Ministry of Spatial Planning and Environment
Overseas Secrétariat
French Coral Reef Initiative
State of Coral Reefs
in French Overseas *Départements* and Territories

New Caledonia, Wallis and Futuna, French Polynesia, Clipperton, Guadeloupe, Martinique, Mayotte, La Réunion, Scattered French Indian Ocean Islands

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French Coral Reef Initiative (IFRECOR)

State of Coral Reefs in French Overseas *Départements* and Territories New Caledonia, Wallis and Futuna, French Polynesia, Clipperton, Guadeloupe, Martinique, Mayotte, La Réunion, Scattered French Indian Ocean Islands

1998

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Introduction

France will be taking over the Secretariat of the International Coral Reefs Initiative (ICRI) from 1999 to 2000, after the United States and Australia. The ICRI is a multilateral initiative set up by governments and organisations to mobilise government support for national and regional plans promoting the protection and sustainable development of coral reef ecosystems and their resources.

This document on the state of coral reefs in the French Overseas *Départements* and Territories was drawn up as part of French undertakings as a member of the ICRI, on request from the French Ministry of Spatial Planning and the Environment and with the support of the Secretariat for Overseas Affairs and the French Institute of the Environment (IFEN).

France has Overseas *Départements* and Territories (DOM-TOM) in three of the world's oceans. Their geographical features vary widely, accounting for the high natural diversity and exceptionally rich resources of the various types of coral reefs they possess. Cultural, historical, political and administrative differences between the DOM-TOM have also given rise to a range of different management tools and methods.

This brochure provides a synopsis of a larger document containing a chapter on each of the DOM-TOM, to be published in English and French. The document was commissioned from C. GABRIE (**Consultant in Tropical Marine and Coastal Environments**) as a preliminary and as yet incomplete assessment of the state of DOM-TOM coral reefs. The assessment was made in collaboration with a large number of managers and researchers. The resulting document is intended as an aid for policy-makers, by describing the specific features of the various coral reefs and explaining why they need to be preserved, and also for scientists, by outlining the management and conservation tools available at national and international level. The document describes the current state of coral reefs, their importance, the pressures being exerted on those ecosystems and the responses made by the various parties involved.

Acknowledgements : we would like to express our thanks to all the researchers and managers, both in the DOM-TOM and metropolitan France, without whose help this report could not have been produced. Special thanks to Michel PICHON and Bernard SALVAT for their invaluable assistance, and to Janice MORRISSEY for her help with the English translation.

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Introducing ICRI

International Coral Reef Initiative (ICRI)

The objectives of the International Coral Reef Initiative (launched by the USA, France, Australia, Japan, United Kingdom, Sweden, Philippines and Jamaica) are to mobilise government support for national and regional plans promoting sustainable development of coral reef ecosystems and their resources, and to raise awareness of the need for continuous monitoring of the health of coral reefs worldwide.

The implementing authorities are the ICRI Secretariat and the ICRI Coordinating and Planning Committee (CPC). Initially chaired by the United States, the Secretariat is currently based in Australia until December 1998, after which France will take over until the end of 2000.

The first international ICRI workshop, held in the Philippines in May 1995, adopted two policy documents - a "Call to Action" and a "Framework for Action" - setting out proposals for an international coral reef strategy and action plan.

Over 120 countries took part in five regional meetings held in 1995 and 1996, with delegations from the Tropical Americas (in Jamaica, July 1995), the South Pacific (Fiji, November 1995) East Africa and the Western Indian Ocean (Seychelles, April 1996), South Asia (Maldives, November 1995) and South East Asia (Indonesia, March 96).

Global Coral Reef Monitoring Network

The Global Coral Reef Monitoring Network (GCRMN) has been operating as part of the ICRI since June 1996, under the aegis of the Intergovernmental Oceanographic Commission (IOC- UNESCO), and subsequently UNEP and IUCN. The aim of the network is to provide reliable data to support decisions on long-term coral reef management, by defining and implementing environmental monitoring and research strategies. The network reports every four years on the health and status of coral reefs worldwide, and on the conditions required to manage them sustainably. More than 70 countries have agreed to join the network. A Strategic Action Plan aiming at extending the network to new regions and sub-regions has been adopted.

The GCRMN project is being developed under the authority of the GCRMN Management Group, which includes IOC-UNESCO, UNEP, IUCN, AIMS and ICLARM (based in Manila). The Coordinator and Management Group are supported by a scientific and technical advisory committee made up of some twenty scientists and delegates from associations and other groups involved in coral reef management.

French Coral Reef Initiative (IFRECOR)

During the first international ICRI seminar, France undertook to implement the policies and strategies which had been established in the Philippines. In order to fulfil its international commitments, the Ministry of Spatial Planning and Environment put forward a proposal for the establishment of a French Coral Reef Initiative.

Nationally, the major issues for France are :

ensure that both policy makers and the public are aware of the cultural, social, ecological, economic and political importance of coral reefs ;

ensure that coral reefs are protected and sustainably managed, with local community participation, as part of integrated coastal management plans in the overseas *départements* and territories ;

establish a monitoring network for coral reefs in overseas *départements* and territories which would be organised into GCRMN sub-nodes, thus becoming an integral part of the international coral reef monitoring network ;
establish a forum in which the overseas*départements* and territories are able to pool their experience on coral reefs and contribute to the dissemination of knowledge among the various interested parties.
Internationally, France intends to :
ensure that French researchers and consultants take part in international research and development activities focusing on coral reef management,
participate in the Global Coral Reef Monitoring Network ;
support the establishment of an international network of pilot projects on the conservation and sustainable management of coral reefs.
This report on the status of coral reefs in french overseas*départements* and territories represents an initial major element for the French Coral Reef Initiative.

Role of the Committee of the French Coral Reef Initiative
prepare a national coral reef strategy and action plan ;
formulate recommendations and views on how to ensure effective protection and sustainable management of coral reefs ;
monitor the enforcement of relevant measures in the overseas*départements* and territories and their integration into existing regional frameworks ;
develop proposals, where necessary, for any legislative and regulatory measures relating to the protection and management of coral reefs in the overseas *départements*, and, where necessary, support competent overseas territories authorities in response to their requests ;
support all activities and measures introduced in favour of coral reefs ;
support calls for national, European and international funding for the protection and management of coral reefs in overseas*départements* and territories ;
develop exchanges of information between policy makers, technicians and scientists on good practice in coral reef management and pool the results of local experience and practical realisations (e.g. sewage treatment plants);
evaluate activities undertaken.

Overseas *départements* and territories (DOM-TOM)
Coral reefs are located in overseas *départements* [1] and territories in three of the world's oceans :
New Caledonia, French Polynesia, Wallis and Futuna Islands and Clipperton Island in the Pacific Ocean ;
La Réunion, Mayotte and the smaller scattered French islands (Tromelin, Juan de Nova, Glorieuses Islands, Europa and Bassas da India) in the Indian Ocean ;
Martinique and Guadeloupe (with its outlying dependencies of Saint Barthélemy, Saint Martin, Marie-Galante, les Saintes and La Désirade) in the Caribbean.
Administratively, La Réunion, Guadeloupe and Martinique are overseas *départements* (DOM). New Caledonia, Wallis and Futuna Islands and French Polynesia are overseas

[1] Regions and *département* are administrative subdivisions of France. There are 4 overseas *départements* , that are also 4 regions, and there are 22 regions divided in 96 *départements* in metropolitan France.

Territories (TOM), and Mayotte is a *Collectivité Territoriale* (with a legal status similar to the territories). The small French islands scattered in the Indian Ocean and Clipperton Island have specific administrative systems.

Geographically, the overseas *t*territories are extremely varied, ranging from the tiny 2 km^2 atoll of Clipperton to the 18 000 km^2 continental island of New Caledonia. While the French Polynesian islands, some 120 in all and with a land area of 3 500 km^2, are scattered widely over the Pacific Ocean, the island of Grande-Terre alone represents virtually the entire land area of New Caledonia. Populations and cultural backgrounds are also highly diverse, and include Melanesian, Polynesian, Caribbean, Mahorese and Réunion Island groups.

The morphology of these islands also varies enormously : Grande-Terre in New Caledonia is a continental island surrounded by a barrier reef ; Wallis, Mayotte and most of the Society Islands in French Polynesia are high volcanic islands surrounded by barrier reefs; La Réunion, Martinique and Guadeloupe are also high islands but surrounded almost exclusively by fringing reefs; while the Tuamotou atolls in French Polynesia, Clipperton Island and those small scattered islands in the Indian Ocean are low-lying coral islands.

Taken together, the coastlines of these different coral reefs stretch over a total length of 5 000 km.

The proportion of lagoon to land area can be very high, as in Mayotte where the lagoon is at least as large as the land area, or in Polynesia where the lagoon area is four times greater than the land area. In the overseas*départements* and territories as a whole, the total lagoon area (about 55 000 km^2) is about double the land area.

Population

Population density largely determines the intensity of man-induced pressures, and varies widely between the different overseas*départements* and territories. New Caledonia is very sparsely populated (11 inhabitants per km^2), and densities are below 100 inhabitants per km^2 in Wallis and Futuna and the Polynesian islands. The highest densities are in the *départements* (Guadeloupe, Martinique and Réunion) and especially in Mayotte, where estimates for 2010 are as high as 650 per km^2.

