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**INTERGOVERNMENTAL OCEANOGRAPHIC COMMISSION
(of UNESCO)**

**STRATEGIES FOR THE PROTECTION AND DEVELOPMENT OF
THE OCEANS AND COASTAL AREAS**

(D R A F T)

This document was prepared by a joint IOC-UNEP Consultant to form a basis for a possible joint UNEP and IOC position paper on matters related to the United Nations Conference on Environment and Development (UNCED), Brazil, 1992. It is therefore submitted to the IOC Assembly and will be submitted to the UNEP Governing Council (Sixteenth Session, May 1991), with the aim of obtaining advice, comments and possibly endorsement from the Governing Bodies for submission to UNCED in an appropriate way.

It should be noted that the document is structured mainly in accordance with the General Assembly Resolution on the Conference.

The Assembly is invited to review the document with the view of endorsing it in principle, and in particular to approve the Executive Summary. In view of the length of the document, and its availability in English only, the Assembly may wish to review only the Executive Summary and endorse it in principle, after possible amendments requested by the Assembly.

The views of the Assembly will be transmitted to the UNEP Governing Council.

The Executive Summary has been endorsed in principle by the Executive Director of UNEP and the Secretary IOC, in consultation.

EXECUTIVE SUMMARY

Importance of the oceans, coastal areas, and their resources

1 The oceans have always had and will play a decisive role in shaping the life of this planet. The global energy budget and the biogeochemical processes on which all life depends are critically determined by the oceans.

2 The interactions between the oceans and the coastal terrestrial areas are numerous and very intimate. The ecological systems of the coastal areas, as well as the socio-economic development of these areas, are heavily influenced by the conditions created by the proximity of the oceans. Nowhere is this mutual interdependence and influence so evident as in the coastal and near-shore zones of enclosed and semi-enclosed seas, and on islands.

3 The near-shore maritime areas contain the largest part of commercially exploitable marine living and mineral resources. They are also the zones used for mariculture, whose full potential is yet to be developed.

4 Due to the numerous advantages offered by the coastal and near-shore areas, they have since antiquity been among the most intensively used parts of the planet. One third of today's population lives on the sea-shores or in their immediate proximity; a variety of industries have developed on a large scale along the coast; the coastal zones are a major recreation area and the basis for expanding tourism, harbours are essential as centres for national and international transport and trade.

Main problems and their causes

5 The nature of the problems affecting the marine and coastal environment has not altered greatly in the past decades. However the incidence and extent of human interference in the coastal areas, as well as our perception of the main threats and corresponding solutions have changed markedly on the basis of knowledge and experience accumulated over the same period. Today the environmental problems are recognized as problems stemming from inadequate or improper development whose ultimate solution should be sought in resolving conflicting interests for space and resources in the framework of an environmentally sound economic development.

6 Aside from some living resources, the open oceans seem to be still largely unaffected, but the physical and ecological degradation of coastal areas and the increase in pollution of near-shore waters from land-based sources are accelerating at an alarming pace. The often dramatic and irreversible alteration of natural coastal ecosystems and the extensive pollution of the sea

are primarily caused by the rapid growth of coastal settlements, the expansion of recreational areas, and the concentration of industrial development in coastal zones, accompanied by inadequate environmental and economic policies. The situation in many enclosed and semi-enclosed seas, largely due to pollution from land-based sources, is of particular concern.

7 The expected impact of predicted climate changes will exacerbate the present problems and may, in areas such as low-lying islands and coastal zones, significantly influence or even imperil their future development and use. The predicted climate change will certainly affect marine living resources in many ways. Large scale changes in total marine fisheries production are not expected, although individual stocks may suffer. Mariculture will probably be more affected. Tropical upwelling zones, which produce large amount of fish resources may shift polewards by hundreds of kilometres. The year to year variability of the resources they support may increase and the increased plankton productivity may reduce oxygen levels and lead to anoxic situations. The increased ultraviolet radiation related to ozone layer depletion may lead, according to some estimates, to detrimental effects on some shallow water ecosystems such as coral reefs, and may affect plankton growth.

8 The oceans and coastal areas are still not considered as finite economic assets which can be used on a sustainable basis only by prudent and rational exploitation. This is particularly evident when development plans and environment confront conventional spending priorities. Therefore relatively low priority is assigned in most national development plans to the protection of these areas and to rational use of their resources. The result is a scarcity of funds needed for measures which could prevent, reduce or eliminate pollution of the marine environment, halt the physical degradation of coastal areas and protect their resources. In reality, such approach leads to seriously reduced capacities for socio-economic development.

9 The situation is specially serious in disadvantaged countries burdened by depletion of natural resources, heavy indebtedness, unstable commodity prices and unfavourable trading systems. International assistance which would allow disadvantaged countries to cope with their environmental problems, often originating from industrialized world (e.g. global climate change), is negligible, frequently even misguided, and is not commensurate with the magnitude of the problems to be solved.

10 The capabilities of most countries, especially the developing ones, are still generally insufficient to cope adequately with the full complexity of the assessment of the problems facing their marine and coastal environment and the rational management of their resources. National institutional structures are generally too weak and lack the interdisciplinary expertise needed for effective action. This weakness of national structures also seriously hampers the effective participation of many countries in international efforts designed to protect and develop the marine and coastal environment.

11 The protection of the marine and coastal environment is reflected in the national legislation of most countries and in numerous international agreements. However, the provisions of these legislative acts are not applied efficiently to guarantee development without undermining the natural resource-base.

12 Public awareness about the problems of the marine and coastal environment is still generally weak although in some countries it plays an important and highly visible role in mobilizing support from broad segments of population for the necessary societal decision-making needed for the development of that environment and rational utilization of its resources.

13 The knowledge accumulated during past decades about the magnitude and the main causes of the problems is considerable and sufficient to realize that the situation is serious and calls for urgent action. The technical solutions to most of these problems are also quite well known and are available. However, present databases and understanding of the processes shaping the natural conditions of oceans and coastal areas are generally inadequate for management purposes and for the reliable predictions about the trends in these conditions and, consequently, forecasts for changes that may be expected contain a relatively high degree of uncertainties.

14 In summary, four main factors, none of them specific to the marine and coastal environment, seem to be at the root of present environmental problems hampering sustainable development:

- (a) inappropriate national and international economic policies and forms of development which do not take into account adequately the environmental consequences of these policies;
- (b) weak regulatory mechanisms and administrative systems dealing with environmental issues;
- (c) insufficient public awareness about the real causes and magnitude of environmental problems, and about the available remedial measures; and
- (d) inadequate forecasting of emerging environmental problems.

