

## The pollution in Mediterranean : current state and looking ahead to 2030

Summary of the report by M. Roland Courteau, Senator of Aude

### I. THE PHYSICAL AND HUMAN GEOGRAPHY OF THE MEDITERRANEAN REGIONS

The Mediterranean Sea is an especially fragmented geographical area.

It is also a border zone between two worlds with markedly different politics, cultures and economies.

Both of these realities must be kept in mind when one examines the various pollutions of the Mediterranean basin and the prospects of their being remedied, for **over 80% of the maritime pollution originates on land.**

#### A. The physical geographic data

##### 1. The terrestrial environment

The Mediterranean, due to its tormented geological history, is surrounded by mountains and plateaux.

**With two consequences:**

- The highest mountain formations are located more to the north and east of the basin; as a result, these regions enjoy more favourable pluviometric conditions than the southern Mediterranean.
- Regarding the atmosphere, this mountainous relief facilitates the formation of violent winds that help transport industrial pollutants from the northern Mediterranean and northern Europe to the south.

##### 2. The maritime hydrography

The Mediterranean functions like a **gigantic "evaporation machine"** (3,130 km<sup>3</sup>/year), evaporation not compensated for by either inflowing river water (430 km<sup>3</sup>/year) nor precipitation (1,000 km<sup>3</sup>/year). This deficit is filled by water flowing in from the Black Sea (180 km<sup>3</sup>/year) and especially the Atlantic (1,520 km<sup>3</sup>/year).

**Its waters are renewed every century.**

### 3. A poor marine environment, but great biodiversity

On average, the waters' gross primary production and their biomass are inferior to those of the Atlantic Ocean.

However, the lack of mixing engenders greater transparency, which in turn facilitates photosynthesis down to a depth of a hundred metres.

**The Mediterranean Sea is one of the world's most biologically diverse regions.**

Although representing only 0.8% of the surface area and 0.3% of the volume of the Earth's oceanic waters, the Mediterranean is home to 7-8% of all known marine species (12,000 described species), with a large endemic population (25% of the total).

#### B. The ever greater weight of human geography

##### 1. Demography

Over a period of 30 years, from 1970 to 2000, **the overall population of the Mediterranean countries exploded**, growing from 285 million to 427 million. In total, this amounted to a 50% increase, rising 14% for the northern countries and 101% for the eastern and southern countries. **With two collateral phenomenon: "littoralization" and urbanization.**

##### a) Littoralization

In total, the coastal populations grew from 96 million to 145 million inhabitants, representing an overall increase of 51% (17.2% for the north and 84% for the east and south), all within a naturally limited area.

## b) Urbanization

## ■ Strong urban growth

Between 1970 and 2000, the urban coastal population grew by 10 million inhabitants in the northern Mediterranean and by **30 million inhabitants in the southern and eastern parts of the basin.**

Another characteristic of this urban development is the progressive creation of **megacities on a European scale** (Barcelona, Marseilles, Rome, Athens, Genoa, Naples, Alexandria) or a **world scale** (Cairo/15-16 million inhabitants, Istanbul/13-14 million inhabitants).

But this should not obscure the fact that the Mediterranean coast also harbours **85 cities with a population of between 300,000 and 1 million inhabitants.**

**Turkey alone is home to 12 cities of over 1 million inhabitants.**

## ■ Spontaneous urban development

In certain southern-Mediterranean countries, particularly Egypt, urban growth is out of control (even the cemeteries are built over in Cairo).

**This complicates the future deployment of antipollution installations.**

## 2. Tourism

**On 5.7% of the world's land area, the Mediterranean basin concentrates 31% of global tourism (275 million visitors).**

These tourist flows generate several types of pressure on the environment:

- **Excessive coastal urban development** in relation to the needs of the resident populations.
- **Increasing water-use tensions** resulting from very specific consumption practices (golf courses, pools, less restrictive individual use for non-residents), as well as from the **concomitance of tourist inflows and low-water periods.**

## 3. The primary sector

## a) Agriculture

In addition to **the generous use of pesticides** (still much more prevalent in the south and east

than in the north), agriculture is a source of two pollution types:

- **Chemical**, due to the unmonitored storage of banned pesticides (persistent organic pollutants) for decades. Such storage facilities are washed out by heavy rains, which then drain into catchment basins and finally out to sea.
- **Physical**, due to the presence (for irrigation purposes) of a hundred reservoir dams that block the alluvium and increase the natural erosion of the coastal zones.