Independent of population densities, the very uneven distribution of people exacerbates the problems in urban areas : densities are generally high in coastal areas, and over 50% of the population is often concentrated in just 5% of the territory around the main towns.

Unless remedial measures are taken, the high projected rate of population increase is a major threat to the environment, particularly in Mayotte, Wallis and Futuna Islands, La Réunion and the Caribbean islands, where the lack of space and the resulting pressures on available land are producing serious impacts on coastal and marine environments.

Administration

Overseas *Départements*

***The DOM (La Réunion, Guadeloupe and Martinique) have been governed both as regions and*départements* since 1982, under the authority of a *Préfet* (state representative), and of local assemblies :*Conseil Régional* (regional council) for the region and*Conseil Général* (*département* council). Citizens are represented on national bodies through elected *députés*

(members of parliament), senators and representatives to the Economic and Social Committee.

Overseas Territories

French Polynesia is an autonomous territory. The territorial authorities are the Government, Territorial Parliament, and the Economic, Social and Cultural Council. The French State is represented by a High Commissioner.

New Caledonia has embarked on a process towards autonomy, of which the main lines were recently approved under a 20-year agreement (Nouméa Agreements, 1998). The administrative entities are the three Provinces (North, South and Province des Iles), each of which has a Provincial Parliament. New Caledonia's institutions include the three Provincial Parliaments, a Congress made up of the three Parliaments, the Government (which elected is by the Congress as New Caledonia's executive body), a Senate of customary chiefs and an Economic and Social Council. The French State is represented by a High Commissioner.
The territorial institutions in **Wallis and Futuna** are the Territorial Parliament and Territorial Council. A Prefect (*Préfet*) represents the French State and is also the Head of the Territory. The islands have three customary kingdoms (one on Wallis and two on Futuna), with their kings (who are members of the Territorial Council), and their ministers.

Mayotte is a *Collectivité Territoriale* (legal status similar to a territorie) and is administrated by a Prefect acting as Head of the executive body, and a *Conseil Général* (county council).
The small French islands scattered in the Indian Ocean are under the authority of the French Junior Minister for the overseas territories, and are attached to La Réunion for administrative purposes.

Clipperton Island is directly under the French Prime Minister's authority.

Economy

A salient feature in nearly all the overseas territories is their rapid economic development, since most have moved from a hunter-gatherer economy to a modern economic system in the space of a few decades. Other features include the disproportionate size of the tertiary sector in most cases, and a high GDP per capita, especially in New Caledonia and Polynesia. Most overseas*départements* and territories economies are highly dependent on the reef and lagoon environment, as a source of food and/or a tourism asset.

Overseas*départements* and territories (DOM-TOM)

Administratively speaking, the **Overseas *Départements*** (DOM) of La Réunion, Guadeloupe and Martinique have dual status as both *départements* and regions[1]. Their administrative powers, laws and regulations are the same as in any other French *département* or region.
Wallis and Futuna Islands, French Polynesia and New Caledonia are **autonomous Overseas Territories (TOM)**. They have full powers over all areas which do not come under French State authority. These include environmental matters and reef resource management, which come under the authority of the three New Caledonian Provinces and the Territory of French Polynesia. French laws and regulations do not apply in these territories, which are responsible for drawing up their own legislation.

As a ***collectivité territoriale***, Mayotte has the legal status of a territorie in which national legislation only applies where explicit provisions are made to this effect. The government promulgates laws by decree, adapting them if necessary, after consultations with the *Conseil Général*.

Types of coral reefs in overseas *départements* and territories

In terms of geomorphology, coral reefs in overseas territories in their three different ocean environments are highly diverse, since they include fringing reefs, some of which are in their early stages of formation, barrier reefs, double barrier reefs, sand cay reefs, atolls and platform reefs.

Fringing reefs form a border around the shoreline. They are usually quite narrow and are either adjacent to the shore or, sometimes, separated from it by a shallow channel. These are the most common reef forms in La Réunion and the Caribbean islands, but are also found around the other islands, inshore from barrier reefs.

Barrier reefs are much wider and separated from the shore by lagoons which may be several kilometres wide and 10 to 70 metres deep. Small coral islands will sometimes form along the reef. Fringing reefs will sometimes form near the shoreline between a barrier reef and the coast. Barrier reefs are found off New Caledonia, the high French Polynesian islands, Wallis Island, Mayotte, the east coast of Martinique and in the Grand Cul-de-Sac Marin in Guadeloupe. **Double barrier reefs**, where two reefs lie parallel, are much rarer, but examples exist off Mayotte and New Caledonia.

Atolls are open sea coral reefs which form a ring enclosing a central lagoon of varying depth, generally less than 100 m. Coral debris accumulating on the atoll rim through wave action will tend to form low-lying coral islands. Atoll rim may be continuous, completely enclosing the lagoon, which in a few rare cases will silt up completely and become covered in coconut palms. Other atoll have rim cutted by one or several passes, allowing sea water to circulate in and out of the lagoon. These are known as open atolls. Sometimes, tectonic movements or sea level change may cause an atoll to be situated well above sea level, as in Makatea Atoll in French Polynesia where the floor of the former lagoon is an average of 60 metres above sea level. Other atolls may become completely submerged, like Portland Atoll in French Polynesia or the Fairway and Lansdowne atolls off New Caledonia.
Atolls vary greatly in size : the largest in the world, with a diameter of over 100 km, is Kwajalein Atoll in the Marshall Islands. Rangiroa Atoll in French Polynesia is the third largest with a length of 80 km. Some French Polynesian atolls, like Tikei or Nukutipipi, are no more than one or two kilometres in diameter. The other atolls, besides the 80 in Polynesia, are Chesterfield, Bellona, Huon, Surprise and Ouvéa atolls in New Caledonia, Clipperton Island in the eastern Pacific, and Europa and Bassas da India in the Indian Ocean.

Platform reefs occur when coral formations build up on shallow areas in the open sea. Sediment accumulating on the reef through wave action eventually forms coral islets, known as "cays", like the Glorieuses Islands, Juan de Nova or Tromelin in the Indian Ocean.

Importance of coral reefs in overseas*départements* and territories

Coral reefs, mangrove swamps and seagrass beds are found in about one third of all shallow coastal waters in the tropics, with coral reefs accounting for 15% and mangrove swamps and seagrass beds for about 9% each. All three ecosystems are of major importance in the tropics, and are closely interconnected through hydrodynamic circulation patterns and trophic systems.

Coral reefs are built up by coral organisms producing their own mineral substrate. With thousands of different species living in the same environment, coral ecosystems - along with tropical forests - are the most highly diversified and complex on the planet. As far as France is concerned, coral ecosystems are undoubtedly those with the highest species diversity of all marine ecosystems. They are also among the most productive, in terms of gross organic production, and as such are often likened to a kind of oasis of life in an otherwise rather barren tropical ocean environment.

Besides their ecological value, coral reefs are of major economic, social and cultural importance to the countries they surround :

Many islands are formed exclusively from coral materials, and owe their very existence to their coral reefs. These include the 80 atolls in French Polynesia, as well as many coral islands scattered over the Indian Ocean.

Coral reefs are of crucial importance as natural barriers protecting shorelines from destructive storms and waves, especially in cyclone areas.

Coral reefs are the main source of food for countless island inhabitants : 90 % of all animal protein consumed in the Pacific islands is from marine species.

With some of the most spectacular marine landscapes in the world, coral reefs are an invaluable asset to local tourism and leisure industries.

Fringing reefs which are actually adjacent to the shoreline are of particular value as spawning grounds and nursery areas for innumerable fish, including a large number of commercial species. Whether juvenile fish survive to replenish stocks is largely determined by the state of health of these fringing reefs.

Importance of ecosystems associated with coral reefs

Seagrass beds are important feeding grounds, especially for a number of threatened marine species including turtles and dugongs. They are important spawning and nursery areas for innumerable species, help to stabilise the coral sediment substrate and provide vital oxygen to surrounding water masses.

Mangrove swamps generate large quantities of organic matter, provide vital breeding and nursery areas, and help to stabilise sediment and protect coastlines from storm damage and coastal erosion. The animals which live in this habitat provide an important source of food for coastal populations.

Heritage value of coral reefs in overseas *départements* and territories

Coral reefs in overseas territories have a cumulative area of 55 000 km^2,

The linear stretch of coral reefs is more than 5 000 km altogether,

Coral reefs of the overseas *départements* and territories are present in three of the world's oceans and so, are very diverse,

French Polynesia includes 20 % of all coral atolls worldwide,

New Caledonia has the second largest barrier reef in the world,

New Caledonia and Mayotte have two of the very few (less than 10) double barrier reefs in the world
Coral reefs have the highest species diversity among marine ecosystems
The overseas *départements* and territories have a high geomorphologic diversity of reef formations
Coral reefs in overseas territories include areas of major importance for many threatened species, including dugongs and turtles.

Social and economic importance of coral reefs in overseas *départements* and territories

Fishing - particularly subsistence fishing - is vital to the livelihood of New Caledonia's Melanesian population as well as to Wallis Islanders and Mahorese and Polynesian communities, especially those living in the remote islands and atolls, and also to a number of communities in Guadeloupe and Martinique.
Tourism associated with coral reefs is a major currency earner and has a vital role in economic development for most of the overseas *départements* and territories, especially in Polynesia and the Caribbean islands.