Remedies

15 *Sustaining human life and well-being requires development and a healthy environment.* Development can become difficult to achieve if natural resources are depleted or the environment degraded. Therefore, the *ultimate goal* of all strategies for the development and protection of the oceans, coastal waters and their resources should be to ensure their *rational use*. In case of *renewable resources*, rational use must imply *indefinite sustainable use*. The use of *non-renewable resources*, obviously, can not be sustained indefinitely, but must provide the economic basis for build-up of activities and conditions which will ensure

or contribute to a *long-term and sustainable socio-economic development*, once the non-renewable resources are exhausted. Consequently, all remedies for the present and anticipated environmental and developmental problems should be designed with that goal in mind, and their appropriateness should be judged from the degree in which they succeeded to achieve that goal.

16 The problems of the oceans, coastal areas and their resources are of global significance and hence their solution requires *global environmental strategies inseparable from global development strategies*.

17 The present problems are most evident in coastal and near-shore areas under the direct onslaught of man's activities. Although seemingly local in nature, these problems are so widespread and are so evident even at sites far away from their origin that only globally applied strategies have a chance to achieve *long-term solutions*. However, the type and intensity of measures and policies, if they are to be effective, must be made in response to the actual situation, keeping in mind that a solution at one site should not create a nuisance elsewhere. Consequently, the most cost-effective remedies should be sought through *action on local and national level, undertaken in the framework and as part of wider regional and global development strategies*.

18 The protection of high seas and of their resources obviously require a *global approach* because unco-ordinated local or unilateral national action cannot contribute significantly to the solution of their problems.

19 The application of *environmentally sound management practices* in coastal and maritime activities, rather than narrowly defined "conservation", is now accepted as one key to safeguarding and developing the marine and coastal environment and their resources. The unplanned or poorly planned land- and sea-use practices, the irrational exploitation of natural resources, and the pollution to which they incidentally give rise can be avoided only by these means. Management implies use: *rational use*. Emphasis on the concept of *integrated management* reflects a critical change from earlier views of most environmentalists that the oceans had to be preserved unchanged rather than used rationally.

20 The seas have no physical boundaries to prevent movement of polluted waters. Therefore global or regional strategies are needed to *control transboundary pollution from land-based sources*, including pollution reaching the marine environment through rivers and the atmosphere.

21 Although the effects of predicted climate changes may not be felt in the near future, in the long-term their implications for the socio-economic life of coastal zones may be considerable and *adaptation to the changing conditions* will require a long lead-time. Therefore the full complexity of the potential problems which may be associated with predicted climate changes should be analyzed without delay and the possible *policy options and*

measures which may be used as suitable response to the expected impacts should be examined and reflected in the national *integrated coastal zone management plans*.

22 The policies, measures and arrangements for the protection and use of the marine and coastal environment, if they are to be rational and thus effective in the long term, should be based on an *improved understanding* of marine and coastal ecology, including ecosystem dynamics; of the relevant ocean processes; and of their interaction with terrestrial and atmospheric systems.

23 *Long-term systematic research and observation* programmes should be organized according to a globally co-ordinated strategy to *monitor the changes* in the state of the marine and coastal environment and of ocean processes, and their interaction with atmospheric and terrestrial processes. The results of the research and observations should be critically evaluated and widely disseminated through easily accessible databases.

24 The national institutions in charge of environmental protection in many countries are usually weak or even nonexistent. Their influence on national development plans is frequently only of marginal importance. Without creating *strong national infrastructures*, equipped with interdisciplinary expertise, and without giving them access to the circles where decisions relevant to the protection of environment are made, no effective protection of coastal and marine environment could be expected.

25 The protection and development of seas and coastal areas require a variety of expertise, and above all a good grasp of the cross-sectoral nature of environmental protection. While narrow, sectoral technical expertise exists in most countries, greater efforts should be devoted to the *training* of experts in interdisciplinary skills.

26 Effective protection of the oceans can be achieved only through a high level of *intergovernmental co-operation*. It is essential therefore to strengthen and expand the *multilateral programmes and agreements* designed to protect the marine and coastal environment according to the specific needs of the countries concerned.

27 Existing *global and regional agreements*, although not universal remedies, are among the most forceful international arrangements providing the legal basis and signifying the *political commitment* for joint action. Therefore broader adherence to the existing agreements and strict application of their provisions would contribute considerably to the protection of the marine and coastal environment. Whenever appropriate, existing agreements should be expanded or adapted to the changing needs of the countries concerned, and additional agreements should be adopted to regulate subjects not covered by existing agreements.

28 Although *transfer of technology, experience and data*, provision of *training*, as well as *financial assistance, preferential treatment and compensation* are

usually among the provisions of existing international agreements, the developing countries have benefited relatively little from such provisions.

29 The widest *popular participation* in the protection of the marine and coastal environment is essential. Such participation necessitates involvement of those who may be affected by changing environmental conditions in *decision-making debates* about development schemes which may cause such changes. It also requires broad *educational and public awareness programmes*, including introduction of environmental subjects in school curricula on all levels, as well as the provision of regular information to the general public through mass media and special publicity campaigns about the environmental and developmental issues. Such publicity campaigns should emphasize the importance of the potential *contribution from each individual* to maintain a healthy environment as a basic precondition for sustainable socio-economic development.

30 The lack of funds, particularly in developing countries, is the crucial and single major impediment for a more forceful environmental protection action. The remedy, without which all measures and decisions will remain only at the level of declarations, is in the provision of *financial resources* additional to those currently available, enabling the disadvantaged countries to become *equal partners* in dealing with global economic and environmental issues. The financial resources required are of unprecedented magnitude, unlikely to be met from regular government budgets. They could come from increased flow of assistance through the mechanisms of international agreements, from radical expansion of the present *bilateral arrangements* between developing countries and lending/funding/donor/aid agencies and countries, or from new *multilateral funds* through which such resources would be channelled to disadvantaged countries.

31 However, no combination of policies, technologies and resources can significantly ameliorate the present situation unless the *non-technological roots of the problems* are overcome: population pressure on limited resources and space, competitive nationalism, the global maldistribution of wealth and opportunity, the notion that economic growth and human wellbeing are directly proportional and, last but not least, the illusion that supposes civilizations to be self-supporting without help from natural ecosystems. Obviously, in order to achieve these, a *new attitude, based on global solidarity*, would be required.

INTRODUCTION

0.1 The oceans cover 71 percent of the surface of the globe. Historically they played, and continue to play, a major role in shaping the conditions which make the life possible on our planet. The global energy budget and the global biogeochemical cycles on which all life depends are critically influenced by the properties of the oceans and by oceanic processes.

0.2 Most of the earth's life, expressed as biomass, exist within the vast volume of the oceans. The fertility of the seas is determined by the abundance of its plant life, phytoplankton in particular. It is generally high in great upwelling zones and in the shallow coastal waters. The annual phytoplankton production is estimated between 15 and 30 billion (10^{12}) tonnes of carbon. Only part of this biomass gets converted into higher forms of marine life: the annual world fish production is estimated as not more than 30 million (10^6) tonnes of carbon.

