Protecting the Mediterranean from land-based pollution

UNEP

UNITED NATIONS ENVIRONMENT PROGRAMME
MEDITERRANEAN ACTION PLAN
MED POL

MAP

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Foreword

Not all news is bad news in the Mediterranean. The silent, invisible, however arduous, battle through which the Mediterranean countries have engaged themselves to prevent, halt, reduce and, ultimately, eliminate the increasingly heavy pressure of hundreds of sea-based and land-based sources of pollution, has already started giving its fruits.

Even so, this is not enough, given the magnitude of the problem. This document provides an in depth view of the main sources of contamination originating from human activities on land, which represent around 80% of the pollution loads on the sea, as well as their effects and the response of the region.

Just some self-explanatory facts: around 150 million people are concentrated on only 46,000 kms of coastline, with 110 million of them living in urban centres; some 200 million tourists a year currently arrive in the Mediterranean, most of them to the coasts, a figure that doubled over only 20 years; more than 200 petrochemical and energy installations, chemical industries and chlorine plants are located on the narrow Mediterranean coastline, heavy pollution load carried to the sea by around 80 rivers, among other complex sources of contamination from the land.

An enormous complex challenge, to which the Mediterranean countries have been devoting particular attention over the last three decades. A key step was the adoption of the Mediterranean Action Plan (MAP) in 1975. Shortly after, the Contracting Parties adopted and signed the Protocol for the Protection of the Mediterranean Sea against Land-Based Sources, known as the LBS Protocol, which entered into force in 1983. Since its adoption, MAP has been carrying out an intensive calendar of activities, mainly through its MED POL Programme, which focuses on assessment and control of marine pollution.

Then, and shortly after the 1992 Earth Summit in Rio, the Mediterranean States gave effect at the regional level to the Agenda 21 resolutions, approving an Agenda MED 21. The Barcelona Convention was then revised in 1995 to give legal status to the commitments made at Rio. In the same year, 108 countries and the European Commission adopted the Washington Declaration, a commitment to protect and preserve the marine and environment from the impacts of land based activities, giving priority to the implementation of the specific goals of the Global Programme of Action (GPA) in the region. Consequently, the LBS Protocol was revised in 1996, leading to the setting up in 1997 of a Strategic Action Programme (SAP) which represents the regional adaptation of the principals of the GPA. Last but not least, a new impulse has been given to the efforts through the support of the SAP by the Council of the Global Environment Facility (GEF). Following the first SAP assessment, over six billion US dollars should be invested to adequately treat urban and industrial wastes in the area.

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These are the main challenges and these, the key tools supporting this effort which is aimed at defeating the complex land-based sources of pollution. So far, much has been done with relevant achievements. Still, much more has to be done. The capacity has to be reinforced. National Governments, local communities, industries and the touristic sector as well as internationol institutions would have to substantially increase their contribution, with special expectations put on the Euro-Mediterranean Partnership. This is a duty towards our common heritage and future generations.

Lucien CHABASON

Co-ordinator,
Mediterranean Action Plan

1 Introduction

A wealth of information on the state of the extremely complex marine and coastal environment of the Mediterranean basin has been obtained over the years. It confirms a global pattern, namely, that while ship-based activities continue to add substantial loadings of various pollutants, the majority of pollution loads to the marine environment, around 80%, originate from human activities on land.

Although many uncertainties still remain about the unique contribution of the different fluxes (rivers, atmosphere, non-point sources, etc.) and the fate of the contaminants generated, the major land-based sources of pollution of the coastal and marine environment in the Mediterranean can be fairly clearly defined. The intensity of demographic pressure, the nature and intensity of development activities, the state and type of industry and agriculture are some of the factors contributing to each country's unique pollution problems, which often transcend boundaries and pose a regional threat.

Municipal, industrial and agricultural wastes, airborne particles and river run-off, carrying nutrients, pathogens, heavy metals, persistent organic pollutants, oil and radioactive substances are the major land-based sources of pollution that affect the most productive areas of the marine environment such as estuaries and shallow coastal waters. Pollutants introduced into the environment far inland, at long distances from any coastline, eventually reach the sea through air currents or river drainage. In addition, physical changes to the coastline from human activities threaten coastal and marine habitats of vital importance in maintaining a healthy ecosystem. Human health and economic productivity are, in turn, also affected by the impact of land-based pollutant sources, which lead to the closure of shellfish-growing areas, beaches rendered unsuitable for swimming, destroyed habitats and contaminated sites.

The countries of the Mediterranean have for long been aware that this source of degradation of the marine environment is a problem calling for global action at the national, regional and international levels and that it means addressing concerns and activities that cut across all sectors of society.

The major developments concerning the response of the Mediterranean countries to the problem of land-based pollution are presented here, following a review of the most important land-based pressures and their effects on the Mediterranean marine and coastal environment.

It will be shown how the measures taken by the Mediterranean countries follow the global commitments made for the protection and preservation of the marine environment from the impact of land-based activities.

The review of land-based pressures and effects draws on information from the data available in the UNEP/MAP reports and databases (including the databases of the MED POL Programme for Pollution Assessment and Control in the Mediterranean and the Blue Plan Regional Activity Centre), integrating the most recent information up to the year 2000.

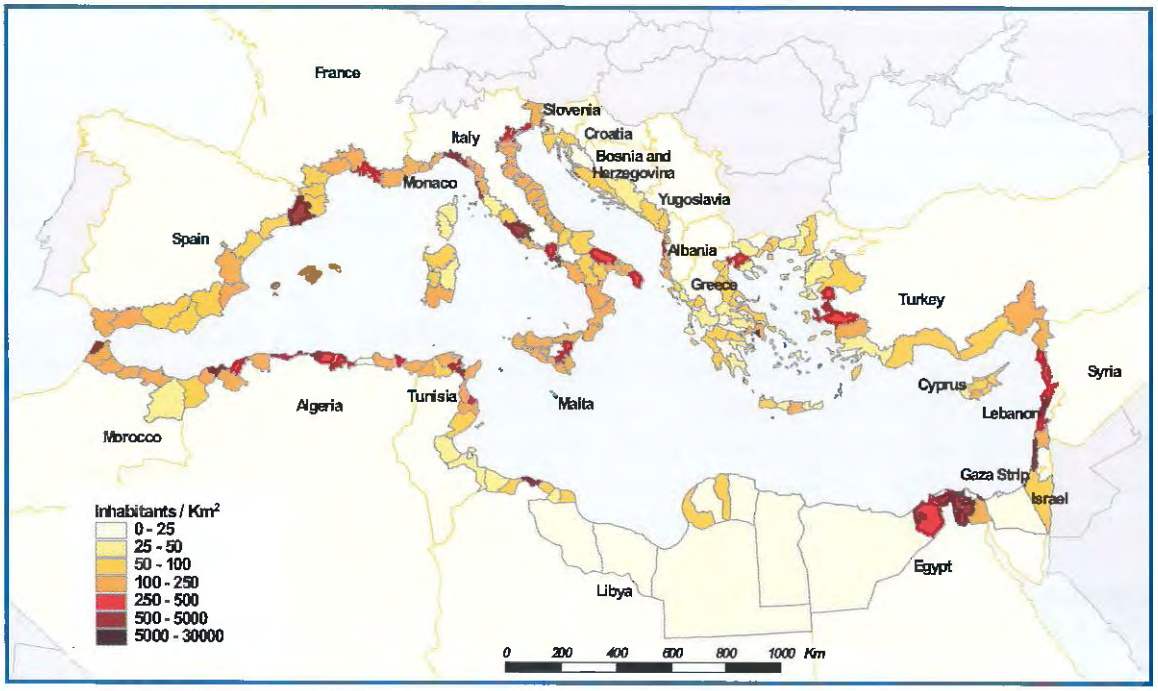
2.1 Population dynamics in the Mediterranean

Concentration on the coast and in big cities

The resident population of the Mediterranean coastal states has almost doubled in the past 40 years, reaching 450 million in 1997. Although the current mean rate of population growth of 1.3% per year is already showing signs of decreasing, the population of the coastal states of the Mediterranean is expected to reach approximately 600 million in 2050 and possibly 700 million by the end of the 21st century. At present, one third of the Mediterranean population, around 145 million people, is concentrated in the narrow coastal areas **(Figure 2.1)**.

At the same time, the rural areas of the Mediterranean are increasingly being abandoned in favour of the large urban agglomerations on the coast. This is particularly evident in the southern and eastern Mediterranean **(Figure 2.2)**. The rate of abandonment of rural areas follows the rate of population increase so the Mediterranean urban population, 40% of which is currently concentrated on the coast, is expected to double by the year 2025.

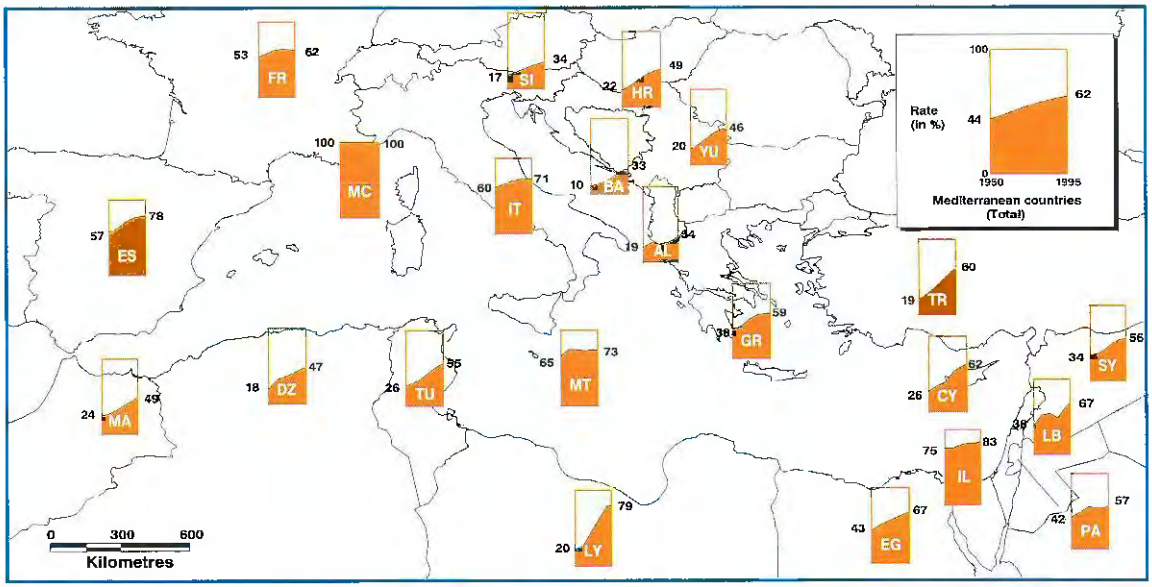
Figure 2.1 Population density in coastal Mediterranean regions



Source: Blue Plan Databases

The heavy population load on the coast, concentrated in large cities, is causing an increasing strain on labour and housing markets, on water supply, on transport, sanitation and public health, on the stability of natural habitats and on the marine environment of the Mediterranean, which is receiving increasing amounts of waste. The pressure resulting from this population load is not equally shared between the northern and southern Mediterranean countries, but has shown a shift in the past 50 years from the north, which accounted for two thirds of the Mediterranean population in 1950, to the south, which at present accounts for 50% of the Mediterranean population.

Figure 2.2 Growth of urbanisation rates in Mediterranean countries or territories between 1950 and 1995



Source: Géopolis 1998 © Blue Plan 1999

Tourism: an intense seasonal increase in the population

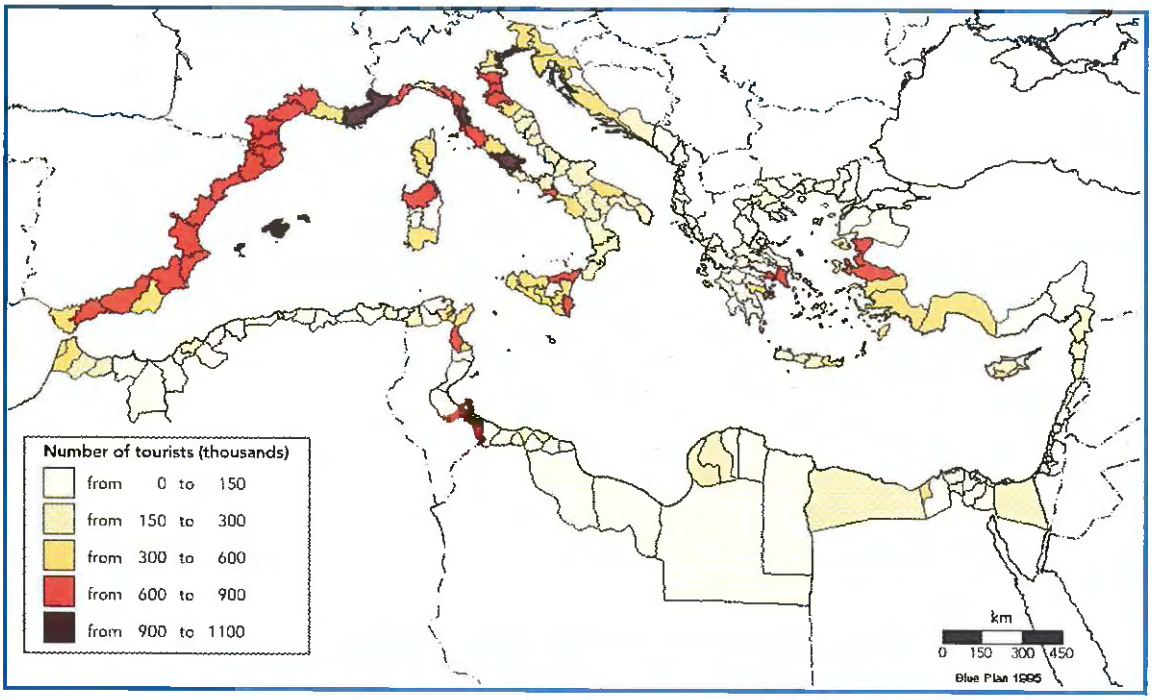
The pressure exerted on the Mediterranean coast from the heavy resident population load is dramatically amplified by the intensive seasonal increase in the population caused by tourism. Owing to its mild climate, its extraordinary natural beauty and its rich cultural heritage, the Mediterranean has become one of the prime tourist destinations in the world. At least 50% of the tourists arriving in the Mediterranean are concentrated on the coast, while in some countries coastal tourism represents up to 90% of the total. The pressure of mass tourism, which is heaviest on the north-western coast of the Mediterranean **(Figure 2.3)**, translates into further stress on the already over-burdened natural resources, further land-use conflicts and further deterioration of historic sites, fragile natural habitats and coastal and marine ecosystems **(Table 2.1)**. For tourism, the environment is not only a raw material to be exploited but also a resource to be conserved. Nevertheless, the pressure is likely to increase in the future, with an estimated doubling of tourism-related development in the Mediterranean, escalating from 135 million arrivals in 1990 to a projected 350 million in 2025.

Dense settlements on the coast call for increased sewage treatment

The dense human settlements established along the Mediterranean coast produce large amounts of municipal wastewater. Residences, hotels, other tourist facilities and businesses are usually, though not always, connected to municipal sewer systems. These systems may or may not (as is the case for a large number of small and medium-sized communities in the Mediterranean) be connected to wastewater treatment facilities so the wastewater is discharged into the sea, either untreated or after varying degrees of treatment. It enters the sea through outfalls or by seepage resulting from leaks or other faults in the sewerage system. It carries increased loads of nutrients such as nitrogen and phosphorus and a heavy load of microorganisms, including bacterial and viral pathogens. In large cities, municipal wastewaters usually also contain a variety of chemical wastes both from households and from industries that develop along-

side urban populations and discharge directly into the public sewerage system, with or without previous treatment. As cities grow, sewerage networks and treatment facilities must be expanded and upgraded to deal with increasing demand. At major tourist resorts with intense, short-term population pressure during the peak summer season, the sewage treatment plants are frequently totally unable to cope with the additional loads discharging water that is still highly polluted into the sea. Improperly discharged sewage impacts heavily on marine and freshwater ecosystems, on human health and on fishing and other economic and recreational activities.