STATE of Coral Reefs

Coral reefs worldwide
Coral reefs throughout the world are becoming severely degraded, especially those near densely populated areas. It has been estimated that 10 % of all coral reefs have been irretrievably damaged, and that 30 % are highly endangered.

Coral reefs in overseas *départements* and territories
Coral reefs in overseas *départements* and territories are so widely scattered and diverse that the state of over half of them is practically unknown. The coral formations in New Caledonia, the remote Polynesian archipelagos, Clipperton Island, Wallis and Futuna Islands and the Mayotte barrier reef have practically never been explored. It is therefore difficult to provide an accurate picture, but it is likely that overall, and on the basis of the data available, less than 5% of the entire coral reef area in the overseas*départements* and territories has been degraded.
The most critical problems are in densely populated islands where reefs are close to the shore, i.e. the Caribbean islands, Mayotte, La Réunion and the Society Islands in French Polynesia. In many cases, up to 30% of fringing reefs have been degraded, and on some islands, up to 50% or more of reefs are threatened (Bora-Bora and Mayotte for example).
Conclusions to date are as follows :
The healthiest reefs are those which are least affected by man-induced pressures, i.e. those around New Caledonia and the remote Polynesian atolls and reefs such as the Tuamotou and Gambier archipelagos.
Coral reefs near built-up or densely populated areas are suffering the most damage (Papeete and Nouméa for example), which means that the situation varies considerably within each region. For example, in Polynesia, the reefs around the Society Islands are under considerable stress, while the Tuamotou atolls are still undisturbed.
Fringing reefs, which are close to the shoreline, are the worst affected, while barrier reefs tend to be better protected from human activity by their lagoon and are often undamaged.

Outer reef slopes appear to be the least affected : in French Polynesia, monitoring studies from 1992 to 1997 showed high coral growth on the outer slopes of 13 islands (Chancerelle in CRIOBE-EPHE, 1998)
All reefs are susceptible to drastic change in their condition as a result of catastrophic events - cyclones, *Acanthaster* starfish infestations, coral bleaching or massive sediment flows from the neighbouring land area - which alternate with long periods of stability or very gradual change.

Consequences of coral reef damage
Besides cases of total destruction due to mechanical causes, most damage to coral reefs - as in Polynesia, La Réunion, the Caribbean islands and Mayotte - results in :
increased coral mortality,
decline in the diversity of corals and other organisms,
algal blooms and secondary proliferation of other organisms (alcyonarians etc.),
changes in fish populations, with a decline in carnivorous species and an increase in herbivores,
increased mortality or, conversely, excessive proliferation of sea urchins.

The destruction or degradation of habitat remains the most critical problem.

PRESSURES : Causes of coral reef degradation
The major threats to coral reefs are local (often chronic) human pressures in coastal areas, which have immediate localised impacts, and natural pressures, particularly those related to global climate change. The increase in atmospheric CO2 concentrations is a growing threat which is likely to produce wide-ranging and long-term impacts determining increasingly complex responses to local pressures by coral communities (SCOR, 1998).
Natural pressures
The inherent climatic, relief and soil characteristics of tropical islands are found in all the overseas*départements* and territories, and natural phenomena therefore play a major part in the evolution of coral reef ecosystems. Natural pressures can affect any reef type or zone, including fringing and barrier reefs and outer slopes, unlike man-induced pressures which mainly affect shorelines and their nearby fringing reefs.

Global change
A scientific workshop held in Boston in 1998 (SCOR, 1998) concluded that :
as the expected increase in atmospheric CO2 concentrations continues, aragonite saturation levels in the upper water layers will drop, consequently reducing the rate of coral calcification and creating a significant threat to coral ecosystem function ;
the expected increase in surface temperatures could cause a shift in the isotherms generally associated with coral reef distribution worldwide, resulting in local or regional coral reef degradation linked to episodic high sea surface temperatures ;
projected rates of sea level rise (by 15 to 95 cm by 2100) would not be a limiting factor unless increased CO2 concentrations and other pressures begin to slow down calcification rates to the point where reef construction no longer keeps pace with sea level rise ;

the increasing intensity and frequency of river discharges could increase the turbidity of coastal waters as well as nutrient and other pollutant flows into coastal reefs ;
a 10-20% increase in both the frequency and intensity of cyclones is likely by 2070.

Cyclones

Cyclones, as well as less violent storms, are known to be a major natural long-term factor in determining geomorphologic change in coral reefs and islands, since coral islands are built up from debris dislodged from reefs during violent storms.
Besides the direct destructive impact of cyclonic waves, cyclones produce indirect effects by increasing the amount of particulate matter transported by rivers. This is deposited in large quantities as sediment in the lagoon area around river mouths, causing coral smothering. These effects are especially severe in areas downstream from catchment basins affected by human activities such as mining, farming and earth-moving.
Cyclone damage has been particularly severe in French Polynesia, La Réunion and the Caribbean. In some Polynesian atolls, up to 50, 90 and even 100% destruction of the outer slope communities of coral reefs has been observed, to at least 75 metres in depth in some cases.

Coral bleaching

Although coral bleaching, which affects both corals and other symbiotic organisms, occurs periodically throughout the world, the frequency and intensity of such episodes since the 1980s is without precedent in scientific literature. Coral bleaching results from the disappearance of symbiotic algae (zooxanthellae) and/or a drop in the concentrations of chlorophyll pigments in the zooxanthellae which inhabit host tissues, giving them their colour. Although in most cases corals are capable of regenerating their zooxanthellae, excessively high and persistent stress can cause colony death.
Large-scale coral bleaching episodes have mostly occurred during anomalous El Niño conditions, as in 1983-84, 1994 and 1997-98, which appear when a shift in the balance of the Pacific pressure field combines with the emergence of the warm El Niño current along the Peruvian coast, causing various hydroclimatic disturbances and especially a warming of surface waters.
The most recent event of this kind (1997-98) has had unusually severe and widespread effects in the overseas *départements* and territories, affecting French Polynesia, Mayotte, the small French Indian Ocean islands and La Réunion.

***Acanthaster* infestations**

The crown-of-thorns starfish *Acanthaster planci* is a large starfish which feeds on coral tissues, digesting them on the spot. The reasons for *Acanthaster* population explosions have not yet been established : human activities are often incriminated, either because they eliminate *Acanthaster* predators, or because pollution - especially with eutrophication and sedimentation from land-based sources - encourages larval survival and hence the proliferation of the species. Several researchers currently believe that the problem may be due to natural long-term variations in the population of the species.

In Polynesia, *Acanthaster* starfish have caused profound changes in coral communities and rapidly increasing mortality rates, especially among *Acropora* and *Pocillopora* corals. Although the most severe infestations occurred in 1979 and 1986, they have not ceased and have sometimes caused up to 90% destruction in the worst affected fringing reef areas.

Coral diseases

Outbreaks of bacterial diseases (black band and white band disease) have been observed at irregular intervals in many parts of the world, and especially in the Caribbean. These diseases are not yet well understood. In the overseas *départements* and territories, only the Caribbean reefs have so far been affected, especially in Guadeloupe where white band disease, together with cyclones, have decimated *Acropora palmata* populations.

Human pressures

Land management, mining, agriculture and sediment run-off

Mechanical soil erosion is a natural feature on young tropical islands that are subject to violent rainstorms, but any human activity which tends to destroy plant cover will intensify such naturally occurring degradation. The principal causes of soil erosion in the overseas *départements* and territories are inappropriate farming practices (in Mayotte, Wallis and Futuna, La Réunion and Polynesia), urban construction on slopes and coastlines (Polynesia, Mayotte, La Réunion and the Caribbean islands), mining (New Caledonia) and infrastructure development including road building and hydraulic installations (in all the overseas *départements* and territories).

Earthworks in mountainous areas can cause erosion of large quantities of soil which builds up as sediment along the coastline, profoundly changing its profile and damaging fringing reefs. This sediment not only smothers corals and other sessile organisms, but also increases the turbidity of coastal waters, depriving corals of the light that they need to survive. Eutrophication associated with excessive nutrient discharges exacerbates the problem. This is one of the major causes of coral reef degradation in the overseas *départements* and territories, especially in Mayotte, La Réunion and localised areas in New Caledonia.

Water pollution

Domestic and agricultural pollution can increase the levels of nitrates and phosphates in coastal waters, causing eutrophication which leads to the proliferation of algae and other non reef-building organisms to the detriment of corals, which they smother. These algae may also compete with seagrasses, invading seagrass beds which they will eventually destroy. The reaction of mangrove ecosystems to increased nitrate concentrations in the water is not well known : the few studies to date tend to conclude that there is either no reaction or a slight increase in plant growth. Equally little is known about the effects of chemical pollution (petroleum, detergents and heavy metals) on the metabolism of coral reef organisms, or about the impact of pesticides used in urban areas and farms. However, mangroves are highly sensitive to massive hydrocarbon pollution (oil spills), which usually kills them.

Waste disposal is a problem in almost all the overseas *départements* and territories. With the exception of La Réunion, Bora-Bora in French Polynesia and Nouméa in New

Caledonia, where considerable effort has been made to address the issue, none of the overseas *départements* and territories have adequate facilities, if at all, and water pollution in densely populated areas is a major problem.
Agricultural and domestic pesticide use is exceptionally high in the Caribbean islands, French Polynesia and La Réunion. Some pesticides in common use are highly toxic and persistent. For example, in Polynesia, the concentrations of pesticides in lagoon sediments are comparable to those measured at various sites in metropolitan France and elsewhere that are recognised as polluted. Very high pollutant concentrations have also been recorded in some organisms in Fort de France Bay in Martinique.