0.3 The ecosystems and human activities of terrestrial areas adjacent to the oceans, specifically those of enclosed and semi-enclosed seas, as well as islands, have developed under decisive influence of the sea. The interaction between these coastal areas and the near shore waters is actually so intimate that in considering their future management they should be treated as a single, inseparable entity.

0.4 The coastal and near-shore areas¹ are among the most intensively used parts of the earth. One third of the world population lives within 60 km of the shoreline. The coastal zones are sites for large-scale industrial development, and are a major recreational ground. Harbours are essential centres for national and international trade and transport. About 95 percent of world fisheries catch, close to 80 million tons annually, comes from the near shore areas. Mariculture is a rapidly expanding economic activity.

0.5 Although at present only a fraction of world food supply comes from the oceans, and apart from hydrocarbons and water only a few minerals and chemicals are extracted from the

¹ In the context of this document the term "open oceans" is arbitrarily used for the seaward part of the oceans from the outer limits of the exclusive economic zones, while the "coastal and near-shore areas" are defined as the landward part of the oceans from the outer limits of these zones, together with the adjacent terrestrial environment which influences or is influenced by that part of the oceans.

oceans in any significant amount, the economic value of the oceans is enormous and they are perceived as a potentially significant future source of food, energy and minerals.

0.6 The resources under about 35 percent of the oceans' surface, previously recognized as part of the high seas and common property of mankind, have been recently covered by national jurisdiction of coastal States. The mineral and living resources of these "exclusive economic zones" are considerable and may become, if properly managed, the driving force of the future economic development of many coastal States.

0.7 The present document is an attempt to highlight the inseparable nature of environment and development, to analyze the major problems facing the marine and coastal environment and to recommend strategies which may be applied for the protection and development of that environment.

1 MAIN PROBLEMS, THEIR CAUSES AND POSSIBLE REMEDIES

1.1 The problems of the oceans and coastal areas not only remain as serious as they were identified at the 1972 United Nations conference on human environment, but have actually become much worse, particularly in the near-shore waters of enclosed and semi-enclosed seas. Aside from some living resources, the open oceans seem to be still largely unaffected, but the degradation of coastal and near-shore areas and the increase in pollution from land-based sources is accelerating at an alarming pace. Although it is too easy to be deceived by the vastness of the oceans and to believe that this vastness is a guarantee of invulnerability, the fringes of the oceans are already spoiled in too many places, the malaise is spreading and, if not checked, will gradually engulf the whole globe.

1.2 The danger of the open ocean becoming severely polluted is today considered to be less acute than presumed two decades ago. Studies and observations now indicate that existing problems, and the initial effects of new ones, are most likely to arise in waters close to populated and industrialized coastal areas. Eutrophication and contamination by viruses from sewage disposal are two examples of great concern. Current attention, including research and observations is therefore justifiably concentrated on protecting the coastal and near-shore areas and their resources, especially in the more vulnerable enclosed and semi-enclosed seas, with particular attention being paid to low-resilience resources.

1.3 The present knowledge and experience is generally sufficient to formulate the basis of a rational global strategy for the development and protection of the oceans and coastal areas and to prescribe, within this strategy, specific measures and policies adapted to the actual problems of various countries and regions, and to the capabilities of these countries and regions in applying them.

Coastal and near-shore areas

1.4 Man's marine related activities tend to focus in shallow water near the coast, and the major source of contaminants to the sea is the continental mass. The impact of man along the edges of the oceans is therefore unambiguous, and in many places substantial degradation of the environment is very evident.

1.5 Enclosed and semi-enclosed seas (such as the Mediterranean, the Baltic, the Red Sea, the Black Sea) are particularly vulnerable areas due to the relatively shallow nature of these areas, high density of population on their shores and intensive use of these shores by relatively limited and slow exchange of their waters with those of the large oceans.

1.6 The coastal strip, encompassing the shallow-water and intertidal area along with the immediately adjacent land, is clearly the most vulnerable as well as the most abused marine zone. Its sensitivity is directly tied to the diversity and intensity of the activities which take place there, and the threat to its future is related to the increasing concentration of the world population in these areas. The potential consequences of ill-planned coastal zone development are thus of highest concern.

1.7 In the long-term, the impact of predicted climate changes, especially the various direct and indirect effects of the expected sea level rise, may prove to be among the major environmental problems facing the marine and the adjacent coastal areas of the enclosed and semi-enclosed seas, and of islands.

1.8 Coastal zone management, encompassing integrated development policies and plans and explicit policies for management of the environment and its resources, is today seen as the most effective general framework within which solutions for the environmental problems of coastal and near-shore areas would have to be sought. Sectoral solutions, or solutions relevant only for limited geographic areas, should be undertaken only in the context of large scale national integrated coastal zone management plans in order to ensure that the partial solutions do not weaken the overall developmental goals and targets. Only by this means can the ill-planned land- and sea-use practices, the irrational exploitation of natural resources and the pollution to which they incidentally give rise be avoided. The application of environmentally sound management practices is now accepted as the key to safeguarding the resources of the marine and coastal environment. Management implies use. Emphasis on the concept of management reflects a critical change from earlier concern that the oceans had to be preserved unchanged.

1.9 Formulation, adoption and enforcement of pollution and resource exploitation control measures, including measures designed to protect and rehabilitate damaged living resources, are among the most effective steps in safeguarding the marine and coastal environment. The measures, if they are to be successful, must be commensurate with the severity of the problem and the capacity of the countries to apply them.

1.10 Experience with numerous regional intergovernmental programmes for the protection and management of the marine and coastal environment and of their resources, most of them supported by legally binding agreements, proved that the regional approach is viable and effective. Most of these programmes tend to concentrate on integrated coastal zone management as a general framework within which solutions for coastal and marine environmental problems are sought. The control of pollution from land-based sources is an integral part of these programmes.

1.11 Knowledge and insights into the main problems facing the coastal zones, and specifically those of the enclosed and

semi-enclosed seas, are generally sufficient for meaningful action to be taken which could solve or at least mitigate most of these problems. Action is, however, subject to political commitment and to the availability of funds needed for implementation of rational coastal zone development programmes.

1.12 The main problems hindering more effective action are the inappropriate national and international economic policies, the lack of adequate financial resources and the relatively weak institutional infrastructure needed for a more vigorous implementation of programmes and projects dealing with coastal zone development issues.

1.13 Measures to solve the existing problems and to forestall the emerging ones should not be delayed because the long-term costs of inaction will be severe. Since many of the causes of environmental degradation are rooted in imperfections of the market forces, economic measures would have to play a critical role. However, these measures would have to be balanced with a realistic mix of improved resource management and better regulatory measures, including appropriate fiscal policies, keeping in mind the capacities of various countries to implement them.

Open oceans

1.14 The problems of the open oceans seem to be less severe than those described for coastal waters and near-shore areas.