## b) Fishing and aquaculture

■ Fishing is often carried out in those zones with the richest biotopes. Trawl netting destroys the sea bottom, where fish often spawn.

**The overfishing of tuna destabilizes the food chain and could be one cause of the current increase in jellyfish.**

■ Aquaculture (200,000 tonnes per year, the equivalent of all French Mediterranean catches) is the source of various pollutions (antibiotics, effluents, the transmission of epizootic diseases, domestic species escaping into natural environments).

## 4. Industry

**The Mediterranean suffers from all forms of industrial pollution:**

- *Past pollutants*

The rerelease of PCBs and POPs remaining in river sediments, the persistence of old mines, and the industrial vestiges of the Eastern countries (**Albania is a classic example, with 60g of mercury per litre of seawater recorded at one site.**)

- *Traditional pollutants*

The industrial pollutants of the northern Mediterranean's 3 great rivers (the Po, Ebro and Rhône) and the oil refinery industries (**10,000 tonnes per year of slops released by the refineries in Algeria.**)

- *Transferred pollutants*

These industrial pollutants are produced by already old industries (textiles, fertilizer, chemicals, cement, etc.) that have only arisen over the past twenty years in the south. These industrial activities are rather "dirty" and most often little monitored.

- *Future pollutants*

These are pollutants engendered by the **material equipment of the immaterial economy** (mobile phones, computers, etc.), with which the southern Mediterranean inhabitants are slowly equipping themselves, in the absence of any ad hoc legislation or recycling industries.

### 5. Maritime transport

The Mediterranean is home to dense maritime traffic through limited spaces.

Over a long period, this traffic has grown by 58%.

These risks are amplified by the characteristics of its development: the **gigantic size** of the ships that, for their own propulsion, carry petrol tanks of over 20,000 m<sup>3</sup> (equivalent to the **cargo of the Erika**) and the **ageing of the ships** in the eastern Mediterranean.

### 6. Oil drilling at sea

The Mediterranean harbours some sixty offshore exploration and drilling platforms.

With two underlying risks:

- The old age of certain installations.
- The fluid treatment operations' drift toward the sea bottom in the most modern installations.

**In a semi-closed and little mixed sea, the consequences of an oil platform accident would be much worse than in the oceans.**

## II. CONTAMINATION OF THE MARINE ENVIRONMENTS

### A. An ever incomplete knowledge

#### 1. The magnitude of the task

**Using constant means, up to 50 million years would be necessary to individually test every known molecule.**

**More realistically, if one considers the 30,000 substances targeted by the Reach programme, the current data on their toxicity remains fragmentary:**

- For 21% of these molecules, no data exists.

- For 65%, very little data exists.
- For 11%, we possess minimal information.
- **Only 3% have been fully tested.**

### 2. Unequally explored environments

For a given marine environment, the scope of the inventory or analysis of its contamination depends closely on its geographical location.

While the Mediterranean coastline is rather well watched, at least in the northern part of the basin, the coastal sea environments are less monitored and the sea depths (below 2,000 metres) have been very little explored (7% of the total surface area) and even less studied with regard to pollution.

**Even less documented are the transfer mechanisms between these three geographical zones.**

### B. The current impregnation of the marine environments by the principal contaminants

#### 1. Physical pollutions

**These are pollutions introduced by installations or activities liable to directly modify the physical quality of a coastal environment.**

In addition, **soil mineralisation**, in the event of overflowing rivers, increases the waters' turbidity and modifies the waters' composition by draining in several types of pollution.

#### 2. Chemical contaminants

The observation networks put in place allow for an initial assessment of this type of contamination in the littoral and coastal zones.

##### a) Heavy metals

In the Rhône River, in Arles and for particular flows (depending on the metal, 2-15% is dissolved in the water), **quantities of over 3,000 tonnes are reached annually.**

**However, it must be pointed out that a portion of this contribution is the result of former usages, for the rerelease of metals contained in sediments depends on their location and the magnitude of flooding.**

**But, in total, the Mediterranean's heavy metal content is not notably different from that of the world's other maritime regions.**

b) Traditional chemical contaminants

Most molecules studied belong to three groups identified as being toxic: PCBs, POPs and PAHs.

