chapter 6

Overall assessment

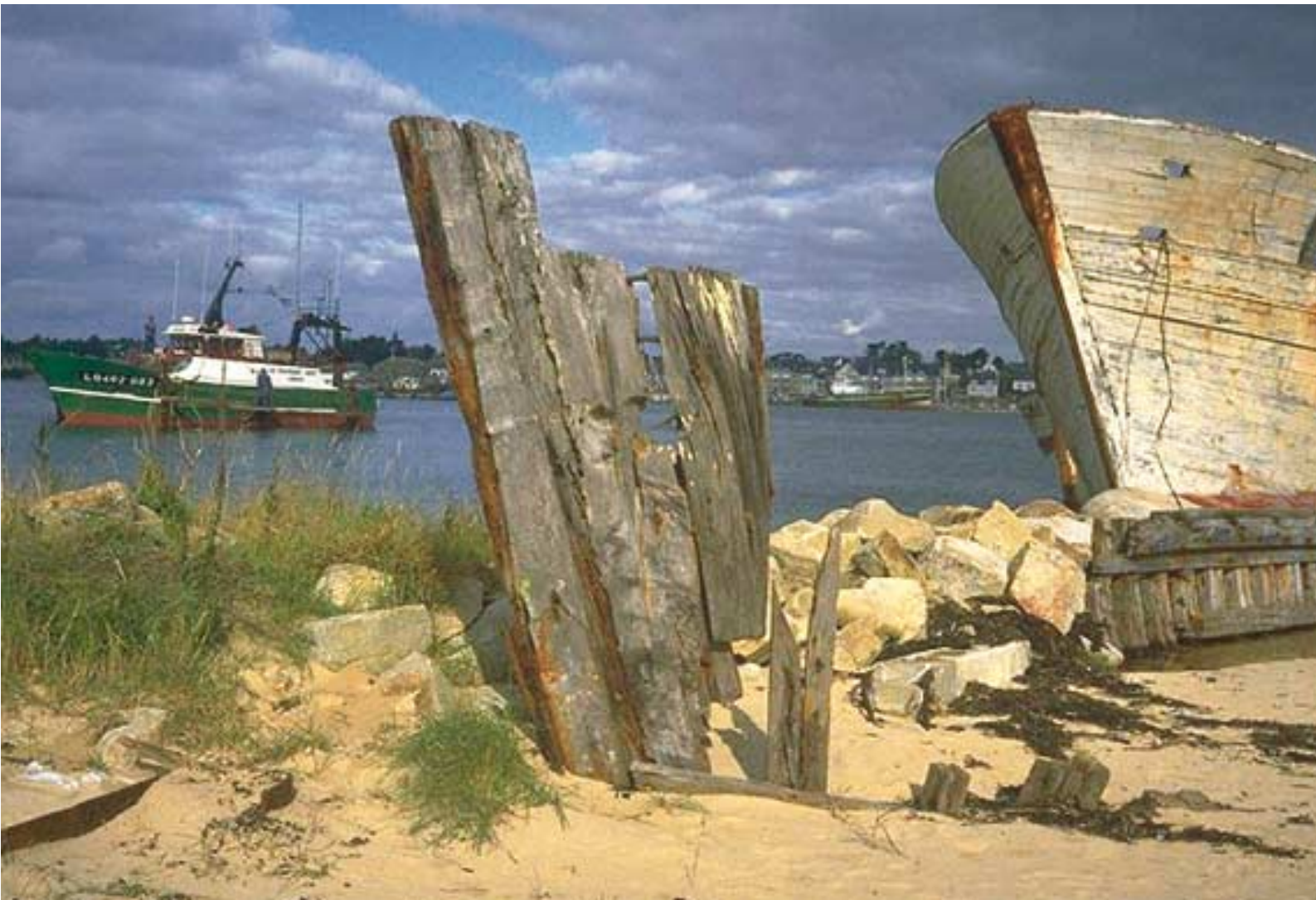
6.1 Introduction

The quality status of the open ocean and coastal zone resources of the Bay of Biscay and Iberian Coast was described in detail in the previous chapters on geography, hydrography and climate (Chapter 2), human activities (Chapter 3), chemistry (Chapter 4) and biology (Chapter 5). This final chapter presents an overall assessment of the quality status of the region.