Figure 2.3 Estimation of tourism in the Mediterranean during the peak period



Source: UNEP/MAP, 1995

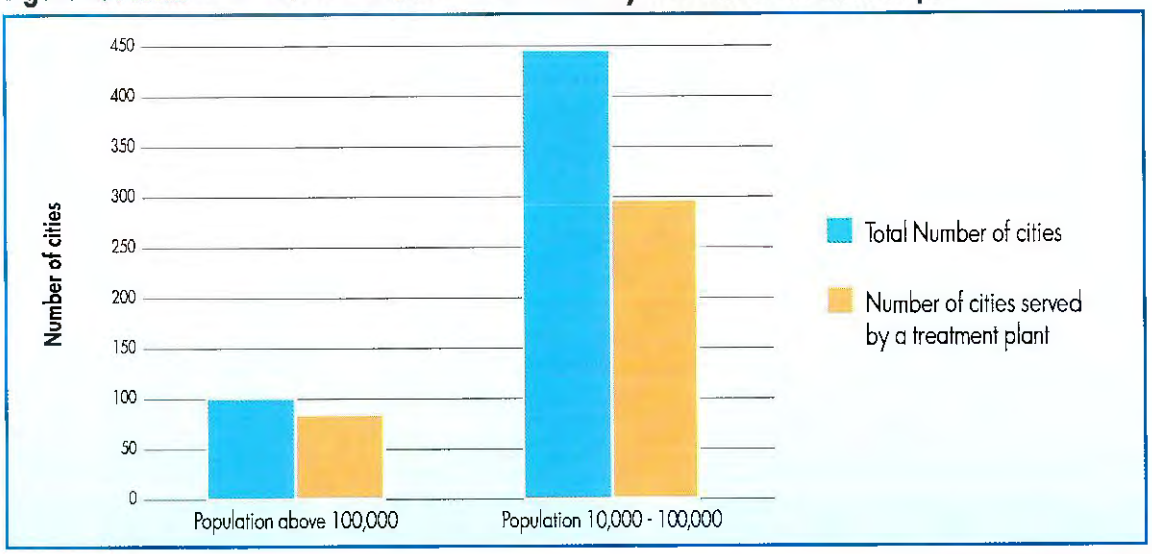
Table 2.1 Impact of tourism on Mediterranean resources

	1990	2000	2010
Land use for accommodation (km²)	2,280	3,700	5,000
Drinking water consumption (hm³)	480	650	995
Residual water (hm³) (60% of drinking water)	260	400	597
Solid waste (thousands of tons)	1,632	2,300	3,419

Source: UNEP/MAP, 1995

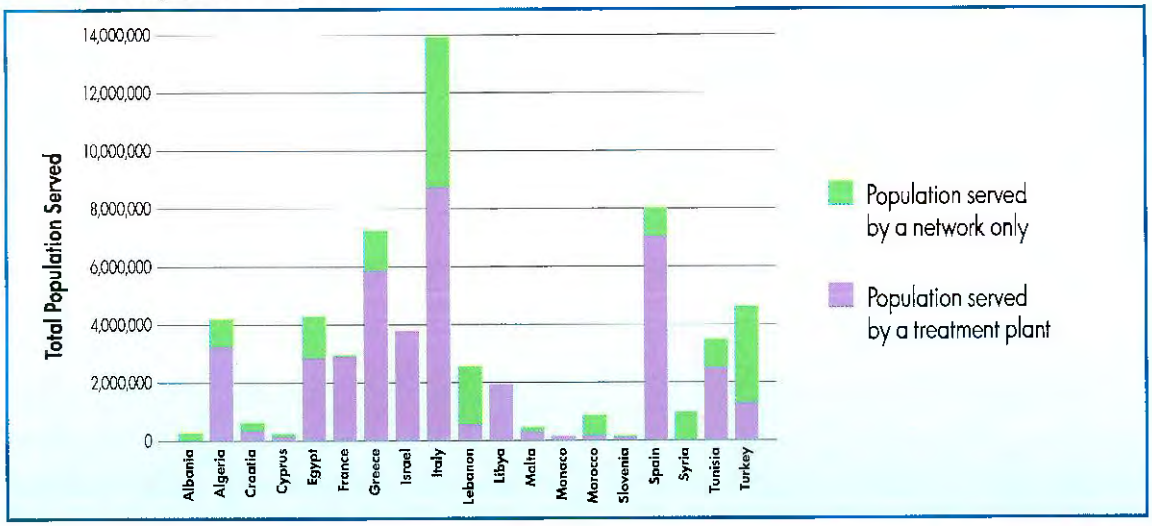
Wastewater treatment plants serve around 55% of 545 coastal cities with more than 10,000 inhabitants in 19 Mediterranean countries reviewed by WHO/EURO as part of the MED POL Programme (UNEP/WHO, 2000). **Figure 2.4** shows the cities that are served by wastewater treatment plants according to the resident population density. **Figure 2.5** illustrates the treatment facilities situation of the Mediterranean coastal population by country. Around 30% of the population of these coastal cities is served by a sewerage network only. This results in the discharge of considerable amounts of untreated wastewater into the sea each year **(Figure 2.6)**. When comparing these results to previous assessments, it should be noted that more information was forthcoming from countries in the latest WHO/EURO assessment.

Figure 2.4 Number of Mediterranean cities served by wastewater treatment plants



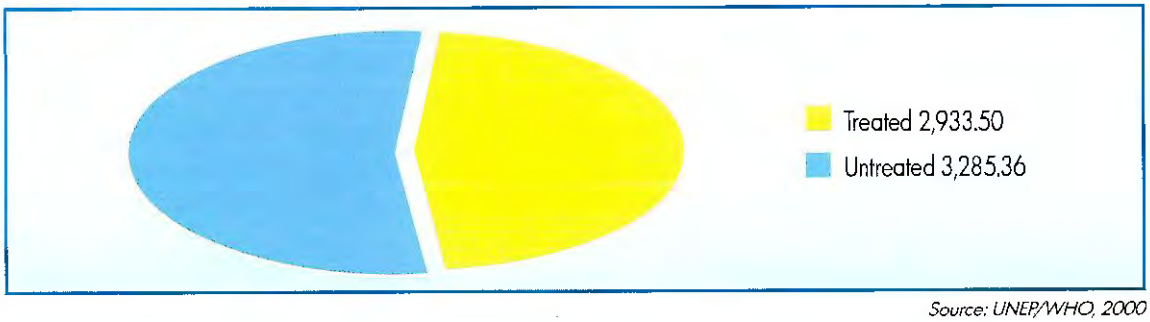
Source: UNEP/WHO, 2000

Figure 2.5 Treatment facility situation in Mediterranean coastal cities with populations above 10,000 inhabitants



Source: UNEP/WHO, 2000

Figure 2.6 Annual load (million m³/year) of wastewater discharged into the sea from coastal cities in the Mediterranean



Source: UNEP/WHO, 2000

2.2 Agriculture: the largest non-point contributor of pollutants to the Mediterranean

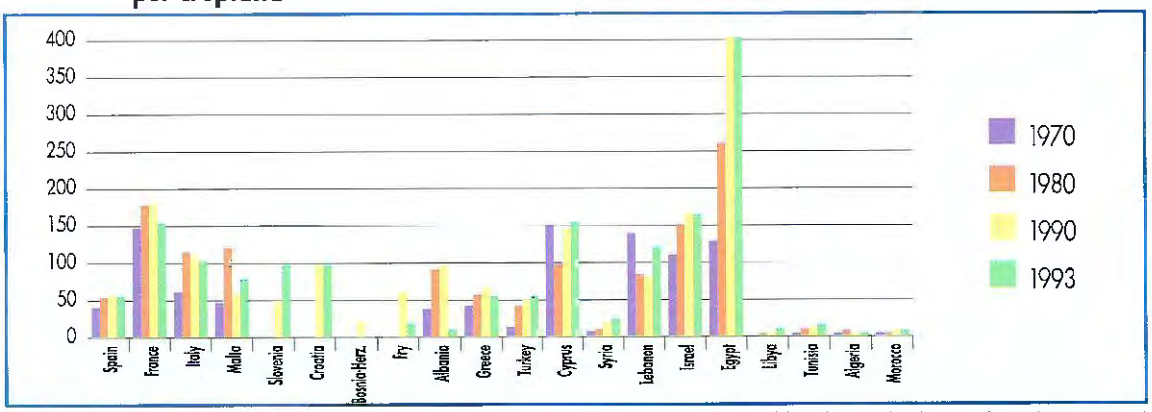
From earliest times, the Mediterranean drainage basin has been subject to exhaustive farming, grazing and the destruction of its forests to meet the food demands of a growing population. Agriculture is conditioned by the basin's terrain. The mountains favour extensive hillside stock-rearing (sheep and goats), while the few alluvial plains of the Ebro, the Rhône, the Po and the Nile favour more classical horticulture or the intensive raising of beef and pigs. In the narrow coastal valleys of the Mediterranean and on the arid coastal slopes the main crops are olives, almonds, pistachios and grapes.

In recent decades, an increasing amount of agricultural land in the coastal zone is being lost to urbanization and industry so the traditional task of preventing soil loss to the sea by terracing the coastal slopes and transporting topsoil upland is in decline. In the south and east, cultivated surfaces continue to expand to cope with the increasing population load, at the expense of forests and grazing land. Food crop cultivation, demanding increasing amounts of fertilizer, is gradually replacing the specialized Mediterranean flora that in the past went a long way towards the prevention of soil erosion. In the north and west, yields are being increased through specialized monocultures, which are highly demanding of water, fertilizers and pesticides, while marginal land is gradually abandoned.

In most Mediterranean countries, all agricultural practices and land use, including cultivation, irrigation, dairy farming, pastures and animal feedlots, are considered as non-point sources of pollution. Agriculture may be only one of a number of non-point sources of pollution through run-off water, sediment transport and leaching, carrying phosphorus, nitrogen, pesticides, metals, pathogens, salts and trace elements, but it has become the largest non-point contributor of pollutants to the Mediterranean. These pollutants gradually find their way to the sea through groundwater, wetlands and rivers in the form of sediment and chemical loads.

In the catchment basin of the Mediterranean and along the coastal zone, particularly on the southern coast, there is strong pressure to use increasing amounts of fertilizer. In Cyprus, Egypt and Israel, the consumption of fertilizer in 1993 was higher than in countries with more advanced agricultural practices such as France, Italy and Spain **(Figure 2.7)**. In regions where soil erosion is most intense, run-off waters cause significant transport of sediments and bound or dissolved nutrients, especially nitrates and phosphates. In addition to the large river basins of the Rhône and the Po, the first six drainage regions which discharge the largest amounts of nutrients into the sea are found in peninsular Italy, Sicily and Sardinia, Greece, Spain and Turkey **(Table 2.2)**.

Figure 2.7 Fertiliser consumption in the Mediterranean countries from 1970 to1993 (kg/ha) per cropland



Data source: The World Bank, Social Indicator of Development 1996

With the intensification of agriculture the use of pesticides has greatly increased in the Mediterranean in the past twenty years, threatening the quality of ground and surface waters, human health and ecosystems. This is most evident in the north-western region, especially in France, Italy and Spain, closely followed by Turkey in the north-east. Aerial transportation contributes a considerable amount of pesticides to the marine environment, particularly organochlorinated compounds. Agricultural run-off through rivers (notably the river Rhône in France, the Ebro in Spain, the Po in Italy, the rivers Axios, Loudias and Aliakmon in Greece and the Nile in Egypt) is the most important point source of pesticides to the Mediterranean.

The salient feature in the Mediterranean in the coming years will be the increasing industrialization of the agro-food system. The northern countries are expected to show continued growth of their agro-food industries, at a slower rate than the other countries and with a tendency towards greater product sophistication rather than major increases in processing capacity. By 2025, countries south and east of the basin are expected to show a five-fold increase in their agro-food activities. These countries will therefore be the most vulnerable to increased pollution and environmental pressures caused by the development of the agro-food sector. Land-based pollution due to the increasing use of large quantities of fertilizers is the most obvious possible outcome in the countries to the south and the east of the Mediterranean basin.

Table 2.2 Soil erosion estimates and discharges of phosphorus (P), nitrogen (N) and organic carbon (Org. C) to the Mediterranean Sea from agricultural land

Country	Drainage area km²	Soil 10^6t	Total P 10^3t	Total N 10^3t	Total Org. C 10^3t	Estimated average annual soil loss t/ha
Albania	30,400	6.8	3.7	6.7	74.1	2.24
Algeria	99,100	55.8	15.9	41.4	387.6	5.3
Cyprus	9,100	14.1	6.9	20.3	161.1	15.49
France	130,000	38.2	25.6	51.7	565.0	34.63
Greece	106,100	207.5	146.7	268.7	2492.3	19.56
Israel	10,300	3.8	1.3	3.2	33.0	3.69
Italy	279,300	410	341.7	619.4	6574.4	80.13
Lebanon	7,800	25.7	6.5	17.4	196.4	32.95
Morocco	62,800	43.7	9.1	29.7	502	6.96
Spain	180,300	116.1	103.1	177.3	1801.1	6.44
Syria	5,700	34	14.8	27.4	267.9	59.65
Tunisia	34,400	54.9	28.7	56.5	571.0	15.96
Turkey	153,700	296.9	129	250.9	3315.0	19.32

Source: UNEP/MAP, 1997

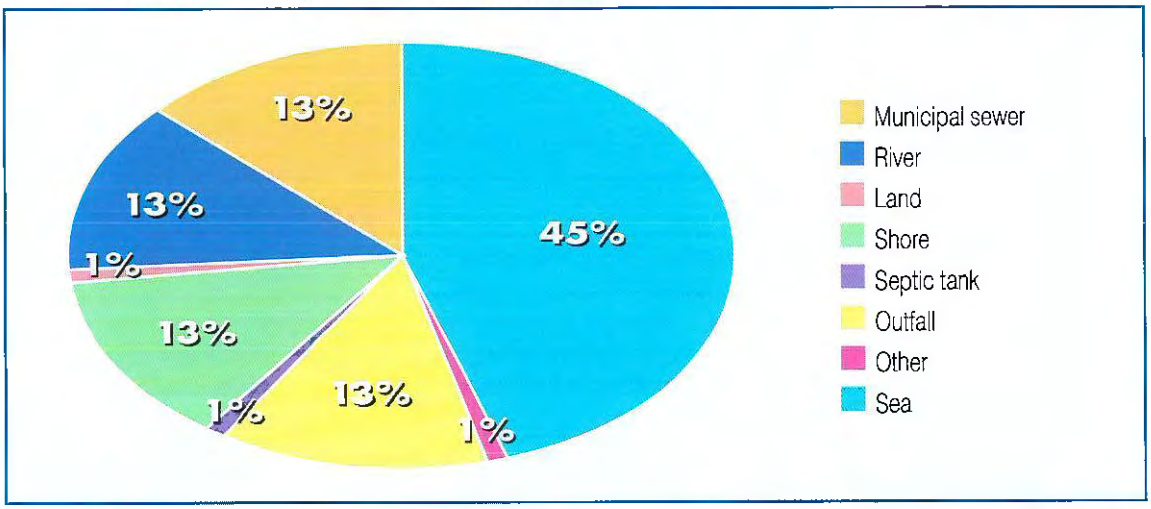
2.3 Industry: the changing face of industrial land-based pollution in the Mediterranean in the 21st century

More than 200 petrochemical and energy installations, basic chemical industries ond chlorine plants are located along the narrow Mediterranean coast and catchment basins of rivers, including at least 40 major oil refineries, in addition to cement plants, steel mills, tanneries, food-processing plants, textile mills, and pulp and paper mills.