1.15 The sheer volume of the water in the open oceans is, for the time being, a natural safeguard against significant pollution, although there is no room for complacency. The first ominous signals in the form of pollutants carried by long-distance transport processes, such as winds and large-scale ocean currents, have already been detected. Of particular concern are pollutants with long residence time due to their slow degradation, organochlorines in particular.

1.16 Pollution from sea-bed exploration and exploitation may become a problem if such activities are undertaken on a larger scale and without adequate environmental considerations.

1.17 Dumping of waste into the depth of the oceans and pollution from ships seem to be, at present, under adequate control, thanks to several international agreements and relatively good compliance with the provisions of these agreements. However, the space for waste disposal will certainly become more scarce on land, and the pressure to use the seabed of the open oceans as a disposal site could be expected to increase in the future.

Resources

1.18 Natural ecosystems are largely responsible for the attractiveness of the coastal and near-shore marine environment, and are essential for the maintenance of their biological productivity on which rests the exploitation of commercially important species. Therefore, the protection of these ecosystems and the rehabilitation of those already damaged, should be a high priority. In that context special attention should be paid to the protection of biological diversity through strict measures protecting the endangered and endemic species and their habitats.

1.19 Ecosystems such as mangroves, wetlands, coral reefs and seagrass-beds are imperiled in many parts of the world by ill-conceived developmental schemes, irrational over-exploitation, pollution, siltation and land-reclamation. Many important fisheries resources, including large marine mammals, are generally over-exploited. The economic value of all these renewable biological resources is very high, but unless the principle of strict sustainability is introduced into their exploitation, the long-term benefits which may be derived from their rational use will be considerably diminished and in some cases even irretrievably lost.

1.20 The mineral resources of the oceans, including those in the sea-bed, as well as seawater itself, represent an inestimable economic asset. Some of these resources (e.g. oil and gas) are known to be non-renewable, or at least non-renewable on other than a geological time-scale. The exploitation of such resources obviously can not be sustained indefinitely, but must provide the economic basis for build-up of activities and conditions which will ensure or contribute to a long-term and sustainable socio-economic development, once the resource is exhausted.

1.21 Seawater, due to its abundance, is frequently forgotten as an important resource. The use of that resource is nevertheless multifaceted and while the quality of the seawater is less important when it is used as a medium for transport (shipping) and waste disposal, or as coolant in industrial plants, other uses require high quality standards (e.g. bathing and shellfish-growing waters, water used for desalination) which can be maintained only through an appropriate resource management plan.

2 COASTAL AND NEAR-SHORE ZONE MANAGEMENT FOR SUSTAINABLE DEVELOPMENT

2.1 The environmental problems of coastal and near-shore areas should be considered as problems stemming from inadequate or improper development and therefore their mitigation and ultimate solution should be sought in resolving conflicting interests for space and resources in the framework of an environmentally sound economic development. Environmental problems are more likely to be solved if, at least in the long-term, the solution proves to be economically acceptable and beneficial. Unfortunately, the complexity of the relationship between costs and benefits seldom allows reliable analysis to be conclusive and placing a monetary value on incremental depreciation of the environment remains problematic.

2.2 The degradation of the marine and coastal environment, particularly in many developing countries, is often the consequence of the current economic relationship between the developed and developing world. Over-exploitation of natural resources (e.g. overfishing) and of the environmental capacity (e.g. tourism) is largely caused and determined by the market forces of developed countries, frequently operating at the expense of the environmental quality and resources of developing countries. Without radical changes in the present pattern of their economic development, and without an accelerated socio-economic development, most of the developing countries will continue to suffer from further environmental degradation and from irrational exploitation of their resources.

2.3 The coastal zones of small island States, which for all practical purposes encompass the entire relatively small land mass of the islands and a maritime zone in size frequently far exceeding the islands' terrestrial areas, are a special case because their future environmentally sound development will increasingly depend on management of their maritime resources.

2.4 In the past, when the space and resources of coastal and near-shore environment seemed limitless, only scant attention was paid to the environmental consequences of coastal development and resource utilization. With the increasing pressure on that space and resources their limits became obvious. Therefore, today no activity or project which may affect the quality of the environment should be undertaken without taking into account its likely environmental impact, related socio-economic costs and benefits, and long-term effects. The formal process, known as environmental impact assessment (EIA) should be made mandatory for all projects, activities and programmes which may have environmental implications.

2.5 In view of the significant role carried by coastal and near-shore zones in the development of all coastal States, the application of proper environmental management measures in these zones is of paramount importance in order to ensure sustainable

development at the national level. Major issues which would have to be considered in this context include:

- marine pollution control;
- sustained management of living resources;
- protection of biological diversity;
- rational exploitation of mineral resources;
- emerging global environmental issues affecting coastal development; and
- tools to achieve goals.

Marine pollution control

Status

2.6 The interface between the land masses and the world oceans is among the most intensively used parts of our planet for a great variety of human activities. The maintenance of this geographically narrow, but very specific environment in a healthy and aesthetically attractive condition is essential if it is to satisfy the multipurpose requirements of the human population.

2.7 Aside from physical degradation of the coastal and near-shore zones, pollution is the major problem affecting these zones. Most of the liquid wastes and a growing fraction of solid wastes resulting from man's activities on land are introduced into the oceans through the land/sea interface. Although the oceans are vast, and their waste-receiving capacity is today recognized as an asset which may be used for the disposal of certain types and quantities of waste, their ability to assimilate these wastes without significant degradation is not limitless. The wastes disposed into the near-shore waters from land-based sources are, in many cases, already severely degrading the quality of waters over the continental shelf, which in their entirety comprise only about 8 percent of the total volume of the oceans.

2.8 Knowledge based on science and experience is sufficient to understand the major effects of uncontrolled release of wastes from land-based sources into the marine environment. Modern technology is today also available to reduce or eliminate the disposal of potential pollutants into the marine environment. However, financial resources and incentives needed to apply this technology are insufficient.

2.9 The threat to the marine and coastal environment from the disposal of increasing amount of wastes from land-based sources is today clearly recognized.

2.10 Numerous attempts, some more successful than the others, have been made to control marine pollution. They range from isolated pragmatic local solutions to control pollution in well defined sites from easily identifiable sources, to loose attempts to curb pollution on national and regional levels through a combination of national measures and regional agreements, and to the global approaches to controlling pollution through the general provisions of international agreements, such as the United Nations Law of the Sea Convention, the London Dumping Convention and the Basel Convention.

2.11 Recognizing that pollution from land-based sources is the major source of marine pollution, in the late 1970s and early 1980s serious thought was given to development of a global agreement for the control of marine pollution from these sources. However, at that time it was felt that pollutants from land-based sources, with a few exceptions (e.g. pollutants from non-point sources reaching the marine environment through atmospheric transport), are essentially a problem for near-shore waters of the countries from which they originate, are highly specific for different regions, and consequently require regulatory measures commensurate with their specificity and with the economic potentials of the countries concerned. Therefore the idea of controlling pollutants from land-based sources through the precise and uniform provisions of a global agreement was abandoned and the adoption of region-specific agreements and arrangements, developed according to a set of globally applicable guidelines (e.g. the 1985 Montreal Guidelines), was seen as the best practical approach. The experience with such agreements and arrangements (e.g. the Bonn and Paris Conventions, the Athens Protocol, the EEC Directives), although far from being fully satisfactory, seems to have justified such an approach.