Two general features of the region must be stressed as they influence all aspects of its character and assessment: on the one hand the lack of data and statistical information for some important human activities and their impacts, and on the other hand the naturally favourable oceanographic conditions of this part of the North-east Atlantic, with its well-oxygenated coastal waters and strong hydrodynamic processes, which have a positive influence on the ecology of the region.

The most significant features of the Region IV ecosystem are the richness and diversity of the flora and fauna. These are a consequence of:

- the biogeography, which allows a mixture of communities of boreal and subtropical origin; including at least 1000 species of phytoplankton, more than 200 species of copepod, around 700 species of fish and 28 species of cetacean;
- the diversity of the substrates and the variability of the topography which together result in a wide range of coastal habitats; and
- the high productivity of the coastal areas, enhanced by processes such as seasonal upwelling, jets and filaments and coastal runoff.



6.2 Assessment of human impacts

With regard to the impact of human activities on water quality and on the marine and coastal environment, thirteen issues were identified and assessed to varying degrees in the previous chapters. Expert judgement was used to prioritise these issues into those of high, medium or lesser importance, taking into account:

- evidence of the direct impact of human activity;
- the degree of degradation, from the large scale to the impact in local areas; and
- the level of public concern and its potential for boosting remediation policies.

6.2.1 Issues of high importance

Fishing

Region IV includes ICES Fishing Areas VIIIa, VIIIb, VIIIc and IXa and has traditionally been an area of intensive fishing activity, particularly with the expansion of engine-powered vessels and trawling over recent decades. The region has a wider variety of fish, shellfish and molluscs of commercial interest than more northern areas. Region IV is also an important nursery ground for hake, sardine, horse mackerel and blue whiting.

The extent to which natural and anthropogenic variability affects future generations of a particular species varies according to aspects of its life cycle, such as whether it has a short or long life span, for example although population fluctuations are more common in short-lived species, they are more persistent in those species for which different cohorts occur within the environment simultaneously.

Synchronous oscillations, such as the NAO, have been related to fluctuations in the recruitment index and abundance of albacore and bluefin tuna, and the intensity of upwelling within the French coastal areas of the Bay of Biscay and along the Iberian coast has a significant relationship with anchovy and sardine recruitment respectively. Sardine recruitment is also influenced by the Gulf Stream and the NAO.

Increasing sea water temperatures appear to be responsible for the appearance of tropical fish along the Iberian coast and the south-eastern shelf of the Bay of Biscay. Several tropical species (*Cyttopsis roseus, Zenopsis conchifer* and *Sphoeroides pachygaster*) have been caught throughout Region IV. During the last few years there seems to have been a change in the distribution of pelagic fish species; this occurred at the same time as the decline in the biomass of sardine stocks.

Measures

Fisheries management tools for the sustainable use of marine living resources include a progressive and significant reduction in fishing fleets, the establishment of TACs for certain species/stocks, and the adoption of technical measures to protect spawning grounds and juveniles and to avoid discards and catches of undersized fish. Taking into account the current depletion risks for several stocks, application of the precautionary approach is recommended, together with further research on ecosystem dynamics and the use of the ecosystem approach for fisheries management, in order to get a better integration of environmental policies and fisheries management.

Concerns

Several fish stocks in Region IV – sardine, hake, anglerfish, some megrims, and migratory species such as bluefin tuna and swordfish – are outside safe biological limits for sustainable fisheries (ICES, 1998). This is due to the combined effects of overfishing and the adverse effects of some natural processes on the recruitment and abundance of these resources.

Fleets operating gear with a low selectivity catch significant quantities of juveniles. As in other areas, these undersized fish are discarded. The extent to which this occurs is difficult to quantify.

Fisheries cause significant mortality. Their main effect is therefore to reduce the abundance and alter the composition and productivity of the resources targeted. This can be quantified to some extent by sampling the landings. Fishing also reduces the average age and size of the fish in the stocks, as increased mortality lowers the probability of any individual fish reaching old age.

Catches of hake, the main demersal fish species targeted in Region IV, comprise about 75% juveniles, which correlates with the poor state of the adult stock. Owing to the intensification of fishing activities since the mid-Nineteenth Century, several low fecundity elasmobranchs which were previously common are now virtually absent from the southern Bay of Biscay.

