and minimize its concentration by 90%.

According to a test carried out in 2006 in 150 beaches of France, Greece, Italy and Spain, 25% of these beaches had the elements of pathogens exceeding recommended levels necessary for the protection of public health. Such sampling and testing methods provide comparative and coherent data the help improve the quality of water for the bathers. Such information helps visitors to choose the beaches based on its water quality and serves as an incentive to improve the environmental situation on the coast and the levels of tourism.

Although the municipal and the industrial discharges in coastal waters are the sources of local pollution, the great rivers, such as the Ebro, the Rhône, the Po and the Nile, arriving to the sea through the industrial and agricultural areas, quite possibly are additional contributors to the pollution of the Mediterranean sea. Eutrophication is marked by yellow, green, brown and red tides. The massive algae growth causes the depletion of oxygen in the water and affects the production of fish and shellfish. This is a detrimental factor for tourism and it also causes significant cosmetic damage in different areas of the Mediterranean Sea. These phenomena are the most serious manifestation of eutrophication. High levels of nutrients promote the growth of certain algae and marine plants that deplete the available oxygen and kill the rest of the animal and plant life.

The nutrients that are most responsible for eutrophication in the Mediterranean are nitrates from fertilizers used in agriculture, organic matter, nitrates and phosphates of the domestic sewer, detergents, and industrial wastewater. Because the Mediterranean Sea is naturally poor in nutrients, the influx of these materials can be beneficial, especially for fishing. However, eutrophication generally creates problems in the masses of confined waters, where the currents are slow and minor.

Figure 2: Areas at risk of eutrophication with high natural heritage in the Balearic Islands (Spain)



Source: own elaboration. MAGRAMA.

On top of this, ship traffic in the Mediterranean Sea generates a high level of oil pollution, caused mostly by bilge oil tankers discharging and releasing ballast water. These discharges contribute around 75% of the 650,000 tons of oil pollution in the Mediterranean Sea. Although the oil pollution is a fundamental concern, other types of maritime pollution are acquiring increasing importance. The growth of the regional maritime trade, dumping sludge from treatment plants and industrial waste has aggravated this situation. In addition, the increase in the maritime transportation of hazardous chemicals involves a growing risk of accidental spills of large amounts of toxic chemicals. Due to the damage that such products and pollution can cause to the human health and the natural ecosystems, the potential risks are very important. At the same time discharges of the recreational boats, constantly increasing in its numbers, also represent a significant threat to the important touristic coastal areas.

3. The degradation of the Mediterranean coast and nearby wetlands

It is a fact that the Mediterranean coast, marine resources and the nearby wetlands are being exploited abusively. Their survival will depend on taking the appropriate measures to restrict the development and sustain the resources. Compared to the Atlantic Ocean, the Mediterranean Sea is relatively poor in fish. Million tons of fish caught in the sea each year makes only about 1.2% of the volume of world catches. However, this high quality fish represents about 5% of the value of world catches. The abuse of fishing is a serious threat and dangerously exceeds the maximum of sustainable catch. Large marine species such as tuna, swordfish and small open-sea species such as sardines and anchovies are being captured abusively. The Mediterranean region has become a net importer of fish. The latest data from the FAO (Food and Agriculture Organization of the United Nations) shows that a combined regional consumption of fishery products is at 14.1 kg per capita per year, of which about 3.4 kg are imported.

It is also important to note that Mediterranean wetlands, freshwater and saltwater are capturing the silt, organic matter and nutrients in solution. Such nutrient supply provides ideal conditions for the growth of plants, which supports various species of fish and the invertebrate species, which feed numerous animals, including birds. The diversity of food sources attracts large numbers of predatory fish and a varied fauna. Moreover, the concentration of population on the coast, which is accompanied by an increase in the density of industrial and other economic activities, has caused great pressure on the limited coastal resources, as well as produced irreversible changes in the use of the earth. Such changes have generally been accompanied by environmental problems that affect the health of the population and slow down the sustainable development in the coastal resources. And it is expected to worsen significantly in the near future.