2.12 The control of pollution from maritime accidents, although subject to several international agreements, has a relatively poor record. As revealed by the recent incident involving the Exxon Valdez, accidents, even when they occur in the most developed countries, lead to massive local environmental damage.

2.13 It could be easily argued that marine pollution is mainly the reflection and consequence of problems created predominantly on land, specifically of problems whose roots are in mismanagement of coastal resources. Consequently, solutions to these problems could be found only within the general framework of integrated and environmentally sound coastal zone development and management.

2.14 For both scientific and managerial purposes it is convenient to consider the issues in two categories, as the short time-scale problems of the near-shore waters and the long time-scale problems of the open oceans. The time division between these two categories may be arbitrarily placed at about 100 years. The two categories are intimately linked in space and time through the intensive interaction between the open oceans and the

near-shore waters, and therefore any meaningful strategy to maintain the healthy state of both should be based on principles common to both categories.

Problems

2.15 The uncontrolled release of wastes from land-based sources into the coastal waters, directly or through rivers and estuaries, is an irresistibly attractive option due to its simplicity and low costs. While the total amount of wastes was relatively small, and their composition largely easily degradable, such uninhibited practice was a rational use of the sea as a resource. However, with the growing amount of the wastes disposed into the sea, and with the changing composition of these wastes, which today contain a large number of toxic and non-degradable substances, the situation has radically changed. With the increasing use of the coastal waters for recreation the maintenance of additional aesthetic and sanitary criteria, previously of less importance, became highly relevant.

2.16 Most type of wastes, once introduced into the sea, can not be removed from there. Their fate is determined by their chemical nature and by the physical transport processes (e.g. mixing, sea currents) of the recipient waters. The distance they can reach depends on these processes and on the rate of their decomposition, with the non-degradable wastes obviously having the chance to travel the farthest.

2.17 Some wastes, mostly natural products, are easily and relatively rapidly decomposed to harmless substances, although their end products, if excessively concentrated, may lead to serious disturbances of ecosystems (e.g. eutrophication due to excess of nutrients). Disturbances caused by such wastes can be usually easily remedied by reduction of their input into the recipient waters or by dispersing their input into a larger body of water.

2.18 Other wastes, mostly artificial man-made substances, are degraded only very slowly in the marine environment and may pose aesthetic problems as well as hinder some maritime activities (e.g. discarded or lost nylon fishing nets and plastic sheets may get entangled with boat propellers).

2.19 Certain wastes, such as metals, can not be degraded and although they undergo certain chemical transformations, they remain usually absorbed to the bottom sediments, relatively close to the point of their discharge. Since many of such wastes are highly toxic, their slow but steady accumulation in the sediments may lead to profound ecological changes. The recovery of the damaged ecological systems is usually a very slow process and can not be quickly enhanced by reducing the flow of wastes into the recipient waters.

2.20 Mineral oil (petroleum) and its derivatives, while grossly overrated by popular opinion as serious pollutants originating from ships, particularly maritime accidents, are actually more important as pollutants originating from land-based sources. The widely practised coastal releases of used lubricating oils into the coastal environment is of particular concern, because they contain a variety of highly toxic non-degradable chemicals. Petroleum, being a natural product, is only moderately toxic but some of its end-forms (e.g. tar balls) may seriously degrade the recreational quality of bathing beaches.

2.21 Some other oily substances (e.g. PCBs) and some of the most effective anti-fouling paints (e.g. TBT) are among the most dangerous contaminants of the marine environment due to their extremely slow breakdown to less harmful components and their high toxicity.

2.22 Although the extent of pollution from land-based sources is so ubiquitous that it is assuming global dimensions, the transfrontier effects of this pollution are generally less severe than it is perceived by non-experts. With the exception of substances whose decay is extremely slow, and of discharges from sites in the vicinity of State borders, most of the pollutants remain within the coastal waters of the countries from which they have originated, or they degrade and dilute to insignificant amounts and concentrations before reaching the neighbouring countries. Nevertheless, due to the absence of physical boundaries in the oceans, the pollutants from land-based sources should be considered as a potentially important source of transboundary pollution which does not respect political frontiers.

2.23 Ships flying "flags of convenience" are a special problem because the countries where they are registered do not usually adhere to the strict internationally adopted rules for pollution control.

Remedies

2.24 Viable marine pollution control strategies must be realistic (i.e. within the limits of the economic capabilities of those who are expected to apply them) and should be socially and politically acceptable. They should be a part of wider strategies ensuring sustainable social and economic development on local, national, regional and global levels. Above all, they should not lead to uncritical transfer of problems from the marine environment to other sectors of the biosphere. The most successful national pollution control strategies are developed as an integral part of national coastal zone development plans and are reflected as such in national legislative acts or in decisions of comparable weight. No pollution control strategies have chance to be effectively implemented unless they are co-ordinated and supervised by a national institution with sufficient authority and adequate technical capability.

2.25 The following elements would have to be taken into account in formulating a globally applicable long-term strategy for marine pollution control:

- (a) correct assessment of the present sources, quantities, levels and effects of, and risk resulting from marine pollution;
- (b) improved forecasts of emerging problems;
- (c) measures to eliminate or diminish the causes, and to mitigate the effects of marine pollution, including special measures to deal with pollution emergencies;
- (d) mechanisms to facilitate and ensure the implementation of the strategy, compliance with its provisions and monitoring of its effectiveness;
- (e) mechanisms to adjust or modify the strategy on the basis of new knowledge and experience, and in the light of changing conditions for the use of the oceans and coastal areas;
- (f) public awareness building.

2.26 Any assessment of the state of the marine environment is incomplete without a hazard/risk assessment for which, in addition to the information on the levels and effects of pollutants, data on land- and sea-use practices, as well as on the sources, type and amount of waste reaching the marine environment are also needed. Therefore a comprehensive and meaningful assessment can be prepared only as a joint effort of marine scientists, economists, health experts, planners and representatives of the "polluter" communities.

2.27 In developing the strategy it should be borne in mind that some of today's concerns may become tomorrow's irrelevancies, and vice versa. Some of the changes can be foreseen on the basis of trends in demographic, economic and developmental indicators. It is probable that with the diminished reserves of petroleum and with the improved safety in shipping, pollution caused by petroleum will be less significant. The rising cost of some materials, such as certain metals, may stimulate their reuse and recovery from wastes. Due to the growing concentration of population, industry and tourism in coastal areas, the quantity of waste produced can be expected to increase with the concomitant demand for cleaner and safer environment.