Aggregate extraction and dredging
Dredging in fringing reefs is carried out either to extract coral aggregate for construction and road building, or to improve harbours and sea channels. Dredging for extraction purposes causes virtually irreversible destruction of the site, while reef areas in the vicinity of any dredging operations are disturbed to a greater or lesser degree by plumes of fine coral particles which are carried along in suspension by currents, causing coral smothering and changes in reef populations.
These activities have increased rapidly in Polynesia in particular, and have destroyed a great many reefs. In Mayotte and Wallis and Futuna, uncontrolled removal of beach sand is causing severe erosion problems.

Coastal reclamation
Because many coral islands are so small, coastal development (air strips, road building etc.) frequently damages their coral reefs and mangrove swamps. Reclamation of reefs or mangroves to create building land totally destroys the entire area and disrupts the pattern of currents in the lagoon.
Coastal reclamation is very common in French Polynesia, especially in the Society Islands, where large portions of reef flat (amounting to 3% of all fringing reef area) have already been lost. In relation to island size, reclamation operations have been most extensive in Bora-Bora, where the area of land reclaimed in this way is now equivalent to an area nearly 7 metres wide around the entire island. In the Caribbean islands, extensive coastal development work has also been largely responsible for the loss of many coastal habitats including coral reefs, seagrass beds and especially mangrove swamps.

Exploitation of biological resources
Because reproduction in many marine species involves the dispersal of their larvae by ocean currents, they are unlikely to become extinct through human exploitation, except in a few rare cases where species are endemic. However, intensive exploitation can cause severe population declines, as in Futuna, Mayotte, La Réunion and the Caribbean islands. The main problems are as follows :
use of destructive fishing methods - explosives, poison, crowbars, small-mesh nets, stone fishing (*muro-ami*) etc. - which damage habitats and kill species and juveniles indiscriminately ;
destruction of spawning grounds and nurseries ;
overfishing of molluscs, corals and other slow-moving or static species ;
overfishing of rare or endemic species.

Some destructive fishing methods

French Polynesia : gill netting, spearguns, stone fishing (*muro-ami*).

Wallis and Futuna : fishing *au tas de caillou* (where a pile of stones sheltering fish is progressively moved towards a fish trap), poison (futu), dynamite.

Mayotte : gill nets, trammel nets, seine nets, spearguns, *djarifa* fishing (where women drag pieces of cloth through the water), poison (*uruva*), octopus and other species fished by walking on reef flat.

La Réunion : gill nets, fishing lines, octopus and other species fished by walking on reef flat.

Guadeloupe and Martinique : Caribbean hoop nets, gill nets, trammel nets, seine nets.

Tourism

Tourism infrastructure development (hotel building, marinas etc.) and tourism activities are both likely to damage coral reefs.

The construction of tourism facilities causes problems associated with earthworks, reef dredging, lagoon siltation from land-based sources and so on. Most of the problems which arise once facilities are operational are connected to sewage discharge, and can generally be minimised through impact studies and careful implementation of their recommendations.

The most widespread types of damage occur when too many boats anchor on coral reefs or seagrass beds or discharge sewage, and when too many people trample over reef flats, breaking corals and collecting reef organisms.

Scuba diving, sailing and yachting, with their attendant anchoring problems, is especially damaging to coral reefs in the Caribbean.

Introduced species

As opposed to the situation in overseas *départements* and territories land areas, the introduction of new species into marine habitats, such as the *Trochus* or *Turbo* in French Polynesia or New Caledonia, does not seem to have caused any particular problems.

RESPONSES

Relevant organisations

Overseas *départements* and territories

In the DOM, the major administrative entities involved are the State, the *Conseil Régional* for each region, the *Conseil Général* for each *département* , and the municipalities (*communes*). Each of these entities has its own sphere of competence. The main environmental authority involved is the regional Office of the Environment (DIREN - *Direction Régionale à l'Environnement*), which represents the Ministry of Spatial Planning and Environment at local level. The regional and *département* authorities also include an environmental unit. In La Réunion, a tripartite structure (CLOE -*Cellule locale pour l'environnement*) representing the State, the Region and the *Département* has been established to coordinate activities. Small-scale fishing and coastal management are under the regional authorities, with support from the French State through devolution arrangements (Land management, Maritime affairs etc.).

A scientific and technical committee for the natural heritage has been established in each of the*départements*, under the ZNIEFF scheme for the identification natural areas of ecological and wildlife interest.
In the TOM, the administrative position varies according to the case :
In Wallis and Futuna Islands and Mayotte, the main relevant bodies are the technical departments of the French Agriculture and Fisheries Directorate. In Mayotte, a local Fisheries and Environment Unit also operates under the Directorate, and has direct responsibility for the marine environment along with the Mayotte Environmental Delegation, which is one of the *Préfecture* departments (the *Préfecture* represents the French State). Mayotte also has a consultative commission for the environment and a heritage conservation commission. Wallis and Futuna have recently established their own territorial environment department (*Service Territorial de l'Environnement*).
In New Caledonia, all matters relating to the environment - including the marine environment - and to the management of coastal resources come under Provincial authorities, i.e. the Natural Resources Directorate in the South Province and the Fisheries Department in the North and Islands Provinces. The French State is responsible for applying the provisions of international conventions.
In French Polynesia, there is no State technical department and all environmental matters come under Territorial authorities. The Polynesian Ministry of the Environment and its technical arm (the Environment Delegation), together with the Marine Resources Department, are the main bodies involved in the protection and management of coral reefs. The French Polynesian Coastal Conservation Agency (*Conservatoire Polynésien du Littoral*), which operates as part of the Public Properties Authority (*Service des Domaines*), is responsible for land acquisitions under the coastal conservation policy, but has few funds.
In all these overseas *départements* and territories, responsibility for coastal management lies with their spatial planning and infrastructure authorities. In addition, a number of specialised commissions (environment, resource management etc.) are more or less directly involved in the protection and management of coral reefs.
Finally, numerous conservation organisations are extremely active in all the overseas *départements* and territories except Wallis and Futuna : three in New Caledonia, about forty in Polynesia including fourteen grouped together as a federation, about fifteen in Martinique, fifty or more in Guadeloupe, five specialising in coral reefs in Mayotte, and six in La Réunion.

Metropolitan France

Ministry of Spatial Planning and Environment
The departments most directly involved in coral reef initiatives are :
The Directorate-General for Administration and Development (DGAD), which includes the International Affairs department (SAI), the Research and Economic Affairs department (SRAE) and the "Ecology and Natural Heritage Management" research committee (EGPN).
The Natural Areas and Landscapes Directorate (DNP) which includes the Natural Areas, Hunting, Nature, and Wild Flora and Fauna departments (responsible for CITES implementation).

The Water Directorate.

The **State Secretariat for Overseas Affairs** (*Secrétariat d'Etat à l'Outre-Mer*) is responsible for initiating, promoting and coordinating overseas activities, and for facilitating dialogue between local, national and European bodies. It has the power to initiate overseas activities through special overseas *départements* and territories budget lines (FIDES, FIDOM).

Institute for Ecology and Biodiversity Management (IEGB - *Institut d'Ecologie et de Gestion de la Biodiversité*)
The IEGB was set up by the Environment Ministry in 1995 as an umbrella organisation grouping the various areas of competence of the National Natural History Museum (based in different laboratories) around the central topic of Ecology and Biodiversity Management. The IEGB is the main advisory body to the government (particularly the DNP) for policy decisions on the conservation and restoration of the natural heritage and biodiversity. It also advises on the implementation of European Union legislation and international conventions on environmental protection. In particular, the IEGB is responsible for coordinating activities under the ZNIEFF scheme for natural areas of ecological and wildlife interest.

The Coastal and Lakeshore Conservation Agency (CEL)
The French Coastal and Lakeshore Conservation Agency (CELRL - *Conservatoire de l'Espace Littoral et des Rivages Lacustres*) is a public administrative body which implements land acquisition policies to preserve coastal areas, outstanding sites, landscapes and ecosystems. Its area of responsibility was extended by decree to include the*départements* and Mayotte, in 1977 and 1995 respectively. The CELRL is made up of seven Shoreline Delegations (*Conseils de Rivage*) including one for the Caribbean islands and Guyana (*Conseil des Rivages Antilles-Guyane*) and one for the*départements* in the Indian Ocean (*Conseil des Rivages de l'Océan Indien*), which are made up of representatives from the *Conseil Général* and *Conseil Régional* for each administrative entity. The CEL's correspondents in these areas are the local DIREN (Regional Offices of the Environment). Its responsibility does not extend to the TOM.

French Coral Reef Society (ACOR)
ACOR (*Assocation Française pour les Récifs Coralliens*) was set up in 1997. It now has 130 members operating throughout the overseas *départements* and territories, including researchers, teachers, administrators, private sector experts and engineers and French coral reef management organisations. The organisation's aims are to provide a forum for all public and private individuals and corporate entities with an interest in furthering coral reef research, protection and management, to represent its members in national and international fora and to promote research on coral reefs and their protection and management.

French IUCN Committee
The French IUCN Committee was established in 1995 and now includes 45 institutional members (representing the State, public and parapublic agencies,

associations and foundations) and 150 experts. The Committee is organised into commissions (national parks, environmental strategy and planning, environmental law, species survival) and specialised working groups, including one for the overseas *départements* and territories and one for coastal and marine area planning.