For the main fish stocks the effects of discarding can be assessed using models, but are much less clear for the other components of the ecosystem. Discards may enhance the provision of food for birds, demersal fish or benthic scavengers such as crustaceans and starfish. Discards may also alter the structure of benthic communities in favour of the scavengers.

Bottom trawls generate the most discards due to their use in mixed species fisheries and the low selectivity of the gear. The average discard rate for this fishery is about 50%, ranging from 35% in ICES Division VIIIc to 59% in ICES Division IXa. Gillnets have an average discard rate of 25% and long lines only 9%. Pelagic trawl fisheries are mainly conducted by French vessels and the target species (anchovy, sardine, hake) usually represent a large proportion of the catch, although discard rates are consistently high (up to 100%) for Atlantic horse mackerel which has a low

value in France, in contrast to the situation in Spain and Portugal.

The species discarded in the greatest numbers in ICES Fishing Area VIIIc is the small fish silvery pout with the medium-sized blue whiting second in importance, representing 33% of the total weight caught and 22% of the total discarded. Both species are dead when discarded.

Climate change

The International Panel on Climate Change predicts a global rise in sea level of 25 – 95 cm (the most likely rise being around 50 cm) by 2100.

Coastal erosion and salt water intrusion into estuaries, coastal lagoons, wetlands and groundwater, represent a true degradation of the coastal environment, which is often irreversible. These effects could increase if sea levels continue to rise and especially if this rise accelerates. Impacts associated with the predicted sea level rise include enhanced coastal erosion, with the consequent flooding of extensive areas of lowlands and wetlands. Salinity in major estuaries and bays, as well as some aquifers, will increase and together with coastal erosion will cause major changes in important habitats for birds and fish.

Concerns

Over future decades it is likely that coastlines will retreat significantly in many areas and that there will also be a perceptible, permanent increase in submerged land and an increase in salt water intrusion.

Other global changes, such as air-sea gas exchanges and sea surface warming, may cause fluctuations in the NAO or changes to the coastal upwelling regime that may in turn affect the distribution, recruitment and abundance of marine species.

Sea surface warming seems to be related to the appearance of tropical fish species along the Iberian coast and the southern shelf of the Bay of Biscay.

6.2.2 Issues of medium importance

Microbiological pollution

Discharges of sewage (treated and untreated) in coastal areas, particularly estuaries, rias and coastal lagoons, affect coastal water quality. Bacteria and viruses, mainly attached to fine particulate matter, influence bathing water quality and can also accumulate in filter-feeding shellfish leading to microbiological contamination.

Measures

Data from monitoring programmes undertaken in France, Portugal and Spain in 1997, in compliance with the EC Directive on Bathing Water Quality, reveal that 87 to 95% of bathing waters were of good or fair quality. Bad water quality is currently associated with beaches near major urban sites. Where standards are not being met, action is being taken by the responsible authority within each country to improve the bacterial quality of the bathing water.

Data from monitoring programmes in shellfish farming areas, in compliance with the EC Directive on Shellfish, reveal that a small proportion of these are of good microbiological quality (Class A), a large proportion are of fair quality (Class B) and a very small proportion are of bad quality (Class C or Forbidden).

As bad quality shellfish production waters occur near outfalls discharging domestic wastewater, urban wastewater treatment plants must be improved in order to achieve the objectives of the Urban Waste Water Treatment Directive.

Marine biotoxins/harmful algal blooms

Some phytoplankton species produce potent neurotoxins that accumulate in filter-feeding shellfish and cause the toxic syndromes PSP, DSP and ASP in human consumers. There are also species which produce toxins that affect caged fish and wildlife, and non toxic species that are noxious at a high biomass. The presence of harmful phytoplankton species in sea water is clearly a cause for concern. There is no good scientific evidence linking anthropogenic activities to their occurrence, but anthropogenic inputs may influence species composition or levels of biomass. Public health authorities are aware that phytotoxins can accumulate in the edible tissues of bivalve molluscs (e.g. mussels) to levels that are dangerous to the human consumer.

Measures

In compliance with the EC Directive on the quality control of water dedicated to shellfish cultivation, France, Portugal and Spain have each established a biotoxin monitoring programme as a basis for closure orders when levels of toxins in shellfish exceed the legal standards.

Concerns

There has been an apparent increase in the frequency and intensity of toxic algal episodes in Region IV with acute shellfish toxicity resulting from the following groups of biotoxins: domoic acid (an amnesic toxin resulting in ASP), okadaic acid and derivatives (diarrhetic toxins resulting in DSP) and saxitoxin-related toxins (paralytic toxins resulting in PSP).