The activities of these industries exert pressure on the Mediterranean environment in a number of ways. Owing to the narrowness of the coastal zone, industries compete strongly with other land uses such as agriculture and housing for an expanding urban population. Some industrial activities, especially the agro-food sector, the iron and steel and the paper industries, are also highly demanding of water. The industrial need for water in the Mediterranean countries is close to 14,000 m^3 a year. Although three-quarters of this water is consumed by industries in the northern part of the Mediterranean, the effect is most serious in areas with low water resources. Industrial pollutants impact the air primarily through emissions of sulphur oxides, nitrogen oxides and carbon monoxide, some of which are responsible for acid rain phenomena in the Mediterranean. Carbon dioxide emissions are also largely due to industry. Industrial solid wastes consisting of slag from coal mining, coal processing and steel making, sludge from the processing of ores, dust and combustion ashes and mine tailings may end up on land in the form of landfill, in rivers or in the Mediterranean sea directly. The mining of mercury is a particularly important problem because Mediterranean countries, which occupy about 0.5% of the Earth's surface, undertake more than half of the world's mercury mining (from 60% to 85% according to estimates for different years) and provide no less than half of the world supply. Industrial wastewater is an important carrier of pollutants to the Mediterranean aquatic environment and includes oils, heavy metals, detergents, solvents and organic chemicals, as well as heated cooling water.

Industrial wastewater is either discharged directly to the sea or through municipal sewerage systems, outfalls, uncontrolled disposal sites and rivers. **Figure 2.8** illustrates the fate of industrial wastewater, based on information received from a survey of a number of Mediterranean countries (UNEP/WHO, 1996a). The survey of pollutants from land-based sources in the Mediterranean, which was carried out by WHO as part of the MED POL Programme, also showed that the annual load of 66 million m^3 of untreated industrial wastewater that entered the sea directly from several Mediterranean countries was responsible for roughly 36% of BOD, 30% af COD, 3% of nutrients, 92% of phenols, 7% of mercury, 37% of lead, 40% of chromium, 24% of zinc and close to 100% of mineral oils, relative to the total pollution load entering the sea from those countries each year. Rivers are important conveyors of industrial pollutants to the Mediterranean. There is documented evidence of contamination of the Po, Ebro and Rhône, large rivers draining into the Mediterranean, with polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and solvents (Meybeck and Ragu, 1997).

Figure 2.8 Fate of discharged industrial wastewater in Mediterranean countries



Source: UNEP/WHO, 1996a

Of the substances produced by industry or released as a result of its activity, the most harmful to human health, marine ecosystems and biodiversity are the toxic, persistent and bioaccumulative pollutants known as TPBs. These include the heavy metals mercury, cadmium and lead, some organametallic compounds (compounds where one metal atom is bound to at least one carbon atom, tributyltin being the most widely known) and numerous organic compounds, called Persistent Organic Pollutants (POPs).

POPs have been grouped together as a result of their important toxic effects, including effects on the functioning of the endocrine system, their propensity for long-range transport and deposition and their typical low water solubility and high accumulation in fatty tissue. All these properties combined translate into serious potential adverse effects on the environment, wildlife and human health at locations near and far from their source. There are numerous POPs that pollute the environment. Twelve of them warrant particular attention because of long-standing concerns about their high toxicity. These 12 POPs are all organochlorines. All 12 have also recently been identified as σendocrine disruptorsσ. They include dioxins and furans, which are produced as unwanted by-products of a number of industrial processes, PCBs and hexachlorobenzene (HCB), which have several industrial uses (hexachlorobenzene is also a pesticide) and are also formed as unwanted by-products. A number of first generation pesticides (DDT, chlordane, heptachlor, aldrin, dieldrin, endrin, toxaphene and mirex) complete the list.

Looking at the export specialization of the Mediterranean countries, which is a fairly accurate reflection of their industrial activity, provides an insight into the most important sources of pressure currently exerted on the environment by industry on a country basis. One group of countries specializes in exporting only a few products, the rest being imported. This is typical of the oil-producing countries, Algeria, Egypt, Libya and Syria. The export of goods such as clothing, textiles and leather, even at a comparative disadvantoge with other countries, characterizes a second group of countries with a wider spread of exports. This group includes, Cyprus, Malta, Morocco, Tunisia and Turkey and the countries of the former Yugoslavia. Each country in this group also has its own more specific exports (chemicals and fertilizers in Morocco; chemicals, oils and lubricants in Tunisia; textile fibres, wool, cotton, paper and cement in Turkey and the

former Yugoslavia). The EU Mediterranean countries comprise a third group, which is characterized by a great diversity of exports and thus much less specialization. The EU Mediterranean countries also account for the greatest share of the petrochemical industries in the Mediterranean basin.

When the value added of the manufacturing industry is considered, three Mediterranean countries, France, Italy and Spain (when combined they account for 87%) currently predominate over the rest. This implies that there is still a considerable gap in industrial development between the northern and the south-eastern countries of the basin. A different picture is likely to emerge in the course of the 21st century. In the north, heavy industries are likely to enter a period of stagnation or even decline, while they are expected to grow in the south. After 2000, fresh expansion of the mining industry is more likely to occur in the countries south and east of the basin rather than in the northern countries. Iron and steel production in the north will remain almost constant, while in the south and east production could increase from 8.5 million metric tons in 1985 to more than 50 million metric tons in 2025. Cement production is likely to decline in the north and increase by more than 150% in the south. The production of petrochemicals by the major industrialized countries in the north is unlikely to increase and there may even be fresh reductions in capacity. On the other hand, new types of industrial activities in the field of petrochemicals could eventually emerge in the south. The production of ammonia is already well into its shift southward and eastward. The chlorine industry is still mainly concentrated on the northern shore of the Mediterranean, but it should experience the same shift southward and eastward as petrochemicals. These likely shifts in industrial production in the 21st century imply a potential increase in industry-related environmental pressures in the southern and eastern part of the Mediterranean basin in the new millennium.

2.4 Rivers: an important source of all types of land-based pollutants into the Mediterranean

River flow into the Mediterranean is greatly influenced by the basin's hydrology, which is very heterogeneous, ranging from an alpine regime of early summer maximum flows to a typical Mediterranean regime of winter high flows and summer low flows, to the semi-arid regime of the southern coast with its episodic floods. In addition, most Mediterranean rivers show large variations in their discharges from day to day and year to year. This regime greatly influences the timing and extent of the input of significant pollution loads, which are carried to the Mediterranean Sea by around eighty identified large and small rivers (UNEP/MAP, 1997).

The levels of nutrients in Mediterranean rivers are about four times lower than those of western European rivers. Nevertheless, nitrate levels in Mediterranean rivers are on the increase and the trend in ammonia levels is variable, depending on the degree of sewage collection and treatment. In EU Mediterranean countries, ammonia levels in rivers have generally decreased as a result of domestic and industrial wastewater collection and treatment. Ammonia levels are still very high in some rivers (Llobregat, Besos, Ter, Tet, Tevere). Phosphate levels in rivers are either increasing dramatically, as in Greece, or steadily, as in France, or they have decreased, as in Italy as a result of a ban on phosphates in detergents (UNEP/MAP, 1997).

Table 2.3 shows the loads of dissolved nutrients in major Mediterranean rivers in decreasing order of river water discharge to the Mediterranean Sea.

The level of **bacterial contamination** of rivers is not well documented in the Mediterranean. It ranges from negligible in rivers running through sparsely populated land to quite severe in some southern rivers. With the few exceptions of some major rivers in Greece and Italy, the situation in EU Mediterranean countries has improved in the last two decades owing to improved sewage treatment and disposal (UNEP/MAP, 1997).

The **heavy metal** load of Mediterranean rivers is generally lower than in most western European rivers. This may be the result of the dilution of urban and industrial loads by the high levels of suspended solids in Mediterranean rivers, combined with a highly erosive environment. Natural variations can sometimes account for even a doubling of heavy metal concentrations in comparison to reference values, but above this level pollution is the most likely explanation. This is the case for Pb concentrations in many rivers (Rhône, Tevere, Herault, Brenta, Martil), as well as for Zn (Adige, Herault, Martil, Po, Tevere), Hg (Po, Rhône), Cu (Ebro, Herault, Orb, Rhône, Tevere) and As (Orb, Herault), as shown in **Table 2.4**. Hundreds of reservoirs from the damming of rivers of the Mediterranean basin are probably retaining much of the sediment-bound metals originating from human activities (UNEP/MAP, 1997).

The load of **organic micropollutants** carried by Mediterranean rivers has not been thoroughly assessed, even though rivers are an important source of input of these chemicals into the Mediterranean (UNEP/MAP, 1997). Industrial chemicals such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) and solvents are known to contaminate large rivers draining into the Mediterranean such as the Po, Ebro and Rhône (Meybeck and Ragu, 1997). Rivers carrying agricultural run-off (notably the river Rhône in France, the Ebro in Spain, the Po in Italy, the rivers Axios, Loudias and Aliakmon in Greece and the Nile in Egypt) are the most important point source of pesticides discharged into the Mediterranean. A number of small Mediterranean rivers running close to land used for intensive agriculture have been found to contain elevated levels of pesticides (> 1mg/l). Residues of the new generation **pesticides** atrazine, simazine, alochlor, molinate and metolachlor have frequently been detected in important rivers draining into the Mediterranean **(Table 2.5)**, although only up to 3% of the quantities of these pesticides applied to cultivated land are exported by rivers (UNEP/MAP, 1997).

River discharges can carry important amounts of the **radionuclides** caesium-137 and plutonium-239, 240 to the adjacent continental shelves (Arnaud et al., 1995), especially in areas where the deposition from the Chernobyl accident was significant on the hinterland (northern Adriatic and Liguro-provencal areas). Riverine geochemical processes may delay the output to the sea of the effluents from the Mediterranean nuclear facilities that are located along rivers. In any case, river input, together with the input from the nuclear industry and exchanges through the straits, amount to no more than 10% of the total ^{137}Cs and $^{239,240}Pu$ delivery to the Mediterranean Sea from fall-out.

Table 2.3 Loads of dissolved nutrients from major Mediterranean rivers discharging into the Mediterranean Sea

Rivers	Flow km³/year	Nitrate ($N\text{-}NO_3$*) mg/l	Ammonium ($N\text{-}NH_4$*) mg/l	Phosphate ($P\text{-}PO_4^{-3}$) mg/l	Country
Po	48.90	2.03	0.21	0.084	Italy
Rhône	48.07	1.48	0.124	0.101	France
Drini	11.39				Albania
Neretva	11.01	0.269	0.029		Croatia
Buna	10.09				Albania
Ebro	9.24	2.3	0.167	0.029	Spain
Tevere	7.38	1.37	1.04	0.26	Italy
Adige	7.29	1.25	0.111	0.03	Italy
Seyhan*	11.30	0.43	0.7	0.14	Turkey
Ceyhan*	13.30	1.03	0.13	0.04	Turkey
Evros/Meric	6.80	1.9	0.05	0.36	Greece/Turkey
Vijose	6.15				Albania
Isser	6.12				Algeria
Akheloos	5.67	0.60	0.035	0.02	Greece
Manavgat Creek*	3.81	0.22			Turkey
Axios	4.90	1.584	0.065	0.48	Greece
Buyuk Menderes*	0.40	0.75	0.33	0.07	Turkey
Mati	3.25				Albania
Volturno	3.10				Italy
Semani	3.02	0.24			Albania
Strymon	2.59	1.236	0.053	0.11	Greece
Goksu*	3.60	0.59	0.18	0.06	Turkey
Brenta	2.32				Italy
Arno	2.10	0.912	0.042	0.50	Italy
Shkumbini	1.94	0.73			Albania
Gediz*		1.18	0.005	0.14	Turkey
Pescara	1.70				Italy
Krka	1.61	0.45	0.031	0.029	Croatia
Moulouya	1.58				Morocco
Var	1.57	0.18	0.031	0.006	France
Reno	1.40				Italy
Aude	1.31	1.42	0.09	0.09	France
Cheliff	1.26				Algeria
Jucar	1.26				Spain
Aliakmon	1.17	0.395	0.05	0.10	Greece
Nestos	1.03	1.24	0.071		Greece
Herault	0.92	0.61	0.06	0.045	France
Orb	0.86	0.67	0.44	0.14	France
Ter	0.84		1.2		Spain
Pinios	0.672	2.32	0.167		Greece
Llobregat	0.466	1.9	3.2	1.2	Spain
Metauro	0.43	1.36	0.0	0.005	Italy
Tet	0.40	1.8	1.5	0.47	France
Argens	0.38	0.74	0.09	0.11	France
Fluvia	0.36		0.054		Italy
Nile	0.30**				Egypt
Besos	0.130	1.9	3.1		Spain
Kishon	0.063				Israel
Tavignano	0.06	0.34			France (Corse)

Note:
** Average values in 1996, Ministry of Energy and Natural Resources of Turkey*
*** Estimates of actual discharge from "Rosetta" and "Damietta" branches*

Source: UNEP/MAP, 1997

Table 2.4 Documented rivers in the Mediterranean for particulate metal contents (mg/g)

Rivers	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Adige		1.63		50		32	49	270
Argens	4.2	0.1	15.6	3.2	< 0.03	9.7	19.6	38.1
Arno			159					
Bradano		2.55						
Brenta							145	
Ceyhan				<10		<20		
Ebro	6.1	1.8	215	71		19	60	
Goksu		0.5	270	16.8			5	27.4
Herault	26.4	0.7	33.6	57.2	0.137	24.3	129	279
Marti			91				517	438
Orb	28.7	0.1	37.5	132	0.29	30.2	68.4	138
Po	7.45	1.74	124	73	1.54	112	75	342
Rhône	13.2	1.8	155	125	0.47	60	120	108
Seyhan				<10		<20		
Tevere		2.0		100			130	280
Var	7.7	0.42	19.8	25	0.0	14.2	5.6	68
Reference Background		0.4		20	0.03		25	100

Source: UNEP/MAP, 1997

The construction of dams and the diversion of river flow for irrigation have severely reduced the river water inputs into the Mediterranean over the past 40 years. The highest retention of river water (probably more than 90%) is on the Nile. Many other rivers such as the Rhône in France and a number of rivers in Spain (Segura, Jucar, Mijares, Ebro, Llobregat, Turia) have also been affected. Decreases are most likely to have occurred in southern Italian, Greek, Turkish and northern African rivers as a result of evaporation in reservoirs, diversion and increased use of water for irrigation. The current estimated reduction in river water discharge for the Mediterranean basin as a whole is between 30% and 40%. The retention of river water behind hundreds of reservoirs in the basin has also resulted in a complete change in the pattern of sediment discharge into the Mediterranean, especially in Algeria, Egypt, Greece, southern and central Italy, Morocco, Spain, Tunisia and Turkey. The retention of sediments behind dams at the same time causes the retention of large quantities of sediment-bound nutrients (P and N), heavy metals and organic micropollutants originating from human activities.