WWF France

For the time being, WWF France activities in the overseas *départements* and territories focus mainly on land-based habitats. The WWF's plans for the medium term include greater involvement in New Caledonia with the establishment of a local WWF office, and in Mayotte with activities focusing on local community management of natural resources, under a project funded by the French GEF.

Regional arrangements

South Pacific

South Pacific Regional Environment Program

The South Pacific Regional Environment Program (SPREP), based in Apia, Samoa, was established to help the countries and territories of the South Pacific to protect and enhance the environment they share and to manage its resources in such a way as to improve living standards for both present and future generations. The SPREP Action Plan is drawn up and approved every four years by the member countries and territories. The most recent action plan for the management of the ocean environment reflects regional concerns and covers the period from 1997 to 2000.

The SPREP also runs the Secretariat for the Apia, Nouméa and Waigani Conventions and takes part in the coordination of various international conventions, particularly the Climate Change and Biodiversity Conventions.

Indian Ocean

United Nations Environment Program and the Regional Seas Programme

UNEP is based in Nairobi and plays a major role in implementing the Nairobi Convention. A Regional Coordination Unit has recently been established in the Seychelles. Coral reefs are covered by the Regional Seas Action Plan under the programmes for marine and coastal protection and management, for marine pollution, for coastal erosion, for environmental impact assessments and for regional atlases and databases.

The **Secretariat for Eastern African Coastal Area Management** (SEACAM) was established in 1997 in Maputo, to implement the 1993 Arusha Declaration on integrated coastal area management in the Indian Ocean and East Africa. SEACAM focuses on capacity building and information sharing in five areas : environmental assessment, capacity building for local NGOs, a database on coastal management activities and stakeholders, public sector management and sustainable funding of coastal management activities.

Indian Ocean Commission's Environment Programme

The Indian Ocean Commission (IOC) was established in 1994 to promote concerted actions and cooperation between its member states (Mauritius, Madagascar, Comoro Islands, Seychelles, and France through La Réunion). The IOC's Regional Environment

Programme (IOC/EU-REP, officially titled "Support to environmental programmes in IOC member countries") is a regional arrangement between the member states. Mayotte and the small French islands scattered in the Indian Ocean are not members, so they are not involved in the activities implemented to date.
The programme's overall objective is to promote a regional policy for the sustainable management of natural resources, including protection and integrated management of coastal areas. The Coastal Zones Project is supported by the European Union through the European Development Fund (EDF), and was launched in 1995 for a five-year period (1995-2000). It is organised on a logical step-by-step basis : the preliminary evaluation phase (pre-audit) was followed by an intermediate evaluation phase (audit), which led in turn to the preparation of a "National Plan for Sustainable Coastal Zone Management" and finally to practical applications through pilot projects. Besides this step-by-step approach, the emphasis is on integrated activities, their usefulness as models or examples at regional level, their practical technical and institutional feasibility, and particularly on the development of a regional sustainable development policy.
Project output to date includes the development and implementation of a regional coral reef monitoring network. A coral reef monitoring methodology, based on the GCRMN system, has recently been approved, and a methodological handbook has been distributed to member countries. The pilot implementation phase is scheduled to begin in 1998.

Caribbean
The Jamaica-based Regional Coordination Unit of **UNEP**'s Action Plan for the Caribbean, under the Regional Seas Programme, plays a major role in implementing the Cartagena Convention.

The **Association of Caribbean States** was set up in Cartagena in 1994 as a consultative and cooperative organisation aiming to identify and promote programmes and policies whose objectives include environmental protection and the conservation of natural resources in the region, and particularly in the Caribbean.

The **WIDECAST** network for the conservation of Caribbean turtles, a government forum of scientists and administrators, was established under the Cartagena Convention on the protection of the Caribbean environment.

France plans to establish a **centre for regional activities in the Caribbean and French Guyana** (CARAG - *Centre d'activités régionales Antilles-Guyane*), based in Guadeloupe, under the UNEP Regional Seas Programme and the Cartagena Convention.

Legislation and regulations

National and local provisions

Major national laws

The French 1976 Nature Protection Act institutes measures on flora and fauna protection, hunting, freshwater fishing and protected areas (national parks and nature reserves).
The 1986 Coast Act recognises that coastlines form an entity which requires specific planning, protection and development policies. Some of the main policy concerns are to protect outstanding natural areas and those that are essential in preserving the balance of ecological and biological systems, to control urban growth and introduce the concept of urban growth buffer zones, and to ensure unrestricted access to shorelines.
The 1992 Water Act recognises that water is part of the national heritage and shared by all, and that water resources must be protected and usable water resources enhanced and developed as a matter of public interest. The provisions of the Act aim to institute balanced systems of water resource management which must, in particular, ensure protection against pollution.

All the major laws (Nature Protection, Coasts and Water) also apply in the*départements*, which therefore have an adequate legal framework.
In the TOM, French laws are only applicable when this is expressly provided for and when they are promulgated and issued locally by the High Commissioner after consultations with the Territory. Therefore, the major national laws do not apply in the territories, and only some apply in Mayotte.
New Caledonia and French Polynesia thus have their own legal framework, which is made up of territorial and provincial regulations in New Caledonia and territorial regulations in French Polynesia. The situation in the different territories and Mayotte therefore varies according to the case :
French Polynesia has fairly comprehensive legal provisions which adequately cover coral reef problems
In New Caledonia, some important legal instruments are entirely absent. Impact studies are not compulsory, and there are no legal provisions for zoning (e.g. SMVM). The Nouméa Agreements have given greater recognition to customary laws and administrative structures, which should strengthen their role in the future.
Mayotte has adapted and extended the Nature Protection Act, which has been applied since 1997. Other national laws do not apply.
Wallis and Futuna have no legal provisions relating to nature protection, besides some fishing regulations. However, bans on certain activities or rules on natural resource use may be issued by customary authorities.

Main regulatory problems in the territories
Absence of legal obligations for nature protection (in the widest sense) in Wallis and Futuna, and impact studies in New Caledonia.
Grey areas regarding precedence between overlapping regulations (New Caledonia, Mayotte).
Enforcement of some laws and regulations can be extremely complex in New Caledonia and French Polynesia as a result of problems relating to the distribution and/or overlap between powers exercised by different public bodies (State/Territory/Provinces in New Caledonia, State/Territory in French Polynesia). This

problem is particularly acute in marine affairs, especially in lagoons, where powers are not always clearly separated and may overlap.
In all the overseas *départements* and territories, even when regulations are adequate, lack of enforcement is a major source of problems because the efforts and means used in attempting to enforce existing rules are often inadequate.

European directives and regulations
The 1992 Habitats Directive on the conservation of natural habitats and wild flora and fauna was designed to protect biodiversity in Europe, in particular through the Europe-wide Natura 2000 network. The Directive requires all Member States to draw up inventories of sites which need to be protected as habitats of various plant and animal species.
The 1979 Birds Directive on the conservation of wild birds sets out measures on protection, conservation, hunting and selling of wild birds and their eggs, nests and habitats.
Regulation 1973/92 institutes a financial instrument for environmental programmes (LIFE 1992), which is designed to contribute to the development and implementation of Community policies and legislation on the environment.
Directive 85/337 sets out rules on impact studies.
Most of the agreements, directives and regulations of the European Union, as well as those which are designed more specifically for ultra-peripheral regions such as the French islands, are applicable in all French *départements* , since these are all considered as European territory. However, the Habitats and Birds Directives do not apply as yet in the*départements*, since their provisions only cover Europe as a geographical entity. The LIFE programme does apply, however, except for activities which are associated with the Birds and Habitats Directives. The Directives on impact studies and CITES provisions apply in all the*départements* as well as metropolitan France.
European Community treaties and law do not apply in the territories as these are not legally part of the European Union.

International conventions
All international conventions on the environment which have been ratified by France are applicable in French overseas territories (except those ratified by the European Community rather than France itself), unless explicit provisions are made to the contrary. To comply with constitutional jurisprudence, the territories parliaments have to be consulted on any bill authorising the ratification of any international convention which addresses issues that come within the scope of the Territory (i.e. including environmental issues). Most of the major conventions are included in the French Ministry of Spatial Planning and Environment's list of international conventions applying to French overseas territories.
However, although these conventions may be applicable in the territories, the relevant authorities often have no legal provisions on how they should be enforced or adequate means, and are not always adequately informed, so that their actual enforcement in those territories remains problematical.

The 1971 **Ramsar Convention** (on wetlands of international importance especially as waterfowl habitat), which has its headquarters at the IUCN, concerns all wetlands and marine areas to a depth of 6 metres and is applicable in all the overseas *départements* and territories.
At present, 10 of the world's Ramsar sites include coral reefs. The only French coral reef site is the Grand Cul-de-Sac Marin off Guadeloupe. The others are in Australia (Moreton, Shoalwater and Corio Bays and Pulu Keeling National Park), Costa Rica (Gandoca-Manzanillo), Guinea (Ile Blanche), Honduras (Parque National Jeannette Kawas and the Refugio de Vida Silvestre Sanctuary) and Venezuela (Archipel de los Roques).
The last Conference of the Parties recognised that coral reefs were not adequately represented and recommended that others should be designated by the Parties (Recommendation 6.7). The French Ministry of Spatial Planning and Environment has therefore asked for proposals to be submitted to the national Ramsar Committee to protect several French coral reef sites under the provisions of the Convention.