Those phytoplankton species resulting in shellfish toxicity are in some cases components of the natural phytoplankton communities of the region, such as *Dinophysis acuta* and *D. acuminata* (DSP), and *Alexandrium minutum* (PSP), while others, such as *Gymnodinium catenatum* (PSP) and *Pseudo-nitzschia*

australis (ASP), have only been recorded recently and have probably been introduced to the region through ballast water from ships.

Intensive monitoring of phytoplankton and shellfish in shellfish production areas is essential in order to guarantee seafood safety and to protect public health and aquaculture resources.

There is a need for further research on toxicity and detoxification processes, phytoplankton bloom dynamics and their relation to oceanographic events, and on inputs of nutrients and organic matter of anthropogenic origin.

Tributyltin

Tributyltin pollution in Arcachon Bay, the first case of which was reported worldwide, is an example of dispersion-induced chemical contamination that has had a major impact on oyster production. In Arcachon Bay, the consequences of the TBT pollution are comparable to those resulting from previous incidents of parasitic epizootic diseases. In 1981, the cessation of all oyster farming activities was officially considered.

Exposure to TBT, derived primarily from antifouling paints, produces distinctive responses in various organisms, notably oysters and dogwhelks; female dogwhelks develop male sexual characteristics, which in severe cases can lead to sterilisation and detrimental effects at the population level. This phenomenon is known as imposex.

In 1996, a survey of TBT effects in dogwhelk from coastal areas off north-western Spain found significant levels of imposex in the industrial bays and estuaries investigated. Female sterility was found in almost all the samples, although the population was not at risk of extinction. Significant levels of imposex in dogwhelk have also been reported in Portugal, but without female sterility.

Measures

The understanding of TBT toxicity has improved considerably since the 1970s when TBT was first used in antifouling paints. The contamination of coastal waters by organotin compounds continues to be problematic; certain areas within harbours are still significant sources of contamination, with concentrations in water occasionally 200 times greater than the EAC. This contamination extends beyond the harbour areas and can affect natural mollusc populations as well as cultivated species.

Regulations concerning TBT have contributed to obvious improvements in regions where they have been properly applied. In particular, they have enabled a resumption of oyster farming. However, these regulations are to an extent limited, firstly because of their geographically sporadic application and secondly because other maritime activities (commercial, fishing or military) continue to contribute to excessive residual contamination. Numerous coasters, fishing vessels and ferries still use organotin-containing antifouling paints.

Early EC limitations on the use of tributyltin oxides in the framework of Directive 76/769 have recently been extended under Directive 99/51/EC to include total bans on use on boats in inland waterways and lakes in any free association with antifouling paints. The Community position is that the remaining use of some TBT in ocean going vessels is addressed more appropriately at IMO. Within the IMO, a general ban on organotin compounds in antifouling paints is being prepared in order to prohibit the application from 2003 and the presence of TBT on ship hulls by the 2008.

Concerns

The extent of the biological impacts observed indicate that the EC Directive regulating the use of TBT-based paints has not been effective in reducing TBT contamination, thus suggesting that the local sources are mainly larger merchant and fishing vessels, to which the current legislation does not apply.

Close attention should be paid to gathering and treating careening waste. Cleaning ship hulls by sand-blasting or by high-pressure water systems will remove toxic wastes. Harbour dredging should be monitored with great care. High concentrations of dissolved organotin compounds measured within harbours are on a par with their presence in highly contaminated sediments stirred up during dredging operations.

Coastal development

As is the case for the other OSPAR Regions, the human population in Region IV is concentrated in coastal areas, creating increasing conflict between the exploitation of natural resources and the consequent development and the need for nature conservation. The main pressures are as follows:

- a high population density and intense economic activity – approximately 36.6 million people live in the coastal areas adjacent to Region IV, and this is also where most of the economic activities and industries are located;
- high inputs of urban wastewater;
- significant changes to the morphology of the coastline – sand and gravel extraction, a reduction in sedimentary flows in rivers, as well as dredging in the main estuaries and in shallow coastal waters, have accelerated erosion in many sensitive sectors of the coastline. In some cases the regeneration of sandy beaches and the construction of artificial structures such as spurs and rock walls have been used as temporary measures to protect the shore. Over occupation of the coastline, mainly related o the expansion of urban areas, has led to the destruction of large areas of dunes and cliffs and to the consequent retreat of the shoreline, with the sea subsequently invading important agricultural areas;