Table 2.5 Pesticide residues in rivers draining into the Mediterranean (mg/l)

Rivers	Alachlor	Atrazine	Metolachlor	Molinate	Simazine
Po (Italy)	<0.03-0.106	0.021-0.118	<0.03-0.605	<0.03-1.750	0.06-0.081
Rhône (France)	<0.001	0.022-0.386	—	—	0.018-0.372
Ebro (Spain)	<0.001-0.267	<0.001-0.190	<0.001-0.554 ?	<0.001-0.568	0.010-0.138
Evros/Meric (Greece/Turkey)	nd-0.37	nd-0.63	—	—	nd-0.32
Axios (Greece)	<0.05-1.30	<0.05-0.70	<0.10-0.50	<0.001-0.9	<0.06-0.3
Aliakmon (Greece)	nd-1.20	nd-0.74	nd-0.63	nd-0.94	nd-0.06
Nile (Egypt)	<0.001	<0.001	<0.001	<0.001	<0.001

Source: Albanis, 1997

The state of the marine and coastal environment 3

3.1 Nutrients: excessive quantities cause euthrophication in most coastal Mediterranean countries

Eutrophication is a process whereby in waters receiving excessive amounts of nutrients, particularly phosphorus and nitrogen, there is enhanced production of microalgae, leading to a series of chain effects. The most serious consequences are the appearance of toxic algal blooms or red tides, the excessive growth of submerged or floating seaweed, visible bacterial blooms and fungal growth and, finally, oxygen depletion caused by the decomposition of large amounts of algae and seaweed, which results in fish kills.

More subtle changes caused by eutrophication occur in the biological community as a whole. As phytoplankton increases at greater rates than zooplankton, there is a gradual decrease in diversity as rarer species disappear, sometimes leading to an increase in jellyfish. Increased water turbidity and sediment transformation often lead to the disappearance of Posidonia oceanica meadows and, as a consequence, the loss of important nurseries for demersal fish. Changes in the pH and sticking algal material can cause skin and eye infections, while certain toxin-producing algae can cause paralytic and diarrhoetic poisoning in consumers of contaminated fish and shellfish.

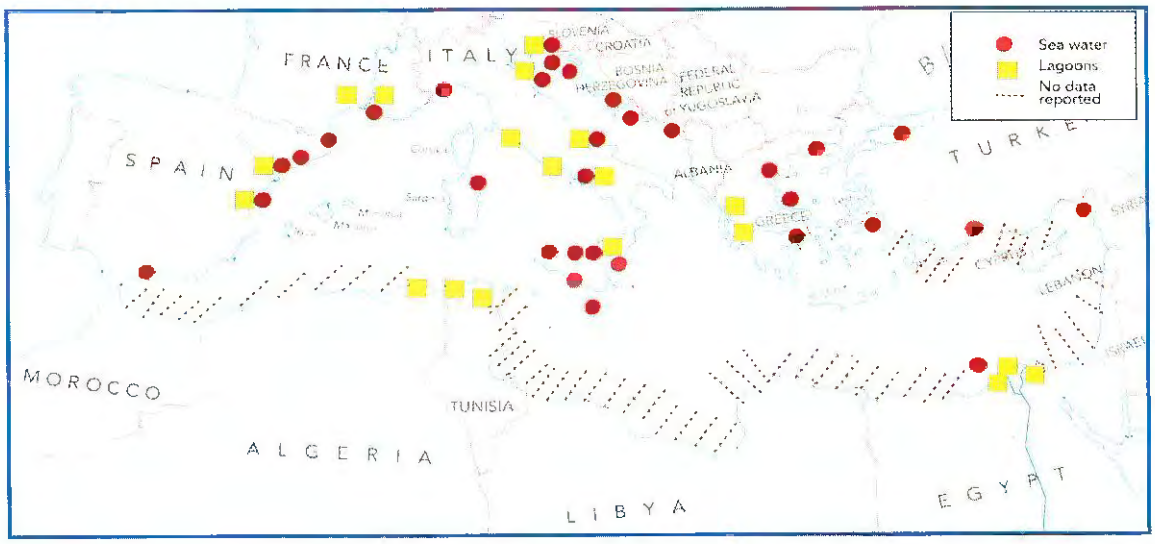
The open waters of the Mediterranean are considered as oligotrophic (nutrient depleted) and in some parts as ultra-oligotrophic, except in areas where the upwelling of nutrient-rich waters occurs. Although an increase in the concentrations of nitrates and phosphates in the intermediate and deep waters of certain parts of the Mediterranean (Souvermezoglou et al., 1999) has been reported over the past ten years, this is mainly along certain coastal sites and the offshore areas nearby, where eutrophication occurs.

Severe eutrophication events occur in enclosed coastal bays receiving large quantities of nutrients of human origin from rivers and/or direct discharges of untreated urban and industrial wastewaters. Eutrophication frequently also occurs in Mediterranean lagoons and estuaries (i.e. aquatic environments where primary productivity is generally high) when water exchange with the sea is low and the supply of nutrients of human origin is high. This problem is usually aggravated by the construction of new installations (ports, quays and breakwaters) in the proximity, which further reduce the exchange of water with the sea.

Figure 3.1 illustrates the sites of the most important eutrophication occurrences in Mediterranean coastal areas and lagoons (UNEP/FAO/WHO, 1996). Almost all coastal Mediterranean countries are affected by eutrophication, although to varying degrees, and most incidents have been reported for the northern Mediterranean (i.e. the bays of the Ebro delta, the Albufera of Valencia, the bays of the Rhône delta, the gulf of Saronikos, the gulf of Thermaikos, the bay of Izmir). The most important areas of extensive eutrophication are the gulf of Lyons and the northern Adriatic coast, particularly along the semi-enclosed bays of the Po delta, the gulf of Venice and the gulf of Trieste on the Italian coast. The Slovenian coast and the bays of Pula, Rijeka, Kastela, Sibenik and Dubrovnik in Croatia also suffer. The key features of the Adriatic, which make it most vulnerable, are believed to be its shallowness, low turbulence during the summer

and the high riverine nutrient input. Although not documented as extensively as for the northern Mediterranean, serious eutrophication problems also exist in the southern countries (as in the coastal waters and lagoons of the Nile delta in Egypt and the coastal lagoons of Tunisia and Algeria) and are likely to increase in the future following increases in the population and further industrial development.

Figure 3.1 Mediterranean areas where eutrophication phenomena have been reported



Source: UNEP/FAO/WHO, 1996 (Modified)

3.2 Microbiological contamination: "hot spots" of contamination with pathogenic microorganisms often coincide with eutrophication "hot spots"

The main cause of microbiological contamination of the Mediterranean Sea is the discharge of untreated or partly treated sewage in coastal waters. Considerable amounts of untreated municipal wastewater enter the Mediterranean each year (UNEP/WHO, 2000). Upstream wastewater discharges carried to the sea by rivers also contribute to the problem, in addition to wind-blown bacteria, viruses and parasites carried from the continents and rain deposited into rivers and the sea. The large number of bathers may be the source of pathogenic microorganisms in crowded bathing waters that are not affected by sewage effluent.

A considerable number of species and strains of pathogenic bacteria, viruses, fungi and protozoa are present in varying amounts in Mediterranean coastal waters. Naturally occurring marine microorganisms, especially toxin-producing dinoflagellate algae, may become a health threat when their concentration in seawater exceeds a certain limit (104 to106 cells per litre), beyond which algal blooms or "red tides" accur. This is often the case in instances of severe eutraphication of Mediterranean coastal waters. The **pathogenic bacteria** recorded in a recent assessment of the state of microbiological pollution of the Mediterranean Sea (UNEP/WHO, 1996b) are listed in **Table 3.1**. Most research work performed in the Mediterranean on **viruses** has been qualitative rather than quantitative. **Table 3.2** lists the viruses that have been isolated in the Mediterranean marine environment so far. Most records are from the northern Mediterranean due to the difficulty, and hence expense, involved in isolating and quanitfying viruses.

Table 3.1 Pathogenic bacteria isolated in Mediterranean coastal waters

Pathogens	Location
Salmonella spp.	Widespread throughout the region
Shigella spp.	East and south
Vibrio cholerae	Algeria, Egypt, France, Italy, Morocco, Spain
V. alginolyticus	Widespread throughout the region
V. parahaemolyticus	Widespread throughout the region
Staphylococcus aureus	Widespread throughout the region
Pseudomonas aeruginosa	Widespread throughout the region
Clostridium perfringens	Widespread throughout the region
Campylobacter spp.	Widespread throughout the region
Aeromonas hydrophila	Widespread throughout the region

Source: WHO, 1991

Table 3.2 Viruses isolated in the Mediterranean marine environment

Viruses		Location
Enteroviruses		
	Poliovirus	Greece, Italy
	Echovirus	France, Greece, Italy
	Coxsackie virus A	France, Italy
	Coxsackie virus B	France, Greece
	Hepatitis A virus	France, Greece, Spain
	Unspecified non-polio	France, Italy
Other viruses		
	Adenovirus	France, Greece, Italy
	Rotavirus	Spain

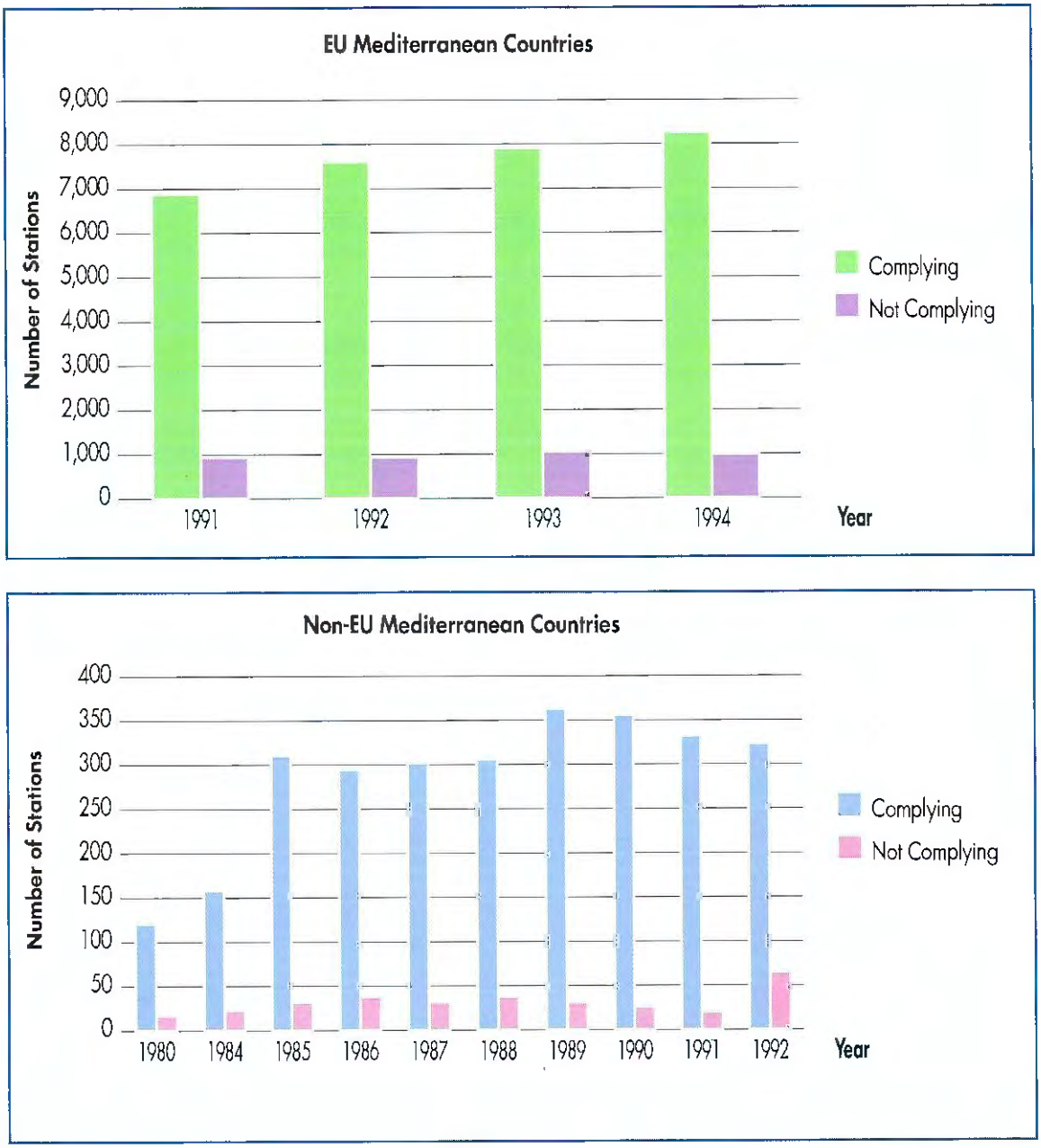
Source: WHO, 1991

The health risk from microbiological contamination is particularly significant in the Mediterranean owing to the warm climate, which allows the extended exposure of a large number of bathers to seawater and sand on crowded beaches in the summer, coupled with the consumption of large quantities of seafood in the coastal areas of the Mediterranean, while considerable amounts of untreated sewage are discharged into coastal waters, in many cases in the vicinity of recreational and shellfish-growing areas. Diseases and disorders associated with infection by pathogenic microorganisms occur among the local Mediterranean populations as well as among tourists visiting the region (UNEP/WHO, 1996b).

Humans are exposed to pathogenic microorganisms in the marine environment either through direct contact with polluted seawater, sand or sediment while swimming or engaging in other recreational activities by the sea or through the consumption of contaminated seafood. The paucity of information on the microbiological quality of shellfish and shellfish-growing waters in the Mediterranean precludes an assessment of the situation. An assessment of the microbiological quality of coastal recreational waters was made on the basis of the MED POL monitoring data for the period 1983-1992 (UNEP/WHO, 1996b). **Figure 3.2** shows the number of bathing water stations complying or not complying with their respective microbiological quality parameters in EU and non-EU Mediterranean countries. Because of the differences in parameters, numerical standards and compliance limits between the guide values of the 1976 EC bathing water Directive used by the EU Mediterranean countries and the 1985 interim criteria for bathing waters used by the non-EU Mediterranean countries, no direct comparisons can be drawn

between the two groups of data. The data submitted to MED POL by the 12 non-EU Mediterranean countries show reasonable microbiological quality of bathing waters overall, although the monitoring frequency was not complied with and the picture of actual monitoring programmes, at least for some countries, is incomplete. The quality of bathing waters in the EU Mediterranean countries shows an improvement that probably reflects the improvement in urban wastewater treatment in these countries over the years.

Figure 3.2 The status of compliance of stations in the EU and non-EU Mediterranean countries with the respective microbiological standards



Source: UNEP/WHO, 1996b

3.3 Mercury, cadmium, lead, tributyltin and organochlorides: TPBs that are a constant threat to the marine environment

The presence of the heavy metals mercury, cadmium and lead, and chlorinated hydrocarbons in the marine environment has been the focus of attention in recent years as these substances are persistent, toxic and easily bioaccumulated and have detrimental effects on marine life and human health.

Heavy metals enter the marine environment from natural and man-made sources. Land-based inputs of heavy metals to the Mediterranean cause local pollution problems, usually near river mouths and coastal industrial outfalls. In the coastal industrial zones with high mercury concentrations identified in the early 1970s (in Tuscany, Kastella Bay near Split, St Gilla Lagoon in the Sardinia Channel, Haifa Bay and Alexandria), the highest concentrations of mercury were measured near the outfalls. Background concentrations may be reached at distances of up to 20 km from an outfall. **Table 3.3** shows the annual heavy metal load (focusing on mercury, cadmium and lead) entering the marine environment from municipal and industrial sources in a number of pollution hot spots in the Mediterranean (UNEP/WHO, 1999).