The 1973 **Washington Convention** on international trade in endangered species of wild fauna and flora (CITES) is also applicable. This convention is designed to control international trade in the species listed in the two Annexes to the Convention : all international trade in Annex 1 species is prohibited, while trade in Annex II species requires a permit. The lists were last updated in December 1997.
In France, the Convention is administrated by the Ministry of Spatial Planning and Environment's Nature and Landscapes Directorate (DNP), which is responsible for issuing permits, while the Fauna and Flora Secretariat of the National Natural History Museum is responsible for scientific matters. Therefore, all overseas *départements* and territories permits are issued by the Ministry in France, except for New Caledonia where powers are delegated to the Territory's Secretary-General. The geographical distances between the overseas *départements* and territories and central government make it difficult to centralise management functions, so a decentralisation process is now under way in which management powers will be delegated to the overseas *départements* and territories.

The aims of the **Paris Convention** on protection of the world's cultural and natural heritage (Paris/Unesco 1972) are to establish a representative list of sites of global cultural and natural importance and to protect and manage these sites. There are no coral reefs in overseas territories on the World Heritage list, but the UNESCO Man and Biosphere programme (MAB), which protects representative ecosystems, has established two French biosphere reserves protecting the coral ecosystems of the Grand Cul-de-Sac Marin in Guadeloupe and Taiaro Atoll in French Polynesia.

Under the **Biodiversity Convention** (Rio, 1992), France contributes funds to the Global Environment Facility (GEF) and has established its own fund (F-GEF). The F-GEF can support measures to protect coral reefs, such as those in the Lesser Antilles and Mayotte. France has implemented an action programme to preserve wild fauna and flora. Except for turtles and marine mammals, this National Action Plan does not yet deal with marine biodiversity, which means that there are no action plans for threatened marine species in the overseas *départements* and territories.

The 1979 **Bonn Convention** on the conservation of migratory species of wild animals aims to protect migratory species, in particular through international agreements, and covers both turtles and marine mammals.

International regional conventions

South Pacific

The 1976 **Apia Convention** on nature conservation in the South Pacific came into force in June 1990. The Parties to the Convention undertake to promote the establishment of protected areas (national parks or reserves) in order to preserve representative examples of natural ecosystems, outstanding landscapes, striking geological formations and regions or objects of aesthetic interest or historical, cultural or scientific value.

The 1996 **Nouméa Convention** on protection of the natural resources and environment in the South Pacific region (SPREP) came into force in 1990. Member countries undertake to prevent, reduce and control pollution in the South Pacific. Two protocols have been signed, on the prevention of pollution by dumping (including radioactive waste), and on cooperation in controlling pollution emergencies in the South Pacific region. The Nouméa Convention also recommends that members should take all necessary measures to protect and preserve rare or fragile ecosystems and declining, threatened and endangered species of fauna and flora and their habitats.

Indian Ocean

The 1985 **Nairobi Convention** and Protocols provides the legal basis for actions concerning the East African marine environment, and addresses protected areas and wild fauna and flora, cooperation in controlling marine pollution emergencies, and an Action Plan for the protection, management and development of the marine and coastal environment in the East African region. The Nairobi Convention came into force on May 30 1996. The Secretariat is located in Seychelles.

The Caribbean

The regional **Cartagena Convention** addresses the protection and enhancement of the marine environment in the Caribbean. It was signed by 19 countries in 1983, and came into force in 1986. Two protocols were also signed, on cooperation in controlling oil spills and on specially protected areas and wildlife. The objectives of the Convention are to control pollution, establish protected areas, preserve rare and fragile ecosystems and the habitats of declining, threatened or endangered species. The Parties also undertake to cooperate on a number of environmental issues and to ensure that environmental impact assessments are carried out for major development projects. The Secretariat is based in Kingston, Jamaica.

Planning and Management Tools

Integrated coastal area management

The 2 August 1984 Act on powers granted to Overseas Regions requires the latter to draw up a Regional Planning Document (SAR - *Schéma d'Aménagement Régional*), which establishes the basis for territorial development and environmental protection policies and the primary functions attributed to the different parts of each region.

The *Schéma de Mise en Valeur de la Mer* (SMVM) is a zoning plan for marine areas, which defines policy guidelines for coastal protection, use and planning, with reference to the French Coast Act. As a urban planning document setting out zoning measures, the SMVM is legally enforceable. It is drawn up under the authority of the Prefect and in collaboration with all stakeholders in the various sectors of activity in each administrative region. The document analyses the existing situation in coastal areas and potential developments in each sector, and sets out policy guidelines, especially with regard to the potential primary functions of the different coastal zones (fishing, aquaculture, agriculture, harbours, urbanisation, environmental protection etc.) and relevant statutes. It also sets out the measures required to protect the marine environment and may specify limitations to be observed in adjoining sectors to preserve habitats and ecosystem balance.
The SMVM for La Réunion was approved on the 6th November 1995. Coral reefs and their outer slopes are officially recognised in the document as sensitive areas and given strictly protected status. The SMVM for Martinique - which is scheduled for approval in the near future - recognises coral reefs and sensitive natural areas requiring the enforcement of specific effluent standards. The SMVM for Guadeloupe is currently being prepared.
There are no such documents for the territories and Mayotte, where French legislation does not apply.

French Polynesia, however, has adopted a similar regulation on zoning plans for marine areas, the PGEM (*Plan de Gestion des Espaces Maritimes)*. This is based on the SMVM, which has been specifically adapted to the Polynesian lagoon environment. The PGEM is also a planning document drawn up to coordinate the rules and conditions for the use of lagoons and coastlines, established according to the primary function attributed to each zone (fishing, conservation, tourism, navigation etc.). Responsibility for drawing up the PGEM lies with the 3 territorial Ministries of the Sea, of the Land Management and of the Environment. The PGEM is drawn up in consultation with all stakeholders, and will be first implemented in the Society Islands.
New Caledonia, as a TOM, has no such legally binding planning documents, but the South Province has commissioned a planning and management document for the greater Nouméa coastal area. Although it has not been officially adopted, the plan is currently in use as a working tool.
In Mayotte, an SMVM and a lagoon management plan are under consideration.

Water management
The French Water Act of the 3 January 1992 (in which Article 44 relates to the DOM) introduced two types of legally binding planning documents, both of which are designed to establish policy guidelines for integrated management. Integrated management means achieving a balance between water resource protection and water uses in the different sectors, in order to guarantee the sustainability of the resource and to maintain environmental quality. The two documents are :
Water Management Master Plans (SDAGE - *Schéma Directeur d'Aménagement et de Gestion des Eaux*) which apply to the major catchment areas and are drawn up by a River Basin Committee (*Comité de Bassin*) on the initiative of the Prefect ;

Water Management Plans (SAGE - *Schéma d'Aménagement et de Gestion des Eaux*) which apply to smaller, indivisible hydrographic units and are drawn up by local water management committees (CLE - *Commission Locale de l'Eau*).
The SDAGE for La Réunion is now being developed, and classifies coral reefs as highly sensitive and vulnerable areas. Domestic and industrial effluent and rainwater run-off will either have to be treated by biological or physico-chemical means, or prevented from entering coral reef areas. Specific recommendations on the levels of effluent treatment required are set out by zone. SAGEs are being drawn up for the south and west coasts of La Réunion. The SDAGE for Guadeloupe and Martinique should be finalised in 1999.

Local Environment Charters
The local Environment Charter concept was first launched in 1992 on the initiative of the Minister of the Environment, to promote environmental management and sustainable development policies through practical activities. The Charter for La Réunion was signed in 1996. Charters have also been drawn up in Polynesia for the islands of Bora-Bora, Huahine, Moorea, Raiata-Tahaa and some municipalities in Tahiti, but are not yet being applied. In the North and South Provinces of New Caledonia, action plans for the environment, with similar principles and aims to the charters, are either being developed or already completed.

Impact studies
Impact studies have only recently been introduced in the overseas *départements* and territories. They are now becoming more widely used, but follow-up procedures are not always adequate and it is likely that the measures prescribed are not always observed. Moreover, they are not systematically carried out by the relevant authorities when development work is undertaken, and are not compulsory evrywhere (New Caledonia and Wallis).

Management of biological resources
The exploitation of biological resources is essentially governed by internal regulations in each overseas *départements* and territories (catch sizes, quotas, seasonal bans, fishing zones, banned species, etc.). New Caledonia is practically the only territories where those management rules (for certain species) are based on scientific studies of population dynamics and species biology. Community management of renewable resources is not a familiar concept in the overseas *départements* and territories, which could to be further developed and applied.

Conservation measures

Marine protected areas
IUCN Protected Area Categories (1984)
Scientific Reserve / Strict Marine Reserve
National Park / Marine National Park
Natural Monument
Nature Conservation Reserve / Marine Sanctuary
Protected Seascape

Resource Reserve
Anthropological Reserve
Multiple Use Area
Biosphere Reserve
World Heritage Site

Legally binding conservation instruments in the overseas *départements* and territories are the same as in metropolitan France (national parks, nature reserves, regional nature parks, biotope protection orders, designated sites, fishing restrictions etc.). Existing French regulations on the marine environment do not readily allow marine parks to be established. Most protected marine areas, whether or not they are included in a national park or known as "marine parks", actually have the legal status of nature reserves.