Coastal areas face the threat of competing in a sense of urban development, tourism, industrial development and agriculture, all of which affect the delicate and valuable coastal ecosystems, coastal aquifers, and wetlands interests. It is unlikely that in the coming decades the urbanization of the Mediterranean coast will slow down. Therefore, there is an urgent need for the environmentally sound development, especially in the case of islands and estuaries whose ecological conditions are highly fragile.

3.1. The depletion and degradation of freshwater resources

It is likely that the depletion of freshwater resources for industrial, agricultural and domestic reasons alone become the most important environmental issue that the Mediterranean countries, especially the coastal areas, have to face these days. Even the countries that do not yet suffer from water crisis are likely to experience large increases in the costs of its supply to meet the growing demand. Improved planning, management and water conservation are vital for economic development. The failure in the protection of freshwater resources will make the current models of development that rely solely on the water not possible to be maintained in many countries.
The actual stock of freshwater, both ground and surface water, are limited due to the pollution. Water quality is questionable in twenty of the twenty nine watersheds that flow into the Mediterranean. This is a consequence of industrial, domestic and agricultural pollution, the majority of which originates far from a coast. The wastewater treatment industry simply does not prove to be sufficient in the coastal areas of north and south regions.

Industrial, agricultural and urban water consumption has increased rapidly in the Mediterranean region. Due to the supply constraints, it is difficult to calculate the actual growth in demand in many countries. Both levels of per capita consumption and consumption patterns vary widely, for example, in the southern countries the irrigation is proportionally much larger than in other countries. It is likely that water demand will increase rapidly in many countries, due to the population growth, urbanization, industrial growth and low prices. Tourism will increase water consumption in the islands and in the main tourist areas, but in these places, especially in the south where the tourist season coincides with the drying station the impact of tourism can be very important. Since the water systems will be designed to meet the growing demand, tourism will contribute to increasing investment costs throughout the region.

3.2. The degradation of land resources

The arable land is a scarce resource in the large parts of the Mediterranean region and is under a great pressure from the development and population. There is a tendency to increase farmland especially in the south since the irrigated land is cultivated throughout the year using more water, fertilizer, and pesticides every time. Simultaneously, the large areas of fertile land are being left to grow to meet the industrial, urban and transport needs.

The notably high levels of natural erosion and degradation put an immense pressure on the ground. The mountainous and hilly terrain make up almost three-quarters of the region, and more than half suffer from erosion due to poor vegetation cover. Samples of land degradation are abundant and striking, for example almost nothing remains of primeval forests, which once covered much of the region in the ancient times.

In addition, the soil erosion degrades the ability of the earth and lowers its productivity. About 35% of farmland suffers substantial losses of soil of between 5 and 50 tons per hectare each year. In the land devoted to agriculture alone there is already a loss of about 300 million tons of annually produced sediment. The countries with the largest areas of erodible surface are Israel (84%), Tunisia (76%), Greece (72%) and Spain (71%).

The forests of the Mediterranean area are among the most degraded in the world. These ancient forests once occupied most of the region, now cover only 5% of its surface, and those that remain are concentrated in the north. Owing to poor soils, low-to-moderate rains and periodic droughts, only few forests have high productivity. Moreover, natural and manmade fires also contribute to the poor management of the damage done to the forest resources in the region.

The salinization of the irrigated land is the result of the lack of drainage and water evaporation which subsequently cause salts to accumulate. These processes reduce and destroy the value of the earth. And restoring the salinized land comes at a high cost. Throughout the region the manifestations of salinization are often accompanied by flooding of soils. It is believed that 5% of the surface of the Mediterranean basin is affected by salinization, including the large areas of irrigated land that used to be productive.

3.3. Solid and hazardous waste materials

The amount and the composition of solid waste produced by the coastal cities of the Mediterranean region vary greatly depending on the situation and the income level. Some estimates indicate that in the coastal cities of the region around 500,000 cubic meters of waste (10 liters of waste per meter of the Mediterranean coast are generated daily).

The consequences of inadequate management of solid waste can be observed throughout the region: junk floating in the sea, beaches polluted with garbage, open air cremations and clogged drains. Even the solid waste which does not contain hazardous material may alter marine life; contaminate ground and surface water resources, threatening tourism and spreading the disease.