Table 3.3. Heavy metal (Hg, Cd, Pb) and oil loads to the sea in a number of priority pollution hot spots in the Mediterranean

			Heavy metal load kg/year			
Hot Spot	**Country**	**Source**	**Hg**	**Cd**	**Pb**	**Oil load (t/year)**
Kastela Bay + ind. Zone	Croatia	Mixed	-	23.3	555.1	-
Sibenik	Croatia	Mixed	-	75	315	-
Zadar + ind.zone	Croatia	Mixed	10.1	23	361	0.113
Pula	Croatia	Mixed	-	0.4	11	8.4
Rijeka + Kvarner Bay	Croatia	Mixed	-	146	150	8.09
Dubrovnik	Croatia	Domestic	-	5.5	1,916	-
Larnaca (petrol refinery)	Cyprus	Industrial	0.07	-	0.06	0.018
Abu-Qir Bay	Egypt	Mixed	-	31+	193+	1,906
El-Mex Bay	Egypt	Mixed	1,278	1,562	-	1,319
Thermaikas Gulf	Greece	Mixed	-	-	-	38
Patraikos Gulf	Greece	Mixed	-	-	-	18.2
Elefsis Bay	Greece	Industrial	-	-	-	17
N.W. Saronic Gulf	Greece	Industrial	-	-	-	5.4
Larymna Bay	Greece	Industrial	-	-	-	940
Haifa Bay	Israel	Mixed	7.3	2,600	-	425
Gush Dan	Israel	Mixed	60	430	1,670	-
Ashdod	Israel	Industrial	-	-	-	11
Tripoli	Libya	Domestic	-	-	0.088 ppm	-
Tetouan	Morocco	Mixed	0.38	14.66	307.59	-
Koper (+ Rizana river)	Slovenia	Mixed	-	752	5,727	-
Izola (+ Delamaris)	Slovenia	Mixed	-	9.3	90.5	-
Piran	Slovenia	Domestic	-	4.26	60.96	-
Tartous	Syria	Mixed	-	54	2,703	-
Lattakia	Syria	Mixed	-	85.4	4,271	-
Banias	Syria	Mixed	-	-	-	438
Gabes	Tunisia	Mixed	-	13.6	80+ ppm	-
Lake of Tunis	Tunisia	Industrial	-	0.15	0.6	-
Lake of Bizerte	Tunisia	Industrial	-	-	100 ppm	-

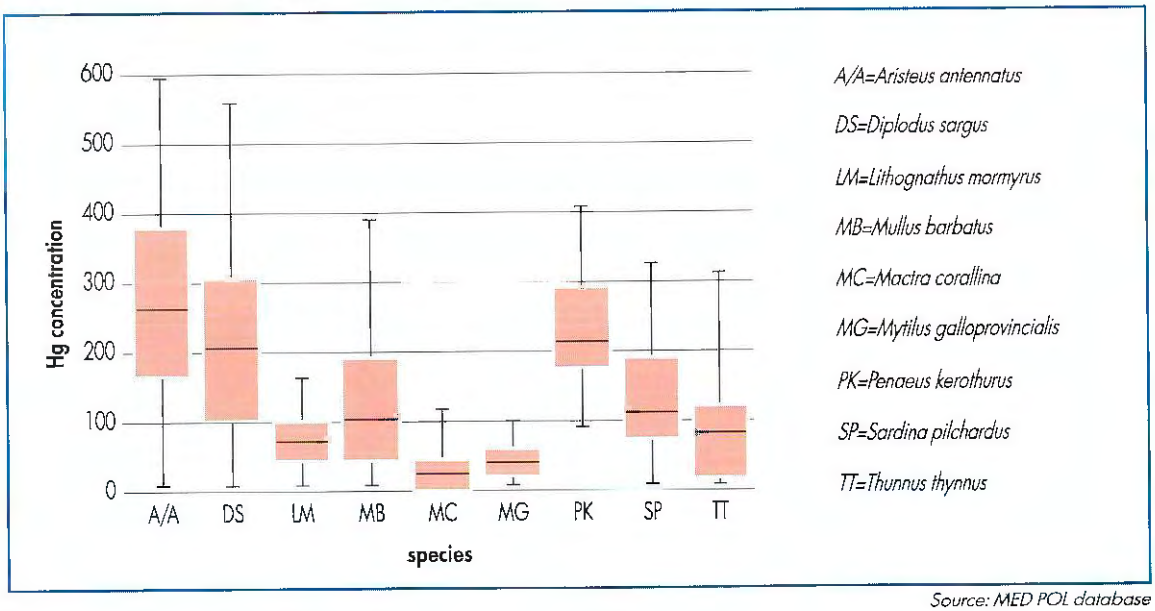
Blank cells mean that no information is available

Source: UNEP/WHO, 1999

With the exception of mercury in sediments and biota, the concentrations of heavy metals in open waters, sediments and biota are generally low. The higher mercury levels are possibly the result of the region being in the Mediterranean-Himalayan "mercuriferous" belt (Bryan, 1976; Bernhard, 1988). Pollution of the Mediterranean Sea by man-made inputs of mercury occurs through the atmosphere and through riverine run-off. A part of the riverine run-off of mercury, i.e. between 10-40 tons per year, and the bulk of the atmospheric deposition, which is also between 10-40 tons per year, enter the Mediterranean Sea as soluble mercury compounds that can be assimilated by the marine biota and can affect marine life (UNEP/WMO, 1998).

Figure 3.3 shows the concentrations of total (organic and inorganic) **mercury** in marine organisms, extracted from the MED POL database (only values obtained after 1987). Most mercury values shown are below the minimum legal limit for seafood intended for human consumption (500ng/g). The concentrations in tuna are for small specimens and are much lower than the levels of mercury found in the larger specimens. Total mercury concentrations only exceeded 1000ng/g in swordfish from the central Mediterranean and the gastropod *Gibbous nassa* from Israel (not included in Figure 3.3).

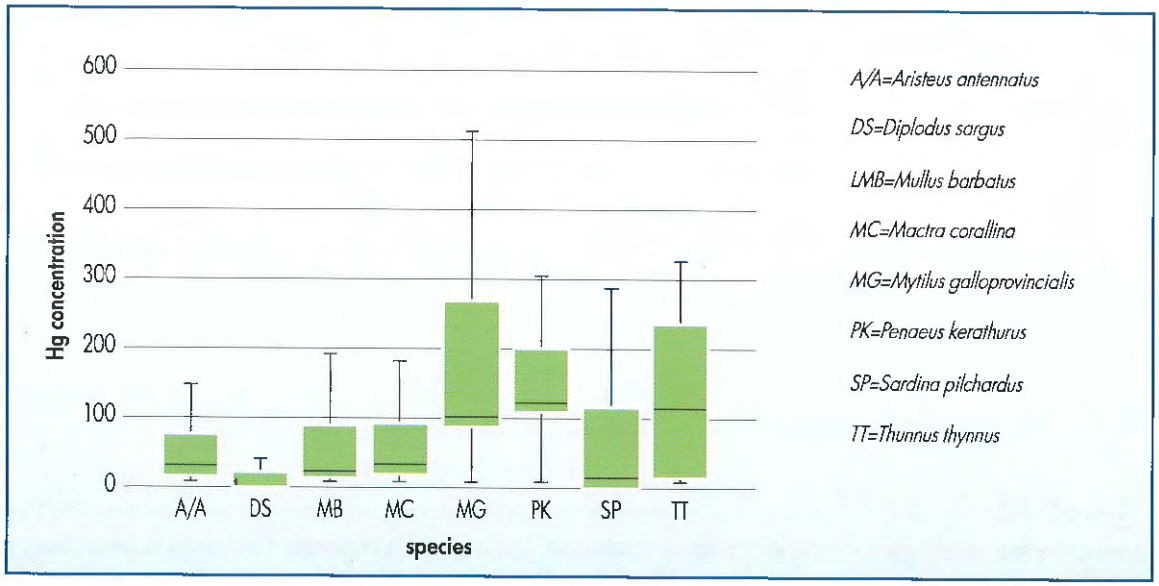
Figure 3.3 Concentrations of mercury (ng/g fresh weight) in selected species from the Mediterranean Sea



Source: MED POL database

High concentrations of **cadmium** (up to 50 mg/kg) have been measured in the sediments of coastal lagoons and other hot spots in the Mediterranean (UNEP/FAO/WHO, 1989). Elsewhere, the values obtained in the surface sediments are lower than the limits adopted for sediment quality criteria (Baudo et al., 1990). **Figure 3.4** shows the concentrations of cadmium in marine organisms, based on data from the MED POL database. The mean cadmium values shown do not exceed 200ng/g FW. Cadmium concentrations exceeded 1000ng/g in some other species (the gastropod Nassarius gibbosulus from Israel, the bivalve *Scapharca inequivalis* from Italy and the limpet *Patella caerulea* from Greece, not included in Figure 3.4.

Figure 3.4 Concentrations of cadmium (ng/g fresh weight) in selected species from the Mediterranean Sea



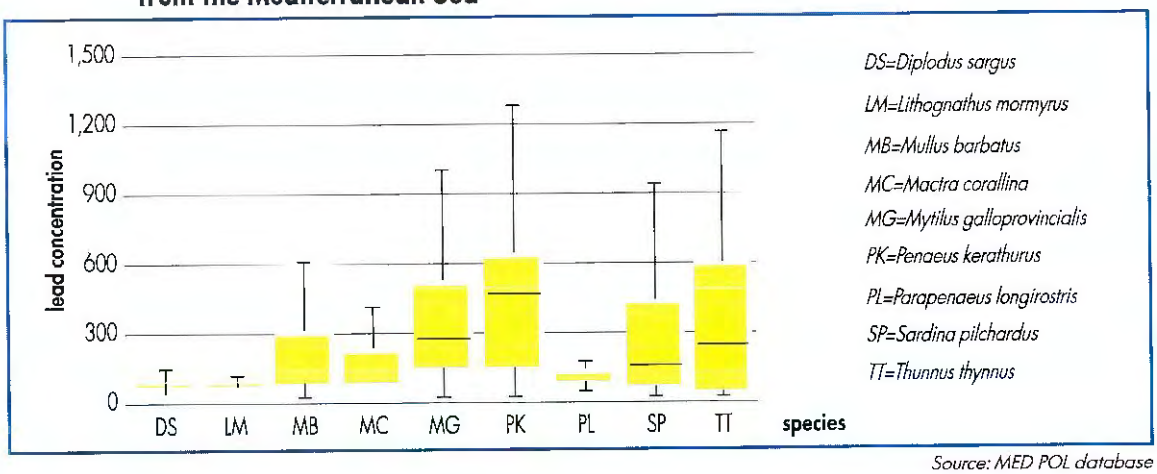
Source: MED POL database

Increased concentrations of **lead** are found near highly-industrialized coastal areas. In estuarine sediments, lead concentrations drop off rapidly within a few kilometres of known anthropogenic point sources (Voutsinou-Taliadouri, 1984). Elsewhere, the concentrations of lead in the surface sediments are lower than the limits adopted by different countries (55-500 mg/kg) for sediment quality criteria (Boudo et al., 1990; Giesy and Hook, 1990). **Figure 3.5** shows leod concentrations in marine organisms from the Mediterronean, based on data from the MED POL database. The concentrations of lead shown for demersal fish are very low, rarely exceeding 600ng/g.

Tributyltin (TBT) is an organo-metallic compound, used mainly as a biocide in anti-fouling paints for ships and boats. It is an endocrine-disrupting chemical whose toxic effect is well documented in molluscs, including sex reversal effects in dogwhelks. The effects on seabirds, marine mammals and fish are now becoming evident all over the world. TBT is detected all over the Mediterranean basin. The levels in seawater are highest (up to 12,150 ng/l) in marinas, commercial shipping areas and shipyards (UNEP, 1996). Elsewhere, most of the seawater concentrations reported are comparable to a "No Observed Effect Level" (20ngTBT/l), although the provisional safe level recommended by the WHO to protect aquatic life and seafood consumers is 10ngTBT/l (WHO, 1990).

Organochlorines ore the most important group of POPs. They are released into the marine environment only from man-made sources. In the1980s, at least 560 tons of organochlorines were discharged into the Mediterranean each year, including 196 tons of DDT and similar compounds (UNEP, 1989). The two main types of organochlorines monitored in the Mediterranean are chlorinated pesticides and polychlorinated biphenyls. The concentration of **DDTs** in the sediments of the Rhône delta (675ng/g dry weight) is typical of the concentrations found in heavily-polluted areas. **PCB** concentrations in sediments are elevated (up to 228ng/g dry weight) in the vicinity of coastal industrialized zones in the Mediterranean.

Figure 3.5 Concentrations of lead (ng/g fresh weight) in selected species from the Mediterranean Sea



Source: MED POL database

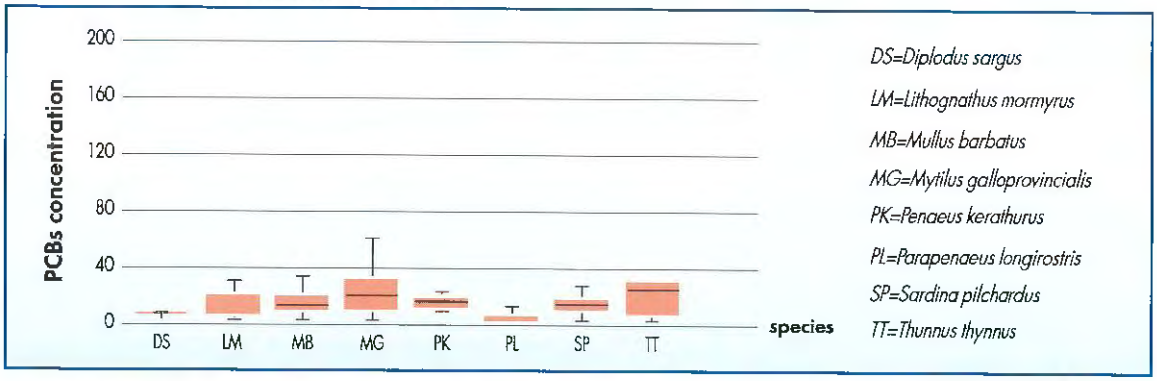
Figures 3.6 and **3.7** show the distribution of concentrations of PCBs and DDTs in Mediterranean marine organisms, based on data from the MED POL database. The values shown are lower than the pre-1987 values. The maximum concentrations of PCBs and DDTs in mussels are much lower than the permissible limits for seafood consumption (1-5mg/g) adopted in some countries (WHO/UNEP, 1995). The concentrations of PCBs and DDTs in sardines from the northwestern Mediterranean and swordfish from the central Mediterranean exceeded the values shown. Marine mammals are the most susceptible to minute concentrations of PCBs and other organochlorines in the marine environment as these contaminants are biomagnified and bioaccumulated in the food chain. Because the sea is the final destination of the bulk of the PCBs released into the environment, the fatty tissue of marine mammals contains concentrations far greater than those found in terrestrial top predators. Dolphins in the Mediterranean are among the marine mammals most highly contaminated by PCBs and DDTs and evidence exists for a link with reproductive disorders and immunosuppression (UNEP, 1996).