- changes to the major drainage basins – dams and dredging have decreased the natural flow of sediments into the coastal zones and even to the continental shelf. The storage capacities of many rivers have been significantly regulated. Dams have interrupted the supply of sand particles to the ocean, contributing to erosion phenomena in coastal areas. Conversely, reduced river run-off due to agricultural irrigation practices can affect coastal mariculture (e.g. as has been the case for the Charente river); and
- the silting of estuaries and coastal lagoons – continuous changes to the coastline cause the silting of coastal wetlands. These areas are among the most productive in biological terms and increasing sedimentation causes these ecosystems to collapse (lagoons gradually become smaller, water quality decreases and the wetland eventually disappears).

Measures

Many of these conflicts could eventually be reduced by adopting and implementing a Code of Good Practice for Coastal Zone Management. Such a code would enable the identification of sensitive coastal areas and the adoption and implementation of measures to minimise human impact, including the enforcement of the EC Urban Waste Water Treatment Directive.

Concerns

The global rise in sea level is already affecting some coastal areas in Region IV.

Litter

The impact of marine litter on cetaceans and sea turtles, mainly plastic bags and other debris, has already been reported. Plastics represent 60 to 95% of marine litter.

Recent regional studies have shown the presence of marine litter along the coasts of Spain and France, with a particularly heavy occurrence along the coast of the French Basque Country during winter. A pilot project to establish assessment methodologies is under way in Portugal.

In terms of the larger sized items of marine litter, operations to collect floating items near the shore should be promoted in order to avoid them drifting further offshore. Approximately 80% of marine litter washing up on beaches comprises driftwood and other natural materials, for the remaining 20% (household waste) land-based collection schemes remain a priority.

Measures

Annex V to the MARPOL Convention, which entered into force December 31 1988, defines rules for the prevention of pollution from marine litter and, in particular, prohibits the ocean disposal of all plastic material. An amendment in effect since 1995 requires all ships of a tonnage equal to or exceeding 400 tonnes, and for those transporting more than 15 people, to file a waste management plan. The application of MARPOL Convention rules should be improved and better prevention of litter disposal in the catchment areas is recommended.

6.2.3 Other important issues

Heavy metals

The highest contaminant concentrations and their geographical distribution in sea water, sediments and biota, reflects the presence of urban and industrial sites in the coastal areas. These high concentrations are mainly found in estuaries, rias and semi-enclosed regions, due to their low flushing rates and to the high levels of urban and industrial activity in such areas.

The accumulation of contaminants in organisms depends on the quantities ingested and on the existence and effectiveness of specific detoxifying mechanisms. In the case of trace metals these mechanisms include metal-lothioneins.

The highest mercury concentrations in wild mussel were found in the Ria of Pontevedra and in the most cont-aminated areas of the Ria of Aveiro and the Tagus Estuary, where different industrial sources of mercury can be identified.

High lead concentrations in mussel and in peppery furrow shell were found in sea areas close to industrial or highly populated regions such as Vigo, Gijón and Bilbao, or the mouth of the Guadalquivir River.

High levels of cadmium were observed in mussel from industrialised sites of Bilbao, in Portuguese oysters from the upper Sado Estuary and in wild mussel at sites remote from urban and industrial areas on the west coast of Galicia.

Portuguese oysters from the upper Sado Estuary and the Guadalquivir Estuary are highly contaminated by copper. These very high concentrations are due to residues from mining activities enhanced by the peculiar physiology of this species. For these reasons, Portuguese oysters from these areas should not be consumed.

Metal concentrations in surface sediments are generally low to moderate. Concentrations above the EACs have been found in sediments from confined sites of the urban and industrial areas of Bilbao, (mercury, cadmium, lead and copper), Gijón (mercury, lead, cadmium and copper), Pontevedra (mercury), Vigo (lead), the Aveiro and Tagus estuaries (mercury, lead and cadmium), Huelva (mercury, cadmium, lead and copper) and the mouths of the Guadalquivir and Guadiana rivers (lead).

Concerns

High concentrations of metals in some molluscs from areas close to known sources is worrying even if there is no evidence of widespread toxic effects.