However, as has already been underlined, most of these substances present two characteristics:

- **A very high persistence in the environment due to their low bioavailability.**
- **A great faculty for bioaccumulation** due to their solubility in fats, which explains why they are often found at the top of the food chain.

This legacy explains why these pollutants are still present in the marine environment, despite their being banned or their usage being strictly limited.

### 3. Nitrate and phosphate pollutions

**The 10-year study conducted by MEDPOL on water decontamination in coastal towns of over 10,000 inhabitants demonstrates a wide variety of situations:** 31% are not served by a wastewater treatment plant (STEP).

At the regional level, there exists a marked difference between the north and the south. In the north, only 11% of towns of over 10,000 inhabitants do not have a sewage treatment system; in the south, this percentage rises to 44%.

**These results are far from being satisfactory, and in fact they conceal a much more degraded situation in the southern Mediterranean:**

- Lacking regular funding, a high percentage of the sewage treatment plants do not function properly.
- Many of these plants are only equipped for primary and secondary treatments depending uniquely on physico-chemical procedures, thereby excluding the destruction of nitrates and phosphates via biological procedures.
- The coast is usually better equipped with treatment plants than the interior, most of whose wastewaters also reach the sea.

**In total, most persons interviewed on this subject estimate that 60-80% of the southern**

**Mediterranean's inhabitants are either not hooked up to wastewater treatment systems or served by incomplete or intermittently functioning systems.**

### 4. Emerging pollutions

**The consumption of pharmaceutical products doubled between 1970 and 2002 and is expected to grow further due to the ageing population.**

**These products are little filtered by sewage treatment plants.**

A 2008 report by the Académie nationale de Pharmacie ("National Academy of Pharmacy") found that many of these specialities had both acute and chronic ecotoxic effects, particularly antibodies, anti-cancers, which can be mutagenic and reprotoxic, and endocrine disruptors (mostly contraceptives), the reprotoxicity of which is high, which reveals their cross-toxicity at doses inferior to the reference dose.

### 5. Micro- and macro-wastes

a) Coastal macro-wastes originate from household waste, tourist installations, rubbish dumps and river waste.

**The density of these macro-wastes is 40/km<sup>2</sup>, but can be greater at the outlets of large cities (Nice, Marseilles, Genoa).**

They are one cause of mortality for the marine life that ingests them (birds, whales, tortoises).

b) Questions concerning the dangers of the polymerization of the Mediterranean

Worldwide, 300 million tonnes of plastic are produced per year (compared to 5 million tonnes in the early 1950s).

This debris (around 300  $\mu$ ), very much present in the Mediterranean (115,000 to 890,000 per km<sup>2</sup>), presents several environmental risks:

- It serves as a vector of invasive species.
- It fixes persistent pollutants and transmits them to the food chain by way of phytoplankton.

### 6. Phytotoxins

The Mediterranean lagoons (which number 26) are very biologically diverse environments, but regularly suffer from the efflorescence of phytotoxins that have deleterious effects on the

lagoons' plant and animal life and on the consumers of seafood.

Certain phytotoxins (polytoxins) are emerging and have aerosol transmission routes that result in respiratory problems.

### 7. Invasive species

Today, 925 exogenous species have been identified in the Mediterranean, of which 56% were estimated permanent in a study carried out by Plan Bleu.

### 8. Hydrocarbon pollution

There are several sources of hydrocarbon pollutions:

- Accidents concerning oil tankers or the petrol contained in the tanks of other ships.
- Incidents linked to port manoeuvres.
- Chronic pollution originating from voluntary discharges (100,000 to 200,000 tonnes per year, depending on the estimate).

## III. OVERLY DISPERSED ANTI-POLLUTION GOVERNANCE

Cooperative policies have slowly been implemented over the past thirty years.

**But one paradox of this common governance is that, over time, the levels of cooperation have accumulated without this profusion of activity really reinforcing the shared solutions targeting the basin's worsening pollution.**

### A. A reminder: the states' predominant role

**The sea remains principally governed by the Mediterranean states. The same is true for Mediterranean law, essentially convention-based, the application of which depends on these same states.**

The basin's level of pollution therefore depends, first and foremost, on the domestic policies of the Mediterranean states.