UNEP

3.4 Petroleum Hydrocarbons: land-based sources of oil also contribute to marine pollution

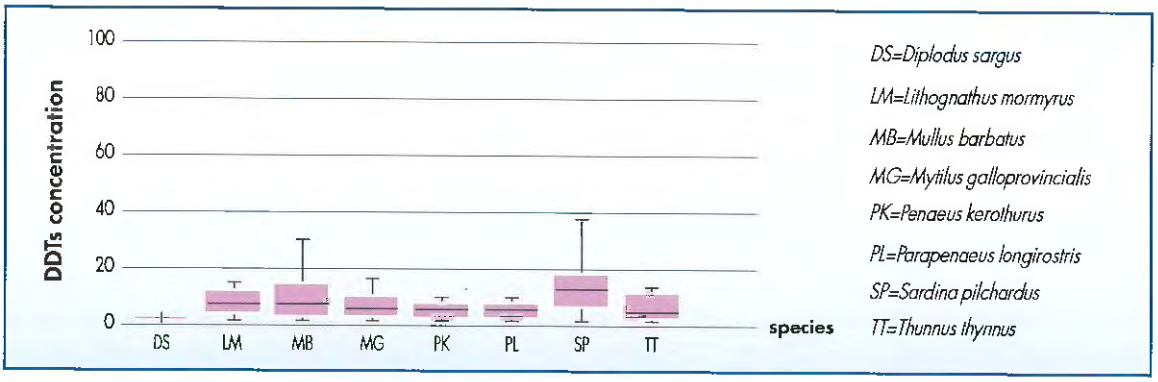
Although incidents at oil terminals account for just over one-tenth of the accidents causing pollution of the sea by petroleum hydrocarbons in the Mediterranean, these incidents, together with routine discharges from land-based installations, contribute to elevated concentrations of petroleum hydrocarbons in the marine environment around the 40 or so oil-related sites (pipelines, terminals and refineries) and at industrial outfalls scattered along the Mediterranean coast. The survey of pollutants from land-based sources in the Mediterranean, which was carried out by WHO as part of the MED POL Programme, showed that the equivalent of 12.5 metric tons of processed oil per million were discharged annually into the marine environment from 13 refineries in six countries (Albania, Algeria, Cyprus, Spain, Syria and Turkey) which submitted information during the period of the land-based sources survey. **Table 3.3** shows the annual load of oil entering the marine environment from municipal and industrial sources in a number of pollution hot spots in the Mediterranean (UNEP/WHO, 1999).

Figure 3.6 Concentrations of PCBs (ng/g fresh weight) in selected species from the Mediterranean Sea



Source: MED POL database

Figure 3.7 Concentrations of DDTs (ng/g fresh weight) in selected species from the Mediterranean Sea



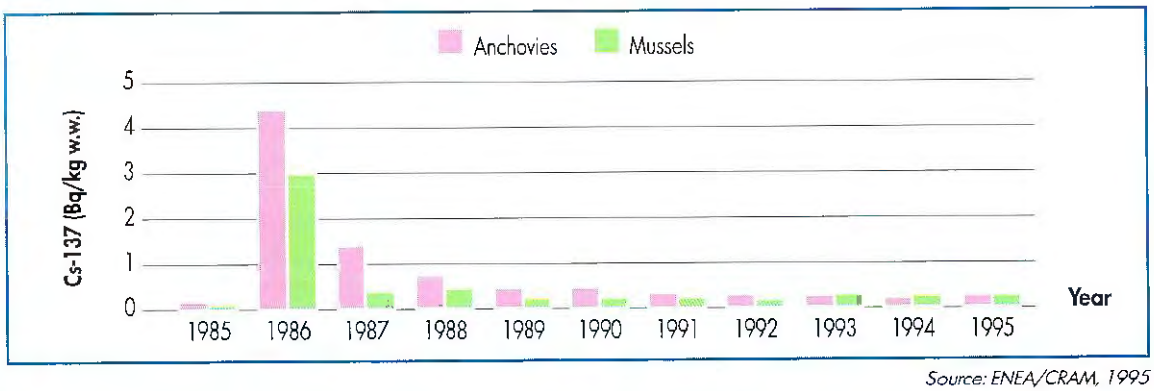
Source: MED POL database

3.5 Radionuclides: by 1988 only a few readionuclides from the Chernobyl accident remained measurable in the marine environment

The major source of man-made radionuclides in the Mediterranean marine environment is fall-out from past nuclear weapon testing and from the Chernobyl accident. The input from nuclear facilities in the Mediterranean might cause local increases in levels of radioactivity in confined areas (EEA, 1999). A rough estimate shows that the Mediterranean inventory of caesium-137 increased between 25% and 40% from the Chernobyl fall-out. By 1988, only a few radionuclides from the Chernobyl accident remained measurable in the marine environment.

Sediments on the continental shelf receiving significont inputs from river discharges usually contain increased concentrations of caesium-137 and plutonium-239, 240 (Arnaud et al., 1995). An example is the increased ^{137}Cs content of the continental shelf sediment in areas where the deposition from the Chernobyl accident on the hinterland was significant (northern Adriatic and Liguro-Provencal areos). The levels of ^{137}Cs and $^{239,240}Pu$ in open surface waters show decreasing trends. The reported concentration of ^{137}Cs in marine organisms is far below the moximum EU permitted level in food (600 Bq/kg). **Figure 3.8** shows the concentration of ^{137}Cs in anchovies and mussels of the northern Adriatic.

Figure 3.8 The concentration of ^{137}Cs in anchovies and mussels of the northern Adriatic (1985 - 1995)



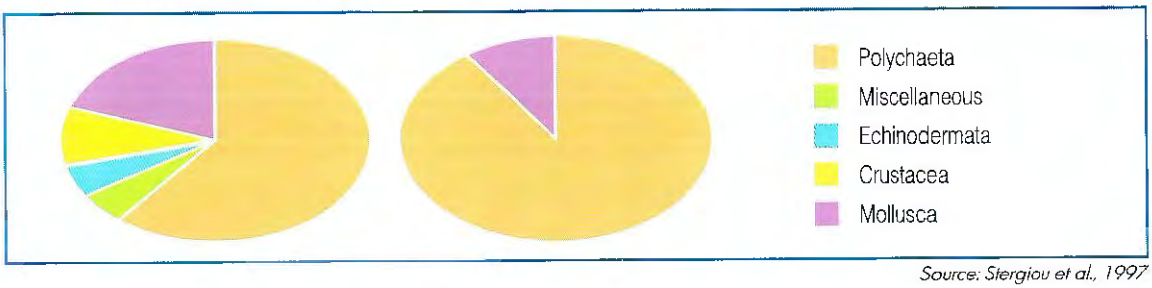
Source: ENEA/CRAM, 1995

3.6 Threatened ecosystem stability: highly diverse coastal ecosystems are more susceptible to disturbance

Development along the coast and the input of pollutants from human activities on land are sources of disturbance for coastal ecosystems, with potentially serious repercussions both in terms of loss of productivity and species diversity, as well as the loss of vital nursery and breeding grounds. Increased water turbidity and sediment transformation caused by eutrophication often lead to the disappearance of sea grass Posidonia oceanica meadows and, as a consequence, the loss of important nurseries for demersal fish. Being highly diverse, coastal ecosystems are particularly vulnerable to disturbance. **Figure 3.9** shows how disturbance caused by land-based pollution leads to a reduction in species richness of a benthic coastal community.

Competition with human activities on the coast results in habitat loss for important species, many of which are endemic and often endangered. The development of tourist facilities on sandy beaches disturbs the nesting of sea turtles. Coastal wetland loss as a result of reclamation for cultivation is a serious threat to breeding colonial sea bird species of the Mediterranean.

Figure 3.9 Benthic community composition in an undisturbed site (left pie) and a polluted area (right pie) in the eastern Mediterranean



Source: Stergiou et al., 1997

The sea is the final destination of the bulk of the organochlorines released into the environment. As a result, the fatty tissue of marine mammals contains concentrations far greater than those found in terrestrial top predators. Dolphins in the Mediterranean are among the marine mammals most highly contaminated by some organochlorines and evidence exists for a link with reproductive disorders and immunosuppression (UNEP, 1996).

4 The Response of the Mediterranean countries to the problem of land-based pollution

4.1 The initial steps in the battle against land-based pollution and recent events leading up to the present situation

As early as the 1970s, it became obvious to the countries surrounding the Mediterranean Sea that, although human activities at sea led to marine pollution, its origin was mainly to be found in land-based activities. As a result, the countries devoted particular attention to the preparation of an appropriate legal instrument to cover this aspect of marine pollution. Shortly after adopting the Mediterranean Action Plan (MAP) and the Barcelona Convention for the Protection of the Mediterranean Sea Against Pollution, the Contracting Parties adopted and signed the Protocol for the Protection of the Mediterranean Sea against Pollution from Land-based Sources (LBS Protocol).

The LBS Protocol entered into force in June 1983 and a calendar of activities for its implementation through the MED POL Programme of Monitoring and Research in the Mediterranean Sea was drawn up by the countries concerned for the period 1985 to 1995, including assessments of priority pollutants listed in Annexes I and II to the LBS Protocol, as well as the development of guidelines on various aspects of waste management covered by the Protocol. On the basis of the assessments of the state of pollution of the Mediterranean Sea by individual substances listed in the LBS Protocol, between 1985 and 1993 the Contracting Parties progressively adopted a number of Common Pollution Control Measures[1].

In the meantime, the Mediterranean States also committed themselves to the achievement of a number of environmental targets for the second decade of operation of the Mediterranean Action Plan (1986-1995) through the adoption of a formal Declaration, later named the Genoa Declaration. One of the priority targets was the establishment of sewage treatment plants in all cities around the Mediterranean with more than 100,000 inhabitants and appropriate outfalls or treatment plants in all towns with more than 10,000 inhabitants. This target was partly achieved.

The 1992 Earth Summit in Rio signalled a change in the pace of events that eventually consolidated the shift in the direction of the MED POL Programme towards action for the prevention and control of pollution from land-based activities. Shortly after the Rio summit, the Mediterranean States, desirous of giving effect to the Agenda 21 resolutions at the Mediterranean level, approved Agenda MED 21, which promotes the integration of environmental concerns into environmental policies in the Mediterranean. This was closely followed by the revision of the Barcelona Convention in 1995 to give legal status to the commitments made at Rio. In the same year, 108 countries and the European Commission adopted the Washington Declaration, a commitment to protect and preserve the marine environment from the impact of land-based activities, inter alia by giving priority to the implementation of the Global Programme of Action for the Protection of the Marine Environment from Land-Based Activities (GPA). The subsequent events in the Mediterranean in the field of land-based pollution control show that the Mediterranean countries are putting into practice the goals of the GPA at the regional level.

[1] For a list of the Common Measures adopted by the Contracting Parties please refer to the Appendix, Section A.

A Focus on the Global Programme of Action (GPA)

Through the adoption of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities in 1995, 108 governments and the European Commission declared their commitment to protect and preserve the marine environment from the adverse environmental impact of land-based activities. UNEP was tasked to lead the coordination effort and to establish a GPA Coordination Office.

The GPA is designed to be a source of conceptual and practical guidance to be drawn upon by national and/or regional authorities for devising and implementing sustained action to prevent, reduce, control and/or eliminate marine degrodation from land-based activities.

The GPA aims at preventing the degradotion of the marine environment from land-based activities by facilitating the duty of states to preserve and protect the marine environment. More specifically, it is recommended that states:

Identify ond assess problems related to land-based activities, in particular:

- **their nature and severity;**
- **the severity and impact of contaminants, including sewage, persistent organic pollutants, radioactive substances, heavy metals, oils, nutrients, sediment mobilization ond litter;**
- **the physical alterations in areas of concern;**
- **the sources of degradation;**
- **the affected or vulnerable areas of concern;**

Establish priorities for action by assessing the above five factors.

Set management objectives for priority problems for source categories ond areas offected on the basis of established priorities.

Identify, evaluate and select strategies and measures to achieve these objectives.

Develop criteria for evaluating the effectiveness of strategies and measures.

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4.2 A major development in the regional legal framework: the revision of the protocol on pollution from land-based sources

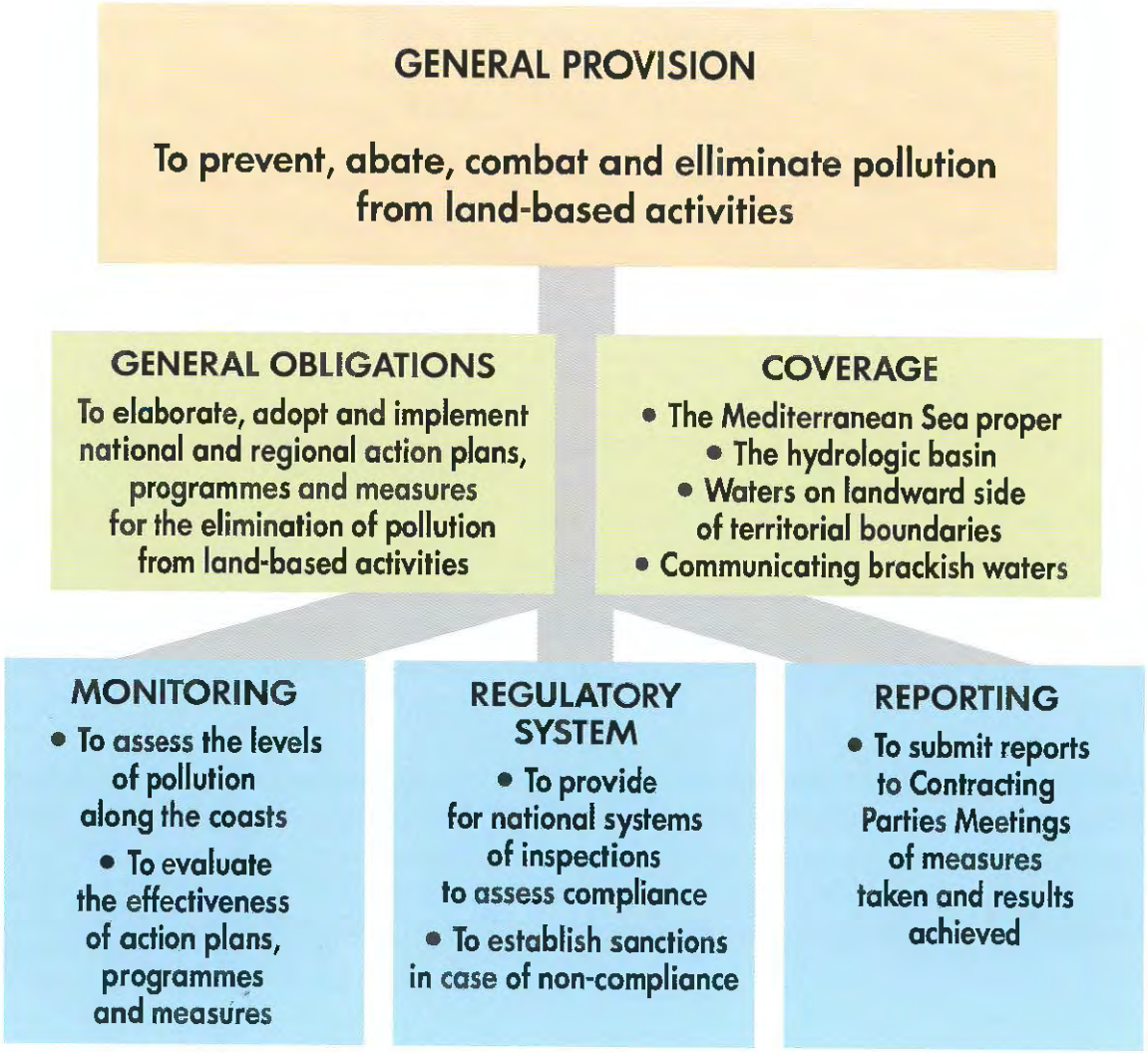
In 1996, the Contracting Parties to the Barcelona Convention signed a revision of the Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources (LBS Protocol).

Under the revised LBS Protocol, the Mediterranean States agreed to take measures to prevent and control the degradation of the Mediterranean Sea area caused by land-based sources and activities originating in their territories, including discharges from rivers, outfalls and coastal establishments. Substances that are toxic, persistent and liable to bioaccumulate are placed first in the list of priority substances to be phased out.

The amended Protocol, under the new title of "Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources and Activities" covers not only the Mediterranean Sea itself, but also the entire watershed area within the territories of the riparian states draining into the Mediterranean Sea, the waters on the landward side of territorial boundaries, as well as communicating brackish waters, marshes, coastal lagoons and ground water.