Dredging

Sediments are currently dredged in harbour areas, estuaries and navigation channels. Dredged material is usually mud, sand, silt or gravel.

In terms of the French coastal and estuarine areas of the Bay of Biscay, the annual quantity of dredged material dumped was approximately 10 x 10^6 m^3 in 1993, with about 1% representing contaminated sediments. Large harbours such as Nantes and Bordeaux account for 94% of the annual input. This material is usually dumped at licensed sites off the main harbours.

Dredging operations in Portugal have increased over the last five years. Sediment quality was assessed prior to dredging in the Tagus, Sado, Mondego and Lima estuaries and in the lagoons of Aveiro and Formosa. Most of the dredged material was dumped in the marine environment, the Portuguese authorities requiring that contaminated material be dumped in deep water. Sandy sediments contained low concentrations of contaminants, while muddy sediments had a broader range of contaminants and were highly contaminated in the vicinity of harbours and industrial sites by metals (mercury, zinc, chromium, lead) and organic compounds.

Measures

Monitoring and research on metal availability and accumulation has suggested that for most metals there is no evidence of uptake by organisms; mussel growth experiments close to dumpsites showed no influence on growth within their first year.

Changes in the nature of the substrate may affect benthic community structure and succession, and thus the type of food available for fish and shellfish.

Rational selection of disposal sites, where sand is placed on a sand bottom or mud on a mud bottom, is essential to minimise the immediate and long-term physical impacts at the site.

Biodiversity

The structure of fish communities showed low levels of diversity in some heavily fished areas (150 – 250 m and 250 – 400 m). Small gregarious species with high growth rates (such as blue whiting and silvery pout) are the dominant species and the main food resources for the demersal predatory fish (such as hake and monkfish) which constitute the target species of the fishery. This could be interpreted as the intensive fishing activities causing a reduction in diversity through the elimination of specialist species with low birth rates, thus altering the balance between predators and prey.

Impacts on the benthic community are essentially due to the physical disturbance by fishing gear. Although it is easy to list the effects qualitatively, it is difficult to quantify the overall impact at the regional scale. Even at a local scale, field studies are few owing to the cost and difficulty of data collection in deep sea areas, and no area is effectively closed to fishing to provide a control.

By-catches of cetaceans are a central issue in the controversies surrounding the summer gillnet fishery for albacore tuna in Region IV. In 1992 and 1993 (when most vessels were still allowed to fish with 5 km nets) observers were placed on board eighteen French netters for 130 trips. A total of 1420 hauls were monitored resulting in the by-catch of 204 common dolphin and 573 striped dolphin. An average by-catch of eight dolphins (both species) was estimated per 100 km of net and per day of fishing. According to recent data, between 1987 and 1997, at least 85 cetaceans died during interactions with different types of fishing gear along the Portuguese coast. Gillnets were responsible for 76% of cases, followed by beach purse-seines with a by-catch of seventeen common dolphin.

Measures

In June 1998, EU fisheries ministers voted to introduce a ban on drift net fishing for tuna to come into effect January 2002. Concern for the consequences on biodiversity (both at the species and ecosystem level) led to the establishment of several protection measures aimed at:

- preserving the biodiversity of native species of flora and fauna and their habitats, especially those considered threatened;
- promoting the investigation and spread of information on issues related to the conservation of nature in order to facilitate sustainable development; and
- creating special zones for conservation that, together with the Special Protected Areas (SPA), will be an important component of the ‘Natura 2000’ net.

These measures constitute the basis of the Habitats Directive, which has already been ratified by France, Portugal and Spain. Several coastal and marine species and ecosystems have been classified according to this Directive and now receive special protection status. Habitats such as coastal lagoons, estuaries and shallow waters deserve particular attention, and several protected areas have already been established in Region IV (maps with coastal protected areas).

The establishment of marine protected areas also represents an important tool for the preservation of biodiversity. In such areas special attention must be given to the sustainable use of natural resources and to the correct management of the ecosystem, in accordance with the Ministerial Statement produced at the 1999 OSPAR meeting in Sintra, Portugal.