2.28 Effective pollution control measures are not formulated only on the basis of scientific arguments. Social, economic and political considerations are equally important in ensuring the conformity of these measures with the overall development plans of a country, region, and even the world. Therefore dialogue is needed among all sectors of the society within a country, and between countries, if realistic and viable solutions are to be achieved.

2.29 Any decision to adopt a particular measure should be preceded by a comparison of the advantages and disadvantages of realistically available alternative options. In choosing between various options emphasis should be placed on environmental considerations, but with full regard to socio-economic and political factors.

2.30 The technical details of the measures, whatever their nature, should be clearly and unambiguously expressed. The time-frame within which action should be taken, as well as the targets and goals to be achieved, should be specified. The justifications (rationale) and the overall benefits expected from a particular measure should also be indicated, since this would contribute to an easier acceptance of measures as being desirable and even necessary, particularly in the case of "unpopular" measures.

2.31 The most effective measure to control marine pollution is to eliminate its source and to ban the release of particularly harmful substances altogether. Whenever possible, existing sources should be eliminated by relocation to sites where their wastes can not reach the marine environment. As a preventive measure and as a principle, national development plans should not envisage coastal locations for industries generating a large amount of pollution, particularly if this pollution is in the form of liquid waste. In practice such solutions are frequently not applicable and therefore various technical measures will be necessary to reduce the amount of waste or to render it less harmful before discharge into the marine environment.

2.32 Waste management, including measures such as reduction of wastes, beneficial use or recycling of wastes, and the application of various waste treatment options are important tools in the hands of those deciding about marine pollution control measures. For ship-generated waste special collection and disposal facilities should be established in all major harbours.

2.33 The uncertainties inherent in prediction of the effects of wastes discharged into the marine environment may frequently result in no measures being taken at all or in an overly restrictive one, on the ground of the "precautionary principle". When opting for either of these extremes, provisions should be made to require additional information as a matter of priority and an early review of the decision should be undertaken in the light of the available new facts. In any case, the burden of proof that the discharge is not, or is not likely to be harmful, should be borne by the originator of the waste.

2.34 Monitoring of the levels and effects of marine pollution and the related scientific research, as well as the monitoring of the amount and quantity of the discharges, should be prescribed as part of the measures adopted for pollution control. The research and monitoring should be well focused on concrete problems and sites in order to generate the information needed for the reassessment, and revision if necessary, of adopted measures.

2.35 The institutional and financial arrangements supporting the implementation of the strategy should be clarified at the onset. Without them the strategy has little chance of improving the conditions of the marine environment.

2.36 The control of pollution from land-based sources should be approached as a waste management problem in the broader context of marine and coastal resource development and use, i.e. in the framework of national coastal zone management plans.

2.37 The following basic principles and elements should be embodied in a rational and environmentally sound coastal waste management policy:

- (a) reuse of the reclaimable fraction of the waste;
- (b) treatment of the non-reclaimable waste to the level at which it could be safely released into the environment;
- (c) consideration of alternative options for the release of non-reclaimable waste before the sea disposal option is accepted;
- (d) application of the "precautionary principle" when sea disposal of waste is authorized;
- (e) monitoring of the ecological effects of the released waste;
- (f) safe storage of the waste which can not be released into the environment without unacceptable environmental consequences;
- (g) improvement of existing and development of new waste management technologies; and
- (h) support to scientific research related to waste management.

2.38 Most wastes contain a considerable fraction which can be reclaimed and reused as valuable resource or raw material. When the cost of reclaiming and recycling of the reusable part of the waste is higher than its market value, remedy should be sought through fiscal measures, such as tax incentives and change in pricing policies, particularly when the reusable part of the waste constitutes an essential raw material of wider national interest (e.g. water in arid countries).

2.39 The level to which a waste should be treated before it is released into the marine environment should be determined by the planned way of its disposal and by the capacity of the environment to receive the treated waste without unacceptable environmental consequences. The environmental conditions and characteristics of the receiving coastal waters should be well known and understood before the start of the release, in order to serve as baseline against which to compare the effects caused by the waste.

2.40 No authorization for release of waste into the marine environment should be issued without considering other options for its disposal. Keeping in mind that waste released into the sea can not be retrieved any longer, disposal on land should be used whenever feasible.

2.41 No waste should be released into the marine environment without formal authorization from relevant national authorities. The authorization should be based on a reasonably good insight into the possible environmental effects which may be expected from the release, obtained through the process known as "environmental impact assessment" (EIA). Due to the enormous complexity of interactions within the ecosphere, the predictions of the possible effects of the waste released into the marine environment are largely based on experience from analogous situations. Since no two situations are identical, when authorizing the release of waste a reasonable safety factor should be applied in specifying the amount and the method of release. In case of doubt the decision-maker should be guided by the "precautionary principle". The use of the marine environment as waste recipient should be considered as use of a valuable and finite national resource and, therefore, should not be free of charge for the user of that resource.

2.42 The obligation to monitor the ecological effects of the release should be an integral part of the formal authorization for the release. The monitoring should be carried out by an independent professional organization/institution at the expense of the party interested in the release. The results of the monitoring should be used by the authority which issued the authorization for periodic reassessment of the conditions under which the release was authorized, and for the revision of these conditions, if necessary.

2.43 Waste which can not be "improved" by treatment to a level required for its release into the environment without unacceptable environmental consequences due to its hazardous properties, should be stored on land in a form which allows for easy retrieval and prevents accidental escape from the storage.

2.44 The financial resources available for improvement of existing and development of new waste management technologies are generally insufficient, particularly in developing countries which mostly rely on expensive imports. Fiscal incentives should be created to stimulate a wider application of technologies used for treatment of wastes.

2.45 A number of "grey areas" exist in our understanding of the behaviour and effects of marine pollutants. As part of the national waste management policies, support should be given for scientific research to elucidate these grey areas and to gain a better insight into the ecological and oceanographic systems and processes relevant to waste management. Specifically, research should be encouraged on the potential threat from new substances which may turn up as important marine contaminants in the future.

Sustained management of living resources¹

Status

2.46 Marine biological productivity is generally limited by the supply of nutrients and is largely limited to the surface waters penetrated by sunlight. Productivity is particularly high in areas shallow enough for bottom waters to be mixed with surface waters by physical oceanic processes, and in areas where nutrient-rich bottom waters are brought to the surface by upwelling. Consequently, the largest concentration of marine living resources is found in marine areas adjacent to the coast.

2.47 Coastal and near shore ecosystems and habitats (e.g. estuaries, marshes, shallow bays and wetlands, mangroves, coral reefs, sea-grass-beds), while a valuable resource in themselves, play a major role in the life cycle of many economically important fisheries resources by providing breeding, nursery and feeding grounds.

2.48 About ninety five percent of the world fisheries catch, which has now reached close to 80 million tons per year, comes from near-shore waters. This value is close to that considered as the maximum potential fisheries can sustainably provide (100 million tons).