The signature of the amended LBS Protocol represents a milestone in the history of the Mediterranean Action Plan as it sets the legal framework for progression from land-based pollution assessment to taking strong action on pollution control.

Protocol for the Protection of the Mediterranean Sea Against Pollution From Land-Based Sources and Activities



4.3 A common strategy to address land-based pollution

One of the major breakthroughs in the Mediterranean countries' efforts to combat land-based pollution, which was prompted by the signature of the revised LBS Protocol, is the preparation and adoption by the Contracting Parties of a Strategic Action Programme (SAP) of regional and national activities to address land-based pollution.

The SAP is an action-oriented MED POL initiative identifying priority target categories of substances and activities to be eliminated or controlled by the Mediterranean countries through a planned timetable for the implementation of specific control measures and interventions. The SAP is the basis for the implementation of the Land-based Sources Protocol by the Mediterranean countries over the next 25 years. In addition, the SAP represents the regional adaptation of the principles and aims of the Global Programme of Action (GPA) to address pollution from land-based activities, adopted in Washington in 1995.

The key land-based activities addressed in the SAP are linked to the urban environment, (particularly municipal wastewater treatment and disposal, urban solid waste disposal and activities contributing to air pollution from mobile sources) and to industrial activities, targeting those responsible for the release of toxic, persistent and bioaccumulative substances into the marine environment, giving special attention to persistent organic pollutants (POPs).

Also addressed are the release of harmful concentrations of nutrients into the marine environment, the storage, transportation and dispasal of radioactive and hazardous wastes and activities that contribute to the destruction of the coastline and coastal habitats.

The Contracting Parties adopted the SAP in 1997 and are expected to bring it up to date and review some aspects of its operation in 2001.

The SAP has built-in scope for the review of detailed operational timetables at two to three-year intervals and a detailed work-plan and time-schedule for 2000-2001 has been prepared by the Secretariat and approved by the countries. The activities earmarked for the biennium will create the infrastructure for the implementation of the SAP and are essential in order to equip all the countries with the necessary tools (regional guidelines, strategies, plans and programmes for sharing technical information and advice, priority capacity-building and preparatory public participation activities) that will allow them eventually to fulfil their priority objectives under the SAP.

The adoption of the SAP and the initiation of activities for its implementation, even before the entry into force of the amended LBS Protocol, is a clear indication of the determination of the countries to take concrete action to combat land-based pollution and at the same time contribute to maintaining and restoring marine biodiversity, safeguarding human health and promoting the sustainable use of marine living resources.

A Focus on Persistent Organic Pollutants (POPs)

Toxic substances that threaten wildlife and people

Persistent Organic Pollutants, otherwise known as "POPs", are organic chemical compounds that are very resistant to natural breakdown processes and are therefore extremely stable and long-lived. Plants and animals absorb POPs from water or food much more efficiently than they can excrete them, resulting in o steady increase in contamination over their lifetime. This is known as bioaccumulation. Predators accumulate into their fatty tissue all of the POPs taken in over the lifespan of all their prey. This process, which is known as biomagnification, can deliver remarkably high concentrations of some POPs in top predators even if the levels in the surrounding physical environment (such as seawater) are quite low. POPs have been associated with a wide range of toxic effects on wildlife ranging from developmental abnormalities to reduced resistance to disease, leading to dramatic population losses, and are suspected of causing a broad range of adverse health effects in humans. POPs tend to pass easily into the atmosphere when they are exposed to the environment and can travel long distances very quickly. As a result, they can be found all over the world regardless of where they are used.

Most POPs do not occur in nature but are synthetic chemicals produced by industry or released as a result of industrial, agricultural or other human activities. There are numerous POPs that pollute the environment. Twelve of them have given rise to particular concern because of long-standing worries about their high toxicity. These 12 POPs are all chlorine-containing compounds thot belong to a class of chemicals known as organochlorines. All 12 have also recently been identified as orendocrine disruptorsor, interfering with the natural signals hormones send to receptors throughout the body. They include dioxins and furans, which are produced as unwanted by-products of a number of industrial processes, PCBs and hexachlorobenzene (HCB), which hove several industrial uses (hexachlorobenzene is also a pesticide) and are also formed as unwanted by-products, and finally a number of first generation pesticides (DDT, chlordane, heptachlor, aldrin, dieldrin, endrin, toxaphene and mirex).

In Article 6 of the Barcelona Resolution on the Environment and Sustainable Development in the Mediterranean Basin, which was adopted by the Contracting Parties in 1995, the Mediterranean countries agreed to eliminate the greatest possible number of toxic, persistent and bioaccumulative organohalogen compounds by the year 2005.

The objective of the Strategic Action Progromme in dealing with the problem of POPs in the marine environment is to reduce and/or eliminate emissions and discharges of POPs that threaten to accumulate to dangerous levels in the marine and coastal environment while giving immediate attention to finding and introducing preferable substitutes for the 12 organochlorine compounds. In adopting the targets of the SAP, the Mediterranean countries hove also made a commitment to use cleaner production processes, including best avoilable techniques, to reduce and/or eliminate hazardous by-products associated with production, incineration and combustion (e.g. dioxins, furans, hexachlorobenzene, polycyclic aromatic hydrocarbons (PAHs)) and to promote the use of best environmental practice for pest control in agriculture and aquaculture.

A global binding Treaty to phase out POPs will be signed by more than 120 Governments in May 2001 in Stockholm, Sweden. It aims to put an end to the manufacture and use of the 12 orgonochlorines, in addition to eliminating existing stocks.

Bringing the MED POL Programme closer to the spirit of the amended LBS Protocol

In the first and second phases of MED POL (1975-1995), the coastal states participated in a Mediterranean research and monitoring programme and eventually designed and implemented marine pollution national monitoring programmes. At the same time, research provided continuous new information on the state of the Mediterranean Sea and contributed to an improved understanding of the effects of pollutants. In1996, MED POL entered its third phase. Known as the Programme for the Assessment and Control of Pollution in the Mediterranean Region (1996-2005), or MED POL Phase III, the third phase of MED POL combines the experience gained from the two previous phases with the new concepts for assessment, prevention and elimination of marine pollution set out in MAP Phase II which, in line with UNCED and Agenda 21, focuses on activities that contribute to sustainable development. By placing greater emphasis than in the past on pollution control, the countries have brought the programme closer to the spirit of the amended LBS Protocol. **This is presently being achieved in practice by giving priority to activities that are directly linked to the implementation of the SAP, in effect also contributing to the implementation by the Mediterranean countries of the goals of the GPA. The MED POL component plays an essential coordinating role in this connection.**

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Providing the scientific basis for the implementation of the LBS Protocol

Through the continuous assessment of pollution-related problems, MED POL Phase III provides the Mediterranean countries with the scientific basis and the rationale for the implementation of the amended LBS Protocol. The assessment component of MED POL Phase III is designed to assist the countries to take measures to combat marine pollution, particularly from land-based sources, by providing them with appropriate information to identify the sources and loads of pollution, the levels and trends of contaminants and to assess potential threats to the Mediterranean environment. A new type of monitoring introduced in the third phase of MED POL aims to provide the countries with a tool for assessing changes in the environmental levels of chemical contaminants over time with a given degree of confidence. This is known as trend monitoring. To achieve this, the trend monitoring programme must be designed in such a way as to minimize variations from other sources of change such as biological and environmental variables and variables in analytical methods. **When this type of monitoring takes place in areas under the direct influence of pollution sources, the countries can assess the efficiency of national pollution control measures.** Trend monitoring in MED POL Phase III involves coastal zone trend monitoring, trend monitoring in pollution hot spot areas, trend monitoring of loads and trend monitoring of biological effects.

Effective pollution control needs to be backed by a **compliance monitoring** programme to assist countries in determining whether there is compliance with their regulatory provisions for pollution control for any given activity. The data obtained are used for making decisions as to whether appropriate enforcement measures should be imposed. The Mediterranean countries carry out compliance monitoring of bathing waters, aquaculture waters and seafood for health-related pollution control, as well as on urban and industrial effluents and at hot spots to determine whether there is compliance with their environmental quality objectives.

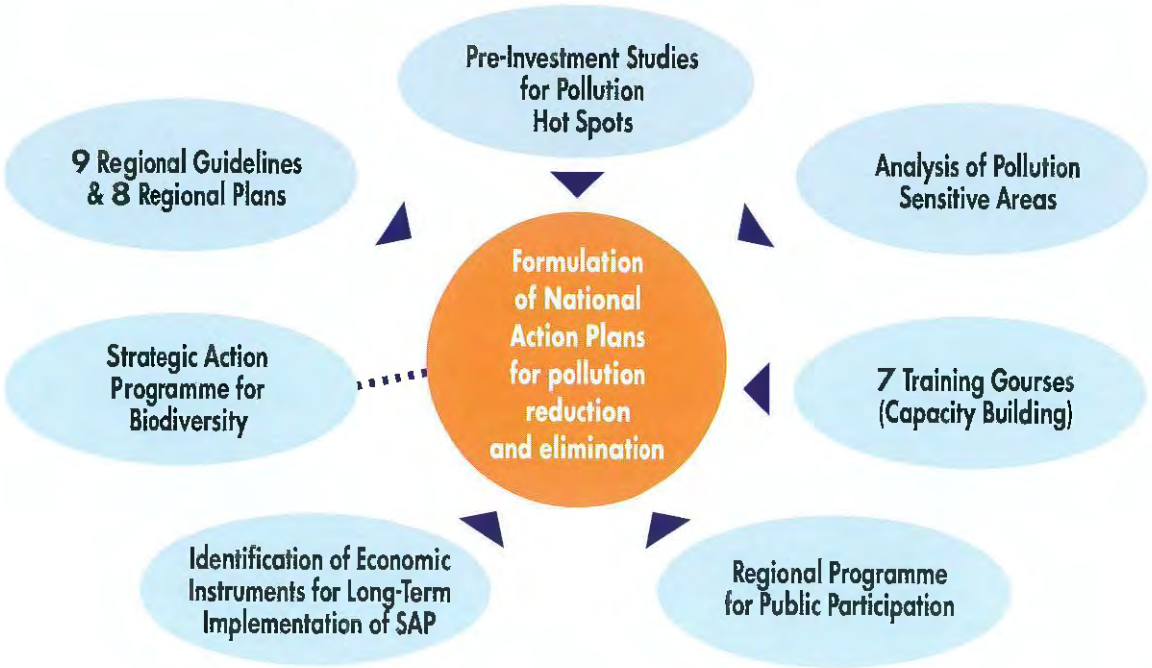
4.4 Preparing the groundwork for the implementation of the SAP

Shortly after its adoption, the SAP was recognized by the Council of the Global Environment Facility (GEF) as an important programme that dealt directly with some of the major concerns relating to international waters. As a result of this recognition, in 1998 the GEF Council approved a three-year Mediterranean GEF Project due to start in January 2001, entailing a contribution of USD 6 million for the realization of a number of important groundwork activities for the Strategic Action Programme that are essential for the Programme's long-term success.

The Global Environment Facility (GEF) and the Mediterranean

The Global Environment Facility (GEF) provides grants and concessional funds to eligible countries for projects and activities that aim to protect the global environment. UNEP, the United Nations Development Programme (UNDP) and the World Bank implement it jointly. Through a GEF Project Development Facility (PDF) Grant, the MED POL Programme prepared a Transboundary Diagnostic Analysis (TDA) for the Mediterranean, which presents an overview of the perceived problems affecting the Mediterranean, including those from land-based activities, and an assessment of their relative magnitude and transboundary significance. The TDA also determines the type of interventions needed at regional and national levels to salve these problems as well as an indication of their cost. Under the same GEF PDF Grant, as part of the MED POL Programme, WHO carried out an Identification of Priority Pollution Hot Spots and Sensitive Areas in the Mediterranean. The TDA and the identification of priority pollution hot spots and sensitive areas provided a justification for the actions subsequently proposed in the SAP, whose preparation was, in effect, the main purpose of the GEF PDF Grant.

MED GEF Project outputs (2001-2003)



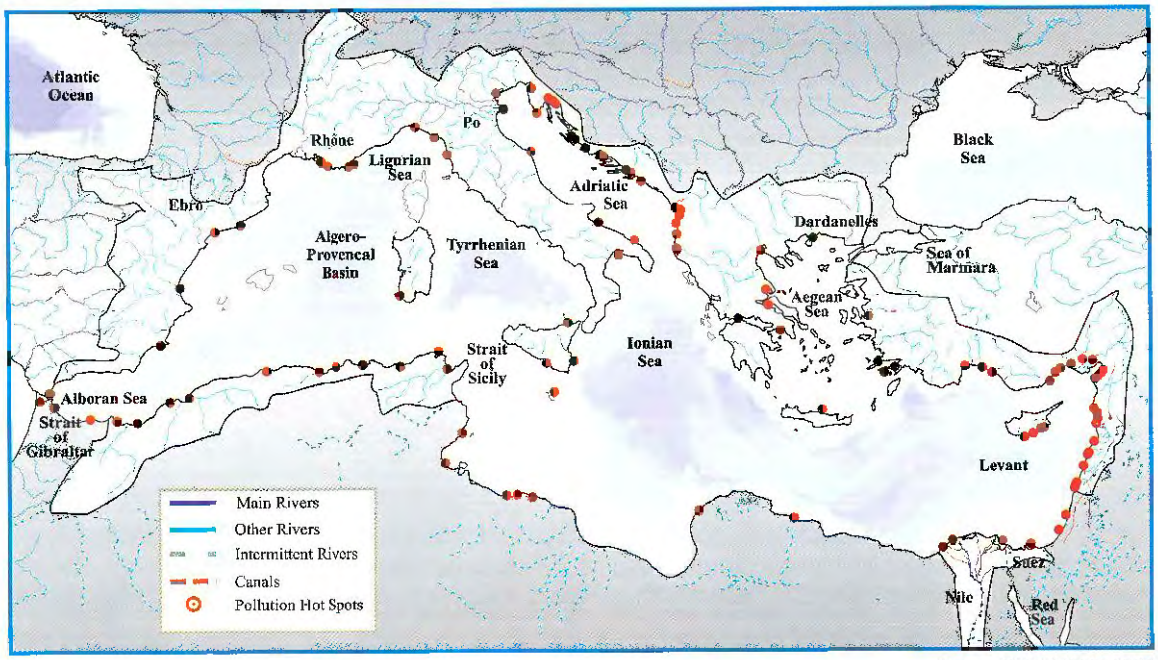
The development of National Action Plans

The National Action Plans (NAPs) are intended to follow on from the adoption in each country of all the targets and activities of the nationally relevant components identified in the SAP. Funds from the Mediterranean GEF Project will be used to support national inter-ministerial committees for the development and implementation of NAPs in 12 eligible countries. The implementation of country-specific National Action Plans to combat pollution from land-based activities is the operational long-term output of the SAP.

Investments in environmental measures for pollution hot spots and sensitive areas

One of the most important components of the SAP which is expected to lead directly to a reduction in polluting inputs to the Mediterranean Sea from land-based activities is the package of actions that accompany the evaluation of the impact of pollution hot spots **(Figure 4.1)** and the environmental audit of pollution-sensitive areas (i.e. those areas of natural or socio-economic value at risk of becoming future pollution hot spots) in the Mediterranean, taking into consideration their regional and trans-boundary significance.

Figure 4.1 The distribution of the identified Mediterranean pollution hot spots



Source: UNEP/MEDU, 1999

Pre-investment studies will be conducted in the most important hot spots and detailed environmental assessment reports will be prepared in the most important pollution sensitive areas from a regional perspective. This will lead to investment by countries and donors in projects aimed at eliminating or reducing transboundary pollution from the priority hot spots, as well as in environmental protection projects and comprehensive integrated management plans in the selected pollution-sensitive areas. GEF funds will be used for the preparation of pre-investment studies in GEF eligible countries.