In the Territories, protected area regulations are specific to each territory. In French Polynesia, protected areas are classified as Territorial Parks or Reserves. New Caledonian reserves are under the Provincial authorities. The South Province has three different types, known as special marine reserves, strict marine reserves and special wildlife reserves (*réserves spéciales marine, réserves marines intégrales, réserves spéciales de faune*).

All protected marine areas in the overseas *départements* and territories are thus classified as reserves, except the Saziley Territorial Park in Mayotte.

The oldest and most numerous marine reserves are in New Caledonia, where some have already been assessed. A new nature reserve is to be established in the near future to cover all coral reefs in La Réunion, where coral reef management policies were first launched in 1997 with the creation of the Marine Park Association.

Protected area management and monitoring is variously implemented : New Caledonia has considerable means in this respect, although they are still inadequate in view of the size of the lagoon ; monitoring facilities exist in Mayotte and La Réunion but not in French Polynesia, where any marine reserves are very remote from Tahiti and not patrolled at all.

The scattered French islands in the Indian Ocean were classified as nature reserves in 1975 by order of the Prefects, but this procedure only provides low-level protection.

ZNIEFF areas

The ZNIEFF scheme (for the identification of natural areas of ecological and wildlife interest) was launched by the French Ministry of Spatial Planning and Environment in 1982, after an appropriate methodology had been devised. The aim was to identify all French areas of particular ecological interest, on the basis of scientific and field data, in order to create a tool to support policy decisions relating to land management, protected areas and fund allocation. The Natural Heritage department of the National Natural History Museum's Institute of Ecology and Biodiversity Management (IEGB) is responsible for coordinating the inventory of land and marine areas, both in metropolitan France and in the *départements*.

The areas identified are of two types :

Type 1 ZNIEFF areas are generally small in size and are established to protect a particular species or habitat.

Type 2 ZNIEFF areas are large, naturally diverse areas which have remained relatively undisturbed by human activities and offer significant biological potential.
The inventory has more recently been extended to marine environments in the *départements*, and a specific methodology was developed in the latter case (Guillaume *et al*, 1996) and tested in three pilot sites in each of the three *départements* (La Réunion, Martinique and Guadeloupe). A workshop was organised in Guadeloupe in November 1997 to validate the method and officially launch the ZNIEFF scheme for the overseas *départements* marine environment (*ZNIEFF-mer des DOM*). The ZNIEFF scheme is not applied in the Territories.

RAMSAR sites
At present, the Grand Cul-de-Sac Marin in Guadeloupe is the only overseas *départements* and territories coral reef area included in the Ramsar list of wetlands of international importance. Discussions are under way between the Ministry of Spatial Planning and Environment and the National Natural History Museum to apply for the inclusion of other overseas *départements* and territories coral reef areas in the Ramsar list.

Biosphere Reserves
Taiaro Atoll in the Tuamotou Archipelago in French Polynesia has been declared a UNESCO Biosphere Reserve under the Man and Biosphere Programme. The Grand Cul-de-Sac Marin in Guadeloupe was designated as a Biosphere Reserve in 1994. Plans are being considered to establish another Biosphere Reserve in Mayotte.

Coastal and Lakeshore Conservation Agency (CELRL)
CELRL was set up to purchase coastal lands for protective purposes, and currently owns 6 sites in Guadeloupe (184 hectares), 6 in Martinique (1 135 hectares), 9 in La Réunion (746 hectares) and 2 in Mayotte (322 hectares).

Coral reef conservation in the overseas *départements* and territories
Protected marine areas exist in all the overseas *départements* and territories except Martinique, Wallis and Futuna Islands, and Clipperton. The small French islands scattered in the Indian Ocean have a specific system which only ensures low-level protection (reserves established by order of the Prefects).
14 protected areas have been established throughout the overseas *départements* and territories (not counting the scattered Indian Ocean islands), with 13 classified as nature reserves and 1 as a park.
62 000 hectares of coral reefs and lagoons are protected, i.e. less than 1% of the total area (not counting the scattered Indian Ocean islands).
1 Ramsar site : the Grand Cul-de-Sac Marin in Guadeloupe.
2 Biosphere Reserves : Taiaro Atoll in French Polynesia and the Grand Cul-de-Sac Marin in Guadeloupe.
ZNIEFF natural areas of ecological and wildlife interest : inventory under way for *départements* marine areas, 3 pilot sites established in each *départements*.
Coastal and Lakeshore Conservation Agency lands in the *départements* and Mayotte : 22 sites purchased covering a total of 2 265 hectares.

Monitoring networks

In the overseas *départements* and territories, marine environmental monitoring focuses on:

bathing water quality

overall water quality (physico-chemical parameters, pollutants)

the health status of coral reefs

Monitoring networks for bathing water quality exist in La Réunion, in the four French Polynesian islands with the largest local and tourist populations and in the Caribbean islands.

At present, there are four coral reef monitoring networks in operation :

a territorial coral reef monitoring network in Tahiti, which was set up in 1989 and has recently been evaluated (for the island of Tahiti only),

a monitoring network for French Polynesian coral reefs, established in 1995 and operating in 11 islands,

a Coral Reef Observatory (ORC - *Observatoire des Récifs Coralliens*) in the South Province of New Caledonia was set up in 1997 and is also part of the global Reef Check monitoring system,

a regional GCRMN network is currently being established in the Indian Ocean, under the Indian Ocean Commission's Environment Programme. Four stations have been operational in La Réunion for nearly a year. In addition, a feasibility study has been completed for physico-chemical and biological water quality monitoring in 17 stations, under the Water Management Plan.

A coral reef observatory (ORC - *Observatoire des Récifs Coralliens*) currently being set up in Mayotte will ultimately become part of a larger marine observatory for coral reefs and rare species.

Links have to be established between these different networks which have been set up independently and have no common methodology, and their data could be centralised at national level.

Worldwide Coral Reef Monitoring

The Global Coral Reef Monitoring Network (GCRMN) is now deployed in 6 regions and in sub-node, within each region. Each regional sub-nodes employs specialised staff to train monitoring teams in each participating country. Monitoring operations are designed for local community involvement, with preliminary funding provided by the countries themselves, development banks and other donor organisations. The methodology needs to be flexible enough to adapt to existing networks. The standard methodology (English et al., 1994) relies on several techniques including manta rows, linear transects, quadrats and population counts for some fish species. Social, economic and cultural parameters are also taken into account. Monitoring data are integrated into the ReefBase database.

(ICLARM, Manila)

ReefCheck is another recently established network (1996) which relies on voluntary divers working under scientific supervision. The network is expanding rapidly, with just over 100 sites monitored today and the first status report published in 1997. Basic methods are very simple and rely on linear transects, with population counts of a small number of indicator fish species, some invertebrates and substrate data. All

monitoring data are centralised and processed by the Hong Kong University of Science and Technology.

France contributes to the development and operation of the GCRMN, of which the various overseas *départements* and territories research centres are potential sub-nodes : La Réunion is already part of the regional IOC sub-node and French Polynesia has already applied to become one of the regional sub-nodes in the South Pacific.
France is also a member of the global Reef Check monitoring network, through New Caledonia. Reef Check operations are also planned in La Réunion and French Polynesia from 1999.

Coral Reef Monitoring in the South Western Indian Ocean.
A methodological handbook on coral reef health monitoring in the South Western Indian Ocean has been issued in French under the IOC Regional Environment Programme. The methodology is an adaptation of the GCRMN system to the specific conditions in the area, and is both simple and cheap to implement. Both reef flats and outer slopes are monitored for :
physico-chemical water and seabed parameters
living organisms depending on the seabed and benthic environment
fish populations.
The method is designed for step by step continuous training of observers, beginning with basic training in the simplest procedures and gradually progressing to more complex observations (Conand et al, 1998).

Research
Except for Wallis and Futuna Islands, where research has only been sporadic, and Mayotte which has no local research centre, there is considerable scope for research activities in the overseas *départements* and territories, especially on coral reefs.
All the overseas *départements* and territories have university faculties, all of which run specialised marine ecology laboratories working on coral reefs : the French University of the Pacific in New Caledonia and French Polynesia, the University of La Réunion, and the Antilles-Guyane University which is based in Guadeloupe but also operates in Martinique.
ORSTOM (the Office of Overseas Scientific and Technical Research) operates in French Polynesia, La Réunion and New Caledonia, which has one of the largest overseas ORSTOM centres (in Nouméa).
French Polynesia has a department of the *Ecole Pratique des Hautes Etudes*, as well as the Island Research Centre and Environmental Observatory at Moorea (CRIOBE - *Centre de Recherches Insulaires et Observatoire de l'Environnement*).
IFREMER, the French Research Institute for Use of the Sea, operates in all the overseas *départements* and territories.
The *Institut Territorial de Recherches Médicales Louis Malardé* is one of the local research organisations in French Polynesia undertaking coral reef studies.
It is estimated that about 150 to 200 French coral reef specialists are currently working in France and the overseas *départements* and territories.