2.49 Fisheries resources provide about 20 percent of the world's total supply of animal protein for direct consumption. If the contribution of fish-meal is included, then this value would be about 25 percent. With the exception of a few industrialized countries, fish is far more important in the diet of developing world. The market value of the world catch is continuing to rise. Shrimp remains the single most valuable commodity, followed by crustaceans.

2.50 With some rare exceptions, most baleen and sperm whales are heavily overfished or depleted, and some species seem to be beyond recovery. Small cetaceans, if properly managed, may provide an important food resource in many developing countries, although experience shows that they have been traditionally exploited in many areas of the world with little concern or effective effort to ensure sustainability.

¹ All marine and brackish-water species, habitats and ecosystems are considered as "living resources" in the context of this section of the document. The term "fisheries resources" is restricted to fish, shellfish, crustacean (including krill) and cephalopod species commercially exploited or exploitable as food for human consumption, or for other purposes (e.g. as fertilizer or animal feed).

2.51 Mariculture permits the exploitation of some of the ocean's primary productivity not available to a capture-based fisheries. Unlike capture fisheries, aquaculture has a great potential for further expansion.

2.52 Modern technology and the extension of national jurisdiction over the living resources of the exclusive economic zones have had a profound effect on the management and harvesting of marine and coastal living resources in the last decades. The mix of exploited species and the countries exploiting them have been changing dramatically.

2.53 The potential advantages of biotechnology in improving genetically the exploitable living resources are becoming apparent. Although not risk-free, the wider application of genetic manipulation can be expected to become more common, particularly in mariculture.

Problems

2.54 Marine pollution, physical destruction of habitats by land-reclamation, drainage, coastal construction and even certain fishing techniques, as well as over-exploitation, are the major factors stressing marine and coastal living resources. Ecosystems at the land-sea boundary are particularly being degraded at an accelerating rate, threatening the maintenance of these ecosystems in a healthy state and hence the sustainable exploitation of marine living resources which depend on them.

2.55 Nutrient-rich wastes may boost primary productivity in oligotrophic seas and may even enhance fisheries resources. However, when in excess, nutrients lead to eutrophication, oxygen depletion and anoxic conditions of deeper layers of stratified seas (e.g. the Black Sea and the Baltic Sea). Coral reefs are particularly sensitive to nutrient enrichment which can lead to the replacement of corals by algae. Blooms of phytoplankton species, arising from excessive disposal of nutrients into the sea, may create paralytic shellfish poisoning necessitating the temporary closure of certain fishing and aquaculture areas, or the prohibition of the sale of products.

2.56 Mariculture, which is rapidly expanding, generates its own local pollution by nutrients and may upset the ecological balance by the introduction of exotic species and diseases.

2.57 Pollutants such as DDT, PCBs, heavy metals and organotin compounds, may influence the living resources in many ways, even at low concentration levels. Reduction in fisheries stocks by spectacular mass mortalities, gradual decline or change in the structure of entire ecosystems, increased occurrence of diseases, deterioration of fish-food quality, reduction of shellfish growth, are the all too well documented consequences of marine pollution.

2.58 Oil spills, unlike most chemical oil-dispersants, are more visible, but perhaps less serious in the long run than discharges of nutrients and toxic chemicals, except in the case of littoral areas of semi-enclosed parts of the seas, where their effects can be particularly severe.

2.59 The removal of plant cover in watersheds and along the coast increases sediment discharge into the near-shore waters. This affects anadromous species (e.g. salmonids), estuarine organisms (e.g. oysters), coral reefs and submerged vegetation of key importance as fish habitat. Extraction of sand and gravel from the seabed affects slow-moving benthic species and their habitats and damages spawning grounds of other species. The mining of corals and coral sand for building material is another very serious problem in many tropical countries. It not only destroys a productive and fragile ecosystem supporting small-scale fisheries, but also deprives the coastline of a natural wave protection barrier. The construction of marinas in pristine coastal areas and the uncontrolled cutting of mangroves are further examples of unwise habitat use and ecosystem destruction.

2.60 Although the level of total catch from marine fisheries has increased in recent years, the major fish stocks are being over-exploited and the level of catch has been maintained largely by increased fishing efforts. It is true that moderate levels of fishing remove old, slow growing individuals, and reduce the abundance of large predators, thereby increasing the productivity of the population and the sustainable yield. However, under more intensive exploitation, large, slow growing species may be reduced to "commercial extinction". A combination of over-fishing and stock fluctuations due to natural events has already led to the decline of some fisheries and to instability in others. The attractive notion that fish populations will come into balance with marine productivity on the one hand and fishing pressure on the other, seems to be flawed. Experience demonstrates that such a balance is rarely achieved and that the stability of fisheries has usually decreased with increased fishing activities.

2.61 Fishing affects the marine habitats, for instance by destroying benthic communities by intensive and indiscriminate dredging and trawling. Illegal techniques, such as the use of dynamite or chemicals to capture reef fish, are also very damaging to both the fish and to the habitat. Although few cases of biological extinction by fishing alone have been documented, heavy fishing can have serious ecological consequences, especially for fragile ecosystems such as coral reefs and sea-grass beds.

2.62 The potential of Antarctic fisheries resources are limited. Their productivity is too small to enable sustainably high catches and major stocks have been depleted one after the other by unsustainable fishing pressure. Krill is still the only extremely abundant resource but its extensive exploitation may impair the exploitation of more valuable species at higher levels in the food chain and harm efforts to restore marine mammal stocks.

2.63 Incidental and intentional capture of marine mammals, turtles and birds is on the increase due to unselective fishing practices and lack of enforcement of regulatory measures. However, many fishing activities such as trawling, drift netting and seining, even when carried out with improved gear in a responsible fashion, may have to capture non-target species in small numbers in order to remain economically viable. The application of unduly restrictive codes of practice could result in the banning of most forms of commercial fishing, whether large-scale or artisanal. The potential hardship caused to coastal human population, particularly in developing countries, and the loss of invaluable protein resources, will have to be taken into account by those advocating stringent measures and norms.

2.64 The widespread use of nylon and other long-lasting synthetic fibres has led to concern regarding possible entanglement and "ghost fishing" by discarded or lost gear. This may be seen as one aspect, although not the most serious, of the growing practise of discarding synthetic materials into the sea.

2.65 The incidental or deliberate movement of marine species around the globe, such as in ships' ballast water and for aquaculture, has considerably accelerated since the beginning of this century, resulting in far reaching ecological consequences. The introduction of diseases has proved particularly serious to emergent aquaculture industries, specially those dealing with mollusc cultures.