Non-indigenous species

By 1996, around a hundred non-indigenous species of great taxonomic diversity (phytoplankton, macroalgae and benthos) had been recorded in the OSPAR Maritime area. Unintentional introductions via shipping (as ballast water and associated sediments, and fouling on hulls) and aquaculture are the major sources of non-indigenous species. Introductions and transfers of marine organisms for fisheries and aquaculture also include the risk of transporting competitors, predators, parasites, pests and diseases. The potential effect of an introduction is hard to predict and control methods have generally been ineffective. The most significant ecological effects of non-indigenous species are pathogenic effects and competition with indigenous species for food, space or light.

Only one non-indigenous species was deliberately introduced to Region IV – the Pacific oyster – introduced by France to cultivate for human consumption. Unfortunately, a by-product of this commercial venture was the introduction of another non-indigenous species – Japweed – that has led to some bays and harbours becoming clogged. To date, most of the non-indigenous species in Region IV have not had significant impacts on either man or the marine ecosystem.

In addition, the algae *Asparagopsis armata* has been reported in French, Portuguese and Spanish waters and *Undaria pinnatifidia* in French and Spanish waters only.

The limpet *Crepidula fornicata* is now a pest on commercial oyster beds in France. One of the best documented cases of damage to native species through international transfers is that caused by the protistan *Bonamia ostrea*. Bonamiasis is a disease of flat oysters, which was first described in 1979 in Brittany where it caused a high level of mortality in flat oyster stocks. It is now widespread in flat oyster populations, where losses due to the disease may reach 80% or more.

Measures

To minimise the problems resulting mainly from shellfish introductions, ICES established a Code of Practice for the Introductions and Transfers of Marine Organisms, which was issued in 1995.

France, Portugal and Spain have not yet put in place practices to minimise the risk of unintentional introductions via ballast water, either through national regulations or by the application of IMO guidelines.

Non-indigenous species are also a threat to biodiversity, human health and to the sustainable use of resources.

Organic contaminants

Owing to their lipophilicity organic compounds tend to leave the aqueous phase and adsorb onto suspended particles, which are then ingested by living organisms or sediment out of the water column. The accumulation of contaminants in marine organisms depends on the quantities ingested and on the existence and effectiveness of specific detoxifying mechanisms. In the case of organic compounds, these include metabolic mechanisms which reduce lipophilicity and favour excretion.

PCB concentrations in biota from the Atlantic Portuguese and Spanish coasts are relatively low, but since industrial activities are the major source of these compounds moderate to high concentrations of $\sum PCB_7$ occur at sites closest to industrial areas of Bilbao, Santander, A Coruña, the Tagus and Sado estuaries and the Gulf of Cadiz. Along the French coast the higher concentrations occur in large estuaries (e.g. the Loire and Gironde). The highest concentrations found near the Bidassoa River require further investigation.

The PCB concentrations in the sediments of estuaries, coastal lagoons and rias of Portugal and Spain are relatively low or moderate in comparison with the EACs. The highest concentrations occur at sites closest to Bilbao, Santander, A Coruña, and the Tagus and Sado estuaries.

Organochlorine pesticide concentrations in mussels from the Galician coast and the Cantabrian Sea are very low. Concentrations are moderately high in Portuguese oysters and peppery furrow shells from the mouth of the Guadalquivir River. DDE concentrations in Portuguese oysters from the Sado Estuary and in clam from the Tagus Estuary are low relative to the EAC.

The concentrations of PAHs in sediments are not high, and only in the case of phenanthrene, pyrene and anthracene are the maximum EACs exceeded. The highest levels occur in the Ria of Bilbao, and show a clear gradient within the estuary and coastal sites, with concentrations decreasing offshore.

Eutrophication/deoxygenation

The direct effect of extra nutrients in sea water is an increase in the growth of phytoplankton. If the nitrogen to phosphorus ratio also deviates from 16 : 1, this can affect the phytoplankton species composition which can in turn lead to changes in the zooplankton community structure. If the zooplankton are unable to take advantage of the additional food, the bacterial decomposition of the excess phytoplankton cells may significantly reduce the oxygen levels in the water. In some cases, the oxygen consumption is so great that anoxic conditions develop. Since this deoxygenation usually occurs near the seabed, following the sedimentation of the dead plant cells, this can result in the death of bottom living fish and benthic organisms.

The few data available on nutrients, dissolved oxygen, phytoplankton species composition and the concentration of benthic fauna indicate no evidence of eutrophication in the coastal zones of Region IV.