However, it also depends on these states' active involvement in the basin's multilateral policies.

In both cases, it has been observed that the degrees of priority, the efforts to implement repressive regulations, and even the meeting of

obligations set down by international agreements vary not only between the north and the south and east, but also among the states of the latter geographical grouping.

## B. The beginnings of anti-pollution governance

### 1. Political governance

- a) The Barcelona Convention's Mediterranean Action Plan (MAP)

Created in 1976, MAP manages 10 anti-pollution protocols agreed to by the 21 Mediterranean states.

After thirty years of existence and despite this imposing convention-based system, MAP's assessment is mixed.

For instance, for most southern and eastern Mediterranean states, it is very difficult to procure reliable information on the pollution of their coastal environments.

- b) The intervention of the European Union

**The progressive construction of a convergent set of environmental laws based principally on directives and whose insufficient application or misunderstanding can be penalized by the European Court of Justice marked a major step forward in the domain.**

But the Union also has available other means of action, in particular:

- The *European Maritime Safety Agency*
- The *European Investment Bank (EIB)*

From 2003 to 2009, the EIB dedicated 1.5 billion euros in loans to an investment for improving the environment.

**Currently, the institution is associated with the Horizon 2020 programme, which seeks to reduce the number of "hot pollutants" in the Mediterranean.**

But its actions, while useful, are **subject to two criticisms:**

- As a bank, it only finances the most technically complete dossiers, which are not always those put forward by the countries

with the greatest need of investment in anti-pollution facilities.

- **It does not take into account the future life of the facilities** that it finances, which explains the poor functioning and maintenance of certain facilities.

c) The Union for the Mediterranean (UfM)

**The Union for the Mediterranean is currently becalmed.**

The initial political will to cooperate for the co-development of the Mediterranean has been thwarted by the territories occupied by Israel.

As a result, even technical meetings (for instance, the meeting on water in 2010) remain blocked, especially considering that all decisions must be reached unanimously.

**In order to relaunch the UfM, it is necessary to separate its political organization from its ability to take action in the area of development.**

Therefore, it is necessary to create, based on voluntary participation and the rule of a qualified majority, an "Environmental Protection Agency" that would allow infrastructure projects to make progress in this domain.

## 2. Lending research greater coherency

In the domain of marine pollution, there exist few common projects:

- Uniting French bodies.
- Uniting French bodies with their counterparts in the principal northern countries (Spain, Italy, Greece).

**While it is true that partnerships have been established within the framework of the 7th European Research Framework Programme, the Mediterranean research bodies - contrary to those of the Baltic Sea - have not gathered together before the European Commission to plead in favour of cooperative research centred on the specificities of the Mediterranean environments.**

## IV. WORRYING TRENDS LOOKING AHEAD TO 2030

**When one examines the main parameters of evolution with regard to Mediterranean pollution, they can be considered both contradictory and, taken together, a cause for worry.**

For a single positive factor – namely, the progressive strengthening of anti-pollution regulations – faces two additional factors contributing to the basin's increased contamination: **the certain progression of anthropic pressure and the effects of climate change.**

### A. Strengthening regulations

As much within the European Union (Reach circular, "Marine Environments Directive") as within France (Grenelle Environment Round Table, Grenelle of the Sea), the rules and regulations governing polluting activities are expected to be strengthened.

**But however positive this movement, it must be underlined that it also carries a risk: that of accentuating the rift between the northern Mediterranean, where polluting activities are on the decline, and the south, where progress in this domain remains fragile.**

### B. Increasing anthropic pressure

#### 1. Demographic growth

**Up until 2025, the demographic growth observed over the past thirty years along the Mediterranean basin is expected to continue in the south, although in a more moderate manner due to the decreased fertility rate.**

Its principal characteristics (more or less spontaneous littoralization and urbanization) will become more marked.

In the southern Mediterranean, the coastal population will grow from 76.7 million to 108 million inhabitants, **representing an increase of 41%.**

In addition to this increase of the southern Mediterranean's coastal population, one must consider the total increase in the population of the southern states, which is expected to grow from 235 million inhabitants in 2020 to 327 million inhabitants (+39%).