From the earliest coral ecosystem studies dating back to the early 1960s - particularly those in Tulear in Madagascar or the Singer-Polignac mission in New Caledonia - French researchers have made important contributions to the advancement of knowledge and understanding of the components, organisation and functions of these ecosystems.
Today, the range of current fundamental and applied research activities conducted in the overseas *départements* and territories, often with international collaboration, is important, from descriptions of communities and biotopes, ecology and ecosystem functions and the carbon cycle to coastal oceanography, reef geology and resource surveys. One can particularly mention research on atoll ecosystems (Tikehau, Takapoto) and carbon flows in coral ecosystems (studies on Tiahura, Moorea) ; geological surveys in Tahiti, New Caledonia and the scattered Indian Ocean islands have produced accurate reconstitutions of coral reef growth strategies during the Holocene period.
As a result of numerous scientific studies and publications, the coral reefs off La Réunion and Moorea in French Polynesia and the New Caledonian lagoon are among the most intensively researched coral environments in the world. The quantity of data collected on French Polynesian reefs, in particular, has produced a number of reference works : Mururoa and Fangataufa (4 volumes), Tikehau, Takapoto, Tubuai and Rapa, the Marquesas and Gambier islands. There are 7 volumes published on the reefs of New Caledonia (Singer-Polignac Foundation).

National Coral Reef Research Programme (PNRCO)
The PNRCO is based on a three-yearly programme. In 1994-1996, the programme focused on the carbon, carbonate and nutrient cycles in coral reefs in the past, present and future, and awarded grants to fourteen projects and several workshops. The focus for 1997-1999 is on : 1) carbonates past and present (biomineralisation and coral reef growth), 2) coral reef and lagoon ecosystem functions (trophic chains, recruitment, stability, successions, bio-indicators, characterisation of degrees of anthropogenic change), 3) reef oceanography (reef-ocean interaction).

National programme on Biodiversity Dynamics and the Environment and Marine Diversity Network
The national programme on Biodiversity Dynamics and the Environment (*Dynamique de la Biodiversité et Environnement*) is the French contribution to the international scientific DIVERSITAS programme. The aim of this programme is to promote international research in 1) functional biodiversity, 2) biodiversity origins, maintenance and losses, 3) systematics, inventories and classification, 4) biodiversity monitoring and 5) conservation, restoration and sustainable use.
The Marine Diversity Network (*Réseau Diversité Marine*) was set up in 1994 with the support of the CNRS (the French National Centre for Scientific Research) and IFREMER. The network supports programmes on 1) flora and fauna inventories, 2) marine genetics and diversity, 3) biodiversity of marine renewable resources and 4) biodiversity and ecosystem functions.

Applied research and coastal engineering in coral reef areas

Several applied research and engineering methods for coral reefs have been developed in the overseas *départements* and territories :
Mapping methods for sites earmarked for development
Methodologies for impact studies in coral areas, with a practical methodological handbook
Development of geotextile screens to prevent coral sediment produced during extraction and dredging operations from settling over reefs
Development of innovative coastal protection and erosion control constructions imitating natural forms (coral platforms, conglomerates and beach rocks)
Restoration of coral beds damaged by seabed dredging, by transplanting live corals to reconstitute coral formations.
Mangrove transplantation and use of mangroves for biological waste treatment.

Funding
Funds for coral protection and management activities in the overseas *départements* and territories are essentially provided through planning agreements signed by the State and the overseas *départements* and territories, and through European Union mechanisms.

National and local funding
Activities provided for in planning agreements (designed to promote overseas *départements* and territories development) are funded in equal proportions by local institutions and the State, through various ministries. Not all funds which concern coral reefs can be readily identified : some are directly intended for coral reef protection, but most go to projects such as waste treatment, which may have equally an important though indirect impact.
Direct funding for coral reef activities is comparatively rare, and the funds provided through planning agreements are very limited. The French Coral Reef Initiative should make every effort to ensure that environmental concerns relating to coral reefs are taken into consideration in the forthcoming negotiations on planning agreements for 1999-2013.
Some examples of projects funded under 1994-1998 planning agreements :
French Polynesia : Marine area management plans and marine parks,
New Caledonia (South Province) : purchase of a patrol vessel, evaluation of marine reserves,
La Réunion : financal contribution to the creation of the Marine Park Association.

European funding
European funding mechanisms which concern the *départements* include ENVIREG (ENVIronment and REGions) 1991-1993, and, more recently, the REGIS programmes (Community initiative concerning the most remote regions) and other funds provided under the European Regional Development Fund (infrastructure), EAGGF (agriculture) and ESF (training, social actions). The La Réunion Marine Park was partly funded under European programmes.
The TOM are not legally part of the European Union. However, under the Treaty of Rome, the overseas countries and territories of the Member States have associate status which makes them eligible for EU funding through the European Development

Fund (EDF). Agreements on their associate status are periodically renegotiated in liaison with the Lomé Convention, once the different EU/ACP (African, Caribbean and Pacific countries) agreements have been signed. After each "decision of association", the Territory, in partnership with the relevant Member State and the European Commission, draws up a new indicative programme establishing the action programmes to be funded under the EDF. Up to now, no European funds to the TOM have been awarded directly to coral reef activities, although the funds provided for waste treatment and research on pearl culture in French Polynesia and the grant to the Nouméa Aquarium deserve to be mentioned.

Private funding

A few sources of private funding also exist. The Naturalia Polynesia Foundation, an umbrella organisation set up by several Polynesian companies (Pacific Perles, Robert Wan, Electricité de Tahiti, Maori Perles, Continent, Nautisport and Total) has funded several coral reef activities in French Polynesia. The New Caledonian Nickel Company funds an environmental programme called "*nickels de l'inititative*", and the Total International Foundation grants funds to a coral reef project under the DIVERSITAS research programme.

Overall, funds for coral reef protection and management are limited. French Coral Reef Initiative should therefore ensure that funds for coral reefs are sought much more actively, through EU mechanisms concerning both *départements* and TOM, national funds, private finance, trust funds and foundations.

ACRONYMS and ABBREVIATIONS

ORGANISATIONS

ACORFrench Coral Reef Society
ADEMEFrench Agency for Environmental and Energy Management
AIMSAustralian Institute of Marine Sciences
BRGMOffice of Geological and Mining Research (France)
CELRLCoastal and Lakeshore Conservation Agency (France)
CEPPacific Nuclear Testing Centre (France)
CIRADCentre for International Cooperation in Developmental Agronomic Research (France)
CLOELocal Environment Coordination Unit (La Réunion)
CNRSNational Centre for Scientific Research (France)
CRIOBEIsland Research Centre and Environmental Observatory (Moorea, French Polynesia)
DAFAgriculture and Forests Directorate (Wallis and Futuna)
DAFEAgriculture, Forests and Environment Directorate (New Caledonia)
DDASS*Département* Office for Health and Social Affairs (France)
DDE*Département* Office for Infrastructure (France)
DIRENRegional Office of the Environment (France)
DNPNature and Landscapes Directorate (France, Environment Ministry)
ICLARMInternational Center for Living Aquatic Resources Management (Philippines)
IEGBInstitute of Ecology and Biodiversity Management (France)
IFREMERFrench Research Institute for Use of the Sea
INRANational Institute of Agronomic Research (France)
IOCIndian Ocean Commission
IOC-UNESCOUNESCO Intergovernmental Oceanographic Commission
IUCNInternational Union for the Conservation of Nature and Natural Resources
NGONon Governmental Organisation
ONCNational Hunting Office (France)
ONFNational Forestry Office (France)
ORSTOMFrench Office of Overseas Scientific and Technical Research
SCORScientific Committee on Oceanographic Research
SEACAMSecretariat for Eastern African Coastal Area Management
SPREPSouth Pacific Regional Environment Programme
UNEPUnited Nations Environment Programme
UNESCOUnited Nations Education, Science and Culture Organisation
WWFWorld Wide Fund for Nature

OTHER ACRONYMS

CARAGCentre for Regional Activities (Caribbean and Guyana)
CITESConvention on International Trade in Endangered Species
CLELocal Water Commission (France)
DPMPublic Marine Property (France)
DOMOverseas *Départements* (France)
EDFEuropean Development Fund
EEZExclusive Economic Zone
ENVIREGENVIronment and REGions (European Community Programme)
ERDFEuropean Regional Development Fund

EUEuropean Union
FADFish aggregation device
FIDESInterministerial Fund for Economic and Social Development
FIDOMInterministerial Fund for Overseas Development
GEFGlobal Environment Facility
ICAMIntegrated Coastal Area Management
GUAGuadeloupe
ICRIInternational Coral Reef Initiative
IOC/EU-REPIndian Ocean Commission/European Union Regional Environment Programme
LIFEFinancial Instrument for the Environment (EU)
MABMan and Biosphere (UNESCO Programme)
MARMartinique
MAYMayotte
NCNew Caledonia
ORCCoral Reef Observatory (New Caledonia, Mayotte)
PGEMMarine Areas Management Plan (French Polynesia)
PNRCONational Research Programme on Coral Reefs (France)
POLPolynesia
PTOMOverseas Countries and Territories (France)
RAMSARConvention on wetlands of international importance
RDPRegional Development Plan
RUNLa Réunion
SAGEWater Management Plan (France)
SARRural Planning Document (France)
SDAGEWater Management Master Plan (France)
SDPSustainable Development Plan
SMVMMarine Coastal Areas Zoning Plan (France - DOM)
SNASensitive Natural Area
TDENS*Département* Tax to Preserve Sensitive Natural Areas (France)
TOMOverseas Territories (France)
WFWallis and Futuna Islands
ZNIEFFNatural Areas of Ecological and Wildlife Interest (France)

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