The development of economic instruments for the sustainable implementation of the SAP

Recent experience in coastal management projects in Mediterranean countries shows that applying economic instruments greatly contributes to effective environmental protection and pollution control. When the costs for the SAP remedial actions are considered **(Table 4.1)**, it becomes evident that the success of the SAP will largely depend on the sustainable financing of its individual components on a national level. The goal of the Secretariat is to develop administrative, legal and fiscal mechanisms for the sustainable financing of the SAP and to assist the governments in implementing these mechanisms by adapting them to meet their national requirements. This will involve setting priorities for financing and mobilizing the financial community and international donors. In a first stage, pilot projects will be implemented in six Mediterranean GEF eligible countries.

Table 4.1 Estimated costs of pollution remedial actions for the SAP

	Estimated cost (million USD)
Hot Spots	6,453.00
Sensitive Areas	195.25
Cities (air pollution, transport, solid wastes, etc.)	2,800.00
Capacity Building	13.00
National Action Plans	11.2
Clean Production	460.7
Monitoring and Enforcement	37.14
Information and Public Participation	2.98
TOTAL	**9,973.27**

Source: UNEP/MEDU, 1997

Guidance in setting the administrative, legal and technical groundwork of the SAP

Setting the administrative, legal and technical groundwork for the implementation of the SAP by the countries is effected through regional guidelines and plans, which should be integrated into the National Action Plans. Funds from the Mediterranean GEF project have been allocated for their preparation. The selected guidelines and plans address those processes and activities for which the MED POL Programme has identified the need for further assistance, including sewage treatment and disposal, disposal of urban solid wastes, industrial wastewater treatment and disposal, riverine and estuarine pollution monitoring and environmental inspection systems. A number of guidelines and plans are intended to strengthen the technical capacity of the countries to take on board the principles introduced by the amended LBS Protocol such as the application of clean technology and best environmental practice[2].

Strengthening country competency to combat land-based pollution

In addition to adequate financial and technical resources, combating pollution from land-based activities also requires specific competencies in areas such as environmental policy formulation and enforcement, scientific capability in the assessment of pollution, for example, river pollution monitoring, as well as technical and managerial capabilities for the implementation of clean production techniques and environmentally-sound technologies such as the proper operation and maintenance of wastewater treatment facilities. The SAP makes provision for a series of regional training courses for trainers with a view to enhancing the capacities of Mediterranean

[2] For a list of the SAP regional guidelines and plans please refer to the Appendix, Section B

countries in the above fields as well as assisting countries to overcome existing inadequacies. Funds from the Mediterranean GEF project will support a number of SAP training courses earmarked for 2001-2003. Modern training techniques are deployed and the training package delivered to the trainers at the end of regional courses includes transparencies and explanatory notes in hard copy and software forms, prepared in a way that facilitates translation and desk-top publishing in any of the Mediterranean languages[3].

Participation of the public in the implementation of the SAP

MAP is actively involved in the distribution of information material on all its projects and is carrying out public information campaigns and special activities to involve the public in environmental protection. It has recently set up an ambitious international infarmation and public awareness strategy that will reach out to braader audiences such as consumers, the private sector and youth, using multilingual literature and modern dissemination methods like the Internet. Funds from the Mediterranean GEF project will be used to organize a workshop in 2001-2002 on the role the public and non-governmental organizations (NGOs) in particular can play in the implementation of the SAP.

4.5 Coupling Med Pol work on pollution assessment with land-based pollution prevention and reduction at source

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The amended LBS Protocol and the SAP state as one of the general commitments of the countries the obligation to take into account the best available techniques and the best environmental practice, including clean technologies, when adopting action plans and taking measures to control land-based pollution.

Through MED POL's cooperation with the Clean Production Regional Activity Centre (CP/RAC) based in Barcelona, Spain, MAP is currently assisting businesses to turn to cleaner production by giving priarity to pollution prevention at source and the minimization of waste flows. Businesses are encouraged to adopt these alternatives as a preferable strategy to end-of-pipe treatment. Over 20 tailor-made case studies on pollution prevention have been prepared and implemented by small Mediterranean industrial enterprises in Croatia, Egypt, Israel, Lebanon, Malta, Morocco, Spain, Tunisia and Turkey.

At the same time, businesses are being informed of useful tools for the assessment of their industrial activity to detect potential apportunities for preventing and reducing pollution at source and for providing them with sufficient data to orient their policy towards cleaner practices and technology that are technically and economically viable. One such tool is known as the Minimization Opportunities Environmental Diagnosis (MOED). The CP/RAC has prepared a manual on the MOED containing a specific work methodology and guidance for experts who work in the environmental sector and intend to carry out diagnoses for businesses in Mediterranean countries.

A priority ongoing MED POL initiative that stems from the commitments under the Strategic Action Programme is ta encourage the Mediterranean countries to introduce public tracking and reporting systems for pollutants known as Pollutant Release and Transfer Registers (PRTR). A PRTR is an environmental database or inventory of potentially harmful releases or transfers to air, water and soil, as well as wastes transported off-site for treatment and disposal. In addition to collecting data from stationary sources, industries in particular, PRTRs are also designed to include estimates of releases from diffuse sources such as agriculturol and transport activities.

[3] For a list of the SAP training courses scheduled for 2001-2003 please refer to the Appendix, Section C.

A first pilot MED POL PRTR project is presently being launched in Egypt in cooperation with the Alexandria branch of the Egyptian Environmental Affairs Agency (EEAA) and ICS/UNIDO in Italy. A specified number of industries in the Alexandria region will be reporting on specific industrial activities and chemical releases and making this information available to interested parties. The successful outcome of this project is expected to accelerate the launching of similar activities throughout the Mediterranean. and soil as well as wastes transported off site for treatment and disposal. In addition to collecting data for PRTRs from stationary sources, industries in particular, PRTRs are also designed to include estimates of releases from diffuse sources such as agricultural and transport activities.

Introducing Pollutant Release and Transfer Registers (PRTRs) in Industry

The development and implementation of a PRTR system adapted to the SAP and national needs gives governments a means of tracking the generation, release and fate of various pollutants over time.
Governments agree to cooperate with affected and interested parties to develop a set of goals and objectives for the system. Accordingly, facilities releasing potentially harmful substances to air, water and soil, as well as wastes transported off-site for treatment and disposal, agree to report periodically on what was released, how much, and to which environmental media. Data would then be made availoble to interested porties.
A PRTR can therefore be an important tool in a government's overall environmental policy, providing information that is otherwise difficult to obtain on the pollution burden, encouraging reporters to reduce pollution by implementing cleaner technologies and engendering broad public support for government environmental policies.

4.6 Reinforcing Med Pol efforts in pollution control

In addition to continuing to provide assistance to countries in the preparation of compliance monitoring programmes, the MED POL Programme is introducing inspection and legislation enforcement initiatives to complement the actions for pollution control in the Mediterranean. MED POL has set up an informal regional network aimed at creating contacts and the exchange of information with regional environmental protection professionals and other networks involved in compliance.

The International Network for Environmental Compliance and Enforcement (INECE) is cooperating with MED POL in the preparation of guidelines for environmental inspectorates in the Mediterranean to assist countries in checking compliance with authorizations and regulations adopted at the national level.

Development in health-related pollution control

Concern about potential adverse health effects from human exposure to contaminated seawater and shellfish has led to the progressive development of quality criteria and standards worldwide. This concern has grown with the increased development of a combination of socio-economic factors. In the Mediterranean, common interim quality criteria for bathing waters were approved and adopted in 1985 and common criteria for shellfish waters in 1987. Closely following the developments in the region and elsewhere such as the preparation of the new EU Bathing Water Directive, MED POL has scheduled for 2001 the preparation of updated quality criteria and standards for recreational and shellfish waters. This will augment the efforts for heolth-related pollution control in the Mediterranean.

4.7 Working on an operational plan for the implementation of the SAP

The SAP is an ambitious undertaking, spanning a lengthy period of 25 years and addressed to countries with varying levels of socio-economic development, technical, scientific and administrative competencies, different cultural values and environmental priorities. To increase the prospects for the SAP's success, it is appropriate to set up from the outset a mechanism that will take on board issues such as the nature of the body that will coordinate SAP activities at the national level, the effective conveyance and assimilation of all the "support structures" of the SAP at the national administrative level, the successful dissemination and assimilation of the tasks by the local stakeholders in each country, as well as the nature of the body that will monitor the progress of all the activities being carried out in each country and the body that will evaluate the outputs. In addition, the operational plan will tackle important practical issues for achieving the financial sustainability of the SAP in the long term. Equally importantly, the operational plan will provide detailed instructions for the countries on how to address the technical concerns that are being raised in the deliberations leading to the updating of the SAP. As an example, detailed instructions will be given to the countries on how to calculate the national budgets for individual targeted pollutants and the actual pollutant reductions required on a national basis in order to reach the targets fixed in the SAP. To achieve this, the operational plan will also provide directions for the identification of the baseline values against which the pollutant reductions should be estimated. These are just some of the crucial issues that will be tackled by a SAP implementation operational plan that is currently in the process of being developed by MED POL.

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4.8 Integrating environmental concerns with development to maximize land-based pollution prevention

To optimize the campaign against land-based pollution and to integrate environmental concerns fully with as many aspects of social and economic development in the Mediterranean as possible, MED POL is working closely with the Mediterranean Commission for Sustainable Development (MSCD). Set up as an advisory body to MAP in 1996, the MCSD is a think-tank for the promotion of sustainable development policy in the Mediterranean, making recommendations to the Contracting Parties on future actions for the promotion of sustainable development in areas such as agriculture, industry, energy, transport, tourism and urban management. "Agriculture and rural development", "Desertification and soil erosion", Urban waste management", Energy and transport", "Natural risks" and "Regional cooperation" are some of the recent themes on the agenda of the MCSD.

The MCSD is presently reaching out to industry in an effort to develop a two-way dialogue with key industrial associations in Mediterranean countries in order to discuss their role in encouraging industries to adopt pollution prevention and eco-efficiency approaches and to diffuse information to their members with a view to the implementation of the SAP. The Commission is also interested in developing a regional Internet information system with links to relevant international and regional websites such as those of the CP/RAC in Spain and ICS/UNIDO in Italy in order to promote the exchange of information on sustainable industrial practices and the sharing of regional experiences of national case studies on clean production and good environmental management. Of special interest is the development of capacity- building in the field, through the training of "actors for improvement" in industry, which includes workshops for organizations managing large industrial zones, focusing on their role in promoting the application of environmental management and decision support systems at the local level.

5 Conclusions

Intense human activity on land, in the form of industrial development, agriculture and tourism, combined with increasing pressures from population growth and heavy urbanization, have their greatest impact on the coastal Mediterranean environment. While the open sea is thought to be in a generally good state, still hosting a wide diversity of marine species despite some alarming signs that land-based contaminants are exerting an adverse effect, only a very small part of the Mediterranean coastal marine environment has remained unaltered.

Pollution hot spots caused by human activities on land occur in coastal areas, often where the physical characteristics of the sea, especially shallowness and low turbulence and flushing rates, favour the retention of land-based pollutants. Eutrophication phenomena caused by the excessive input of nutrients and contamination by microorganisms, toxic, persistent and bioaccumulative substances and oil are most frequent in semi-enclosed gulfs and bays, near ports, harbours and marinas in large Mediterranean coastal cities, industrial sites and areas receiving river run-off. These clusters of aggravated pollution problems are usually persistent and therefore severe enough to pose a regional threat.

The destruction of the coastal environment caused by land-based contaminant sources and activities impacts heavily on the ecological stability of the Mediterranean marine ecosystems, both in terms of loss of productivity and species diversity and of vital nursery and breeding grounds. Competition with human activities on land results in habitat loss for endangered species. Man-made persistent toxic chemicals that are able to travel long distances are threatening the health and reproductive success of marine mammals.

The Mediterranean countries have been aware of these serious problems since the 1970s and have subsequently taken gradual steps to strengthen both the legal and the technical framework for the control of pollution of the marine environment caused by human activities on land, while addressing concerns and activities that cut across all sectors of society. In this respect, the revision of the Protocol for the Protection of the Mediterranean Sea Against Pollution from Land-Based Sources marked an important milestone in the history of the Mediterranean Action Plan, setting a definitive legal framework for progression from land-based pollution assessment to taking strong action in the field of prevention and control.

Most importantly, the Mediterranean countries moved one step further towards action to combat land-based pollution by preparing and adopting a Strategic Action Programme for the implementation of the revised Land-based Sources Protocol over the next 25 years. The MED POL Programme, known in its present phase (1996-2005) as the Programme for the Assessment and Control of Pollution in the Mediterranean Region, is playing an essential coordinating role in this direction, giving priority to activities that are directly linked to the implementation of the SAP. Through a planned timetable, the Mediterranean countries are implementing specific measures for the elimination or control of priority land-based target groups of substances and activities that are of global concern, paying special attention to toxic, persistent and bioaccumulative substances, particularly persistent organic pollutants. Through these actions, the Mediterranean countries are in effect also implementing the goals of the Global Programme of Action.

The adoption of the SAP and the initiation of activities for its implementation even before the entry into force of the amended LBS Protocol reflect the determination of the Mediterranean countries to take tangible action to combat land-based pollution, at the same time contributing to upholding and restoring marine biodiversity and safeguarding human health and marine living resources.

Appendix

A Common Measures adopted by the Contracting Parties for the control of pollution of the Mediterranean Sea

- Interim environmental quality criteria for bathing waters (1985)
- Interim environmental quality criteria for mercury (1985)
- Measures to prevent mercury pollution (1987)
- Environmental quality criteria for shellfish waters (1987)
- Measures for the control of pollution by used lubricating oils (1989)
- Measures for the control of pollution by cadmium and cadmium compounds (1989)
- Measures for the control of pollution by organotin compounds (1989)
- Measures for the control of pollution by organohalogen compounds (1989)
- Measures for the control of pollution by organophosphorus compounds (1991)
- Measures for the control of pollution by persistent synthetic materials (1991)
- Measures for the control of radioactive pollution (1991)
- Measures for the control of pollution by pathogenic microorganisms (1991)
- Measures for the control of pollution by carcinogenic, teratogenic and mutagenic substances (1993)

B Mediterranean GEF Project Regional Cooperative Actions for the SAP

Regional Guidelines

- Sewage treatment and disposal
- Disposal of urban solid waste
- Industrial wastewater treatment and disposal
- BAT, BEP and clean technologies in industries
- BAT and BEP in industrial installations that are sources of BOD and suspended solids
- BEP for the rational use of fertilizers and the reduction of nutrient loss from agriculture
- Environmental inspection system
- Ecological status and stress reduction indicators
- River and estuarine pollution monitoring

Regional Plans

- Collection and disposal of all PCB waste
- Reduction of BOD input to the marine environment
- Reduction of the generation of hazardous waste from industrial installations
- Hazardous waste management
- Regional inventory of quantities and uses of nine pesticides* and PCBs and of the manufacturing or processing industries
- Regional pollution monitoring, reporting and data quality assurance programmes for rivers
- Regional land-based pollution monitoring, reporting and data quality assurance programmes for the marine environment
- Collection of information on levels, trends and loads of pollution reaching the Mediterranean from land-based sources and activities
- DDT, aldrin, dieldrin, endrin, chlordane, heptachlor, mirex, toxaphene and hexachlorobenzene

SAP Training Programme, 2001- 2003

- Operation and maintenance of wastewater treatment plants
- BEP and clean production techniques for priority target industries
- Reporting under the LBS Protocol
- Pollution monitoring and inspection
- River pollution monitoring
- Environmental Impact Assessment

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