**Keeping in mind that many of the non-coastal populations' effluents empty into the sea.**

Over the same period, urbanization is also expected to progress down south: the urban population is expected to grow from 48.5 million to 77.8 million inhabitants (+60%).

## 2. Consequences

Traditionally, this growth will engender several types of environmental pressure:

- The continued mineralization of the coastal soils (facilities, housing).
- The increased production of waste (industrial, municipal, household).
- The increased annual demand for water, which is expected to grow from 290 km<sup>3</sup> to 332 km<sup>3</sup>, with a **25% progression in the south and east, even though these same regions already account for 60% of the world's water-deficient population.**

## C. Certitudes and questions regarding the effects of climate change

### 1. An accepted fact

During the 20th century, an increase in average annual temperatures of 2° C was recorded for the climate of southwestern Europe, with a more marked acceleration during the last thirty years of the century.

This warming of the atmosphere transferred to the Mediterranean Sea, whose temperature and salinity both increased down to a depth of 2,000 metres.

**This phenomenon will continue up until 2030, no matter the policies carried out.**

2. The expected effects

**A warming climate and decreasing rainfall will result in:**

- The development of environments favourable to the propagation of invasive species from the Red Sea.
- The decreased inflow of freshwater, which will also contain more pollutants.

**But other, more dangerous evolutions are expected for the Mediterranean biotopes:**

- Warming waters and rising salinities will not be uniform, neither throughout the basin nor at all depths. These changes could entail a

**modification of the Mediterranean currents**, the consequences of which are unknown for the marine environments.

- Certain scenarios predict a rise in the layer of mixed waters, which is where phytoplankton production is greatest. **This rise could threaten the proper functioning of the food chain.**
- **The acidification of the marine environment**, the progression of which in the Mediterranean parallels that of the oceans, threatens the calcification of a great many species (molluscs, crustaceans, corals, etc.). In addition, this phenomenon is more marked near the coasts and at low depths (where the Mediterranean biotopes are richest).

## PROPOSALS

### **I. UNIFY POLITICAL GOVERNANCE WITH REGARD TO FIGHTING POLLUTION IN THE MEDITERRANEAN**

### **II. ACTIVATE RESEARCH PARTNERSHIPS FOR THE MEDITERRANEAN ENVIRONMENTS**

1. Create in France a research alliance for the marine environments of the Mediterranean.
2. Institutionalize cooperation among the main research institutes of the northern Mediterranean countries.
3. Sponsor the laboratories of the southern and eastern states.

### **III. MODIFY THE CONDITIONS GOVERNING THE PROVISION OF FINANCIAL AIDS TO ANTI-POLLUTION INVESTMENTS**

### **IV. DEAL WITH THE PAST**

1. Eradicate the rerelease of products banned for decades.
2. Treat pesticide stocks.
3. Determine the age of oil platforms.

### **V. PREPARE A SOLUTION TO DEAL WITH THE DEVELOPMENT OF POLLUTIONS GENERATED BY THE IMMATERIAL ECONOMY**

### **VI. BETTER TAKE INTO ACCOUNT THE FUTURE CONSEQUENCES OF CLIMATE CHANGE**

1. Increase the research effort.
2. Implement financial instruments suited to the permanent features of climate change.

### **VII. STRENGTHEN THE FIGHT AGAINST ILLICIT HYDROCARBON DISCHARGES AND CO-OPERATION IN THE EVENT OF ACCIDENTAL SPILLS**

1. Develop the use of satellites.
2. Standardize the information systems for maritime traffic.
3. See to the application for the entire basin of those agreements providing for the installation of equipment to treat bilge water and mud.
4. Pursue initiatives for the standardization of judicial procedures and sanctions.
5. Perfect the application of cooperative agreements governing accidental spills.

### **VIII. INCREASE THE SAFETY OF MARITIME TRAFFIC IN THE MEDITERRANEAN**

### **IX. PAY PARTICULAR ATTENTION TO CERTAIN RESEARCH SUBJECTS**

1. Systematize studies on the effects of pollutants on marine environments.
2. Increase research on emerging pollutants.
3. Consider the risks of the sea's polymerization.

### **X. REACTIVATE THE POLICY OF CREATING MARINE PROTECTED AREAS**

1. In the French Mediterranean.
2. Throughout the basin.