In restricted areas of some estuaries and coastal lagoons (the Bay of Vilaine, Arcachon, Ria Formosa and Huelva) oxygen depletion events have been recorded as the combined result of a high organic load, weak local circulation, high primary productivity and temperature. Only in the Bay of Vilaine, does deoxygenation of bottom waters occur each summer following the phytoplankton blooms.

6.3 Gaps in knowledge

Previous chapters have revealed a remarkable amount of data and information, much of which has not been compiled or assessed for management purposes. There are a number of important topics for which knowledge and understanding are relatively poor, for example:

- the lack of input data for the major contaminants, including atmospheric inputs;
- the lack of quality assurance information for a large number of contaminant datasets;
- the lack of understanding concerning the relationships between contaminant inputs, concentrations and effects data;
- the impact of fishing on benthic species and marine mammals;
- the lack of data on fishing discards for the target and non-target species;
- the lack of understanding concerning the development of toxin-forming species of microalgae and why their presence and abundance is only sometimes associated with the occurrence of toxins in shellfish;
- the risks of introducing non-indigenous species in ballast waters;
- the lack of knowledge concerning the relationship between trends in climate change and changes in the physical environment and how this might influence water movements and biological production;
- the lack of understanding concerning the role of fronts in the variability of the abundance and distribution of fish eggs, fish larvae and adult fish;
- the lack of suitable data sets for identifying temporal trends (e.g. in nutrient concentrations and plankton);
- the lack of understanding concerning interactions between fish stocks and the functioning of marine ecosystems; and
- the lack of data on contaminants in biota and on standards for impact evaluation.

6.4 Overall assessment

The naturally favourable oceanographic conditions in this part of the North-east Atlantic, with its well-oxygenated coastal waters and strong hydrodynamic processes, positively influence the ecology of the region.

Generally, the waters off the Atlantic coast of the Iberian Peninsula and in the Bay of Biscay are relatively unaffected by contamination arising from within Region IV.

Several fish stocks within Region IV – sardine, hake, anglerfish, megrims and swordfish – are outside safe biological limits for sustainable fisheries, as a result of the combined effects of overfishing and the adverse effects of some natural processes on the recruitment and abundance of these resources.

A large proportion of shellfish farming areas are affected by some microbiological pollution, which implies that most of the shellfish must undergo depuration in an approved plant before they can be marketed.

Toxic algal blooms are widespread throughout Region IV, with incidences of acute shellfish toxicity caused by amnesic toxins (ASP), diarrhetic toxins (DSP) and paralytic toxins (PSP).

Mariculture in Region IV is mainly restricted to the cultivation of bivalve molluscs (usually mussels) on moored rafts or long lines. The impact of this type of mariculture is often minimal, but in some areas the deposition of organic detritus beneath suspended mussels has resulted in benthic enrichment; with a substantial increase in the organic content of the sediments, a dramatic decrease in faunal diversity and the predominance of opportunistic organisms.

6.5 Conclusions and recommendations

Taking into account the human activities highlighted in this quality status report, their impact on the marine environment and the evaluation of existing measures, it is recommended that the appropriate authorities consider:

- establishing a Code of Good Practice for Coastal Zone Management;
- implementing the FAO Code of Conduct for Responsible Fisheries;
- increasing the use of Marine Protected Areas as tools for the integrated management of coastal zones, their living resources and the protection and conservation of biological diversity;
- promoting more studies on ecosystem functioning and the sources of variability (natural and anthropogenic), as well as on investigations into the impact of human activities on coastal and marine habitats;
- increasing research on non-indigenous species, ballast water transfers and the control of particular nuisance species;
- increasing research on toxicity and detoxification processes, phytoplankton bloom dynamics and their relation to oceanographic events, and inputs of nutrients and organic matter of anthropogenic origin;

- implementing the 1994 ICES Code of Practice on the Introductions and Transfers of Marine Organisms;
- improving the monitoring and forecasting of human impact on the marine ecosystem, identifying trends in marine ecosystems based on key species and by monitoring the state of conservation in selected areas (mainly estuaries and coastal lagoons);
- developing research and management policy programmes for all activities affecting the marine environment, including the obligatory establishment of environmental assessments for specific areas of concern related to significant effects of human activities;
- applying the precautionary approach to fisheries management;
- promoting experimental work on indigenous biota in different coastal ecosystems to establish reference levels for marine contaminants; and
- establishing national programmes aimed at the recovery of degraded coastal habitats.