3. 4. The air pollution

The air pollution is an increasingly widespread problem in the Mediterranean region. Most air pollutants are generated by various industrial emissions, power plants, heating systems and motor vehicles. Such air pollutants, which are mostly concentrated in big cities and major industrial areas, produce longer-range impacts. For example, the contaminants such as chromium and mercury arrive into the Mediterranean region through the atmosphere in the same amount as they do through the rivers. Moreover, an even higher proportion of lead (90%) reaches the sea from the atmosphere.

At present, car emissions are responsible for a large percentage of air pollution in many cities across the region. These emissions contain carbon monoxide, hydrocarbons, and nitrogen oxides and lead, which are hazardous to public health and mainly causing a variety of respiratory diseases.

4. The priorities of environmental programs in the Mediterranean region

The priorities of environmental programs include actions to correct and prevent environmental problems. All this is embodied in the so-called "integrated water resources management" and introduced in order to ensure that the sustained growth is necessary to avoid irreparable damage to aquifers and to protect freshwater resources. For the sake of public health, we must give priority to the issues of management of urban, industrial and agricultural wastewater. Therefore the following should be encouraged:

- Integrated planning and long-term resource of groundwater and surface water.
- The adoption of minimum cost solutions for the development of water resources.
- The conservation and protection of already identified water resources through pricing and other measures (information, standards, incentives for the use of recycling technologies and reuse of water).

- The introduction of legal and institutional changes in order to strengthen the responsibility for planning and management of water resources and to improve the ability of the organizations that are responsible for data collection, monitoring and analysis of alternatives of such management.
- Coherent strategies for reducing pollution of coastal areas and river basins.
- Management programs of basins that significantly affect water availability (soil conservation, improved pasture, afforestation, management of pesticides and fertilizers as well as the establishment of industrial sites and the disposal of solid waste).

Moreover, the risk to public health causes the issue of waste management acquire top priority in many countries. Although the problem has less known implications, they are potentially important long term. Therefore, the following should be supported:

- The solid waste management, including collection, disposal and recycling.
- Identification of hazardous waste landfills at high risk, implementation of cleaning programs for priority landfills and the development of appropriate landfill for disposal of this waste in the future.
- Strengthening the capacity to monitor and to enforce the rules of the inspection bodies.
- Developing incentives for the adoption of technologies producing little waste, recovery of products as well as recycling.

The prevention of pollution by oil and chemicals is crucial to prevent the damage, which is possibly irreparable, to the coastal areas and natural ecosystems. Therefore, the following should be strengthened:

- The preparation of preventive plans for accidental oil spills in all Mediterranean countries.
- The expansion and rehabilitation of port reception facilities for oil, including floating facilities, with the possible involvement of the private sector.
- The adoption of incentives for improvement in the discharge of ballast water.
- The preparation of complementary plans in anticipation of disasters for the naval accident involving toxic substances.

5. Conclusions

Hereafter, we can draw the following conclusions:

First conclusion: The rate of degradation of the Mediterranean coastal areas should be controlled in order to avoid irreversible loss of natural and historical assets as well as further environmental degradation of coastal areas that are already developed. It is essential to strengthen the capacity of national and local governments to plan and manage the development of these areas.

Second conclusion: The Mediterranean environment is one of the most vulnerable in the world as its marine and coastal environments are exposed to a combination of pressures. Approximately 80% of these pressures arise from contamination from the ground. It also noted that more than half of urban areas, with the population over 100 000 people, in the Mediterranean region has no facilities for wastewater treatment and 60% of this water is discharged directly into the sea in these regions. More than 80% of landfills in southern and eastern Mediterranean region are not subject to any control. The marine environment of the Mediterranean region is especially exposed to agricultural waste, airborne particles and river run-off, which carry pathogens, heavy metals, organic pollutants, and oils into the sea.

Third conclusion: Rapid urbanization, coupled with the unsustainable development of tourism in the Mediterranean coast, has contributed to the emergence of major environmental and health problems. Pollution from industry, shipping and households, the loss of open space and the destruction of coastal ecosystems for construction projects, also contribute to this deterioration. Do not forget that the Mediterranean Sea is facing the world's biggest oil pollution, with over 400,000 tons a year and over 800 invasive alien species.

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