Remedies

2.66 Due to the abundance and resilience of marine living resources, and a lower human pressure on these resources, man's impact on them was in the past relatively small and restricted to specific limited sites and resources. However, since the mid 19th century traditional use and exploitation of these resources driven by increasing market demand, opportunities offered by global trade, technical advances and population growth, has gradually but radically changed the situation. This has led to the breakdown of traditional management systems and to their replacement with mechanisms which did not provide an adequate substitute. Therefore remedies to the present situation should be sought primarily in better management through:

- (a) improvement of national capabilities for the management of living resources;
- (b) integration of living resource management plans into larger scale integrated coastal zone management plans;
- (c) application of environmentally sound technologies for the exploitation of living resources;

- (d) improved knowledge and understanding of factors and processes determining and influencing the response of living resources to exploitation;
- (e) effective environmental protection measures;
- (f) economic measures and fiscal policies stimulating the protection and rational exploitation of living resources;
- (g) legal and administrative measures regulating exploitation at a sustainable level; and
- (h) regional and global collaboration on all issues dealing with living resources or problems shared between several countries.

2.67 The general approach to some of the recommended remedies are reviewed in detail in other sections of this document and therefore in the ensuing paragraphs only the measures specific for marine living resources, particularly those relevant to fisheries resources, will be highlighted.

2.68 Protection and rational exploitation of marine living resources will require considerable changes in current approaches to planning, often involving painful social choices and unpopular decisions. The rational exploitation of still abundant species will be hard to justify to a world opinion alerted by the poor past performance of industry and international management, but the urgent need for more food will be hard to ignore.

2.69 "Acceptable" levels of impact need to be established in advance, with realistic acceptance that any human activity will change quantitatively some components of the environment. The approach generally used in evaluating impacts and the concept of "environmental capacity" seem appropriate to the protection of marine living resources. The level of exploitation and use should not be allowed to affect the capacity of the resource, its environment and those other resources affected by the exploitation, to return to the unexploited condition should that particular activity be discontinued.

2.70 In addition to the need for improved knowledge concerning the state of the marine living resources and the processes influencing that state, special attention should be paid to improving publicly available fisheries statistics, including data on stock potential, both of which are notoriously unreliable and inadequate for sensible planning purposes.

2.71 Greater effort is needed to develop fishing practices and technologies which would be more effective in avoiding non-target species, such as marine mammals and turtles. The implications of and the rationale for certain fishing methods, such as large scale driftnetting in the Pacific which may damage the stock of exploited resources and lead to unjustifiable incidental catch, should be carefully examined.

2.72 Illegal fishing techniques and practices are usually rooted in social and economic circumstances. Although such techniques and practices should be banned in principle, the ban should not be handled only through legislation, administrative measures and at-sea enforcement, but by seeking social and economic remedies for the roots of the problems and by improved education of fishermen.

2.73 The negative side-effects of sand and gravel extraction, although limited to restricted sites, should be reduced by careful planning and attention to operational procedures.

2.74 Artisanal fisheries are very valuable and should be promoted and protected against the aggressiveness of industrial fisheries practices. They employ tens of millions of persons and contribute in excess of 90 percent to all fisheries employment. They are also highly efficient in terms of quantity of fish produced per unit of energy input and per unit of capital invested, and could be considered ecologically sound methods of producing food for direct human consumption at affordable prices.

2.75 A major international effort is needed to control the risk resulting from the introduction of new species and in transfer of organisms into new ecosystems. The potential negative impacts of genetic manipulation, particularly in aquaculture, may have to be also internationally controlled.

2.76 Fisheries jurisdiction has been extended by most coastal countries out to 200 nautical miles ten or more years ago. Fisheries within this zone, particularly in enclosed and semi-enclosed seas, are regulated by numerous bilateral and multilateral international agreements. However, despite the legal frameworks that exist and the regional mechanisms established under them, as the reflection of economic and political reality, fisheries resources are still too often exploited in a non-sustainable manner.

2.77 The adoption of the United Nations Convention on the Law of the Sea stimulated an increase in the relative catches of developing countries and provided a global framework for negotiating fishing rights and for increasing regional and inter-regional co-operation in the area of fisheries. However, many countries are unable to control effectively either domestic or foreign fishing in the exclusive economic zones under their jurisdiction, and to maintain the fish stock at reasonable level in these zones. The pressure of foreign fishing fleets on the resources within national jurisdictional zones is a particular problem, leading to frequent conflicts of interest over fishing rights. International trade in fisheries products is currently dominated by few industrialized countries with well developed distant-water fleets. The situation could change in favour of developing countries which have access to, and jurisdiction over large supplies of fisheries resources. However, the change would

require the establishment of a new and efficient system which would:

- (a) protect the resources of the exclusive economic zones from illegal exploitation by foreign fleets and from mismanagement by their legal "owners"; and
- (b) provide disadvantaged countries with financial resources and the "know-how" needed to exploit their wealth for their own benefit.

2.78 Fisheries beyond the 200 mile limit for many species, and in many areas of the world, are not covered by fisheries management agreements. Even when they are (e.g. tuna, whales), there are major problems of monitoring and control, and therefore the obligations for rational utilization and conservation of marine living resources assumed by the countries participating in these agreements are not implemented and enforced in an effective way.

2.79 The sustainability concept is today accepted as the foundation of modern fisheries management. However, management codes of practice regulating fisheries on the basis of such concept on national, regional or global level, have yet to be developed for most areas. Without such codes, and without their effective enforcement, there is not much hope for rational management of fisheries resources.

Protection of biological diversity

(section yet to be developed)

Rational exploitation of mineral resources

(section yet to be developed)

Emerging global environmental issues affecting coastal development

2.80 The predicted climate change and the depletion of the ozone layer are among the major emerging global environmental issues which are expected to have a significant impact on the oceans and coastal areas, specifically on coastal development.

Status

2.81 The only real certainty about climate change is that it will happen. The current consensus among scientists on the likely effect of human influences on climate in the future, is that the dominant influence is or will soon lead to global warming.

2.82 The earth's climate, including shorter-term variations, is influenced by the interaction of the atmosphere-ocean system. Global warming induced by increased greenhouse gas concentration is delayed by the oceans, hence the change is still to come. Inertia in the climate system due to the influence of the oceans, the biosphere and the long residence times of some greenhouse gases means that climate changes that occur may persist for centuries.

2.83 According to the most recent forecast, adopted by the Second World Climate Conference, if no action is taken to reduce the emissions of greenhouse gases "global warming is predicted to reach 2 to 5 degrees C over the next century, a rate of change unprecedented in the past 10.000 years. The warming is expected to be accompanied by a sea level rise of 65 ± 35 cm by the end of the next century. There remain uncertainties in predictions, particularly in regard to timing, magnitude and regional patterns of climate change."

2.84 The potentially cataclysmic consequences of events which are governed or driven by climate are best illustrated with one of the greatest documented natural disasters in history. On the Ganges delta of Bangladesh a large overcrowded population lives on flat nutritionally marginal lowland, barely above sea-level, despite the ever-present danger from climatic-related events, for which the region is well known. In November 1970, some 300.000 people perished when a huge tidal wave driven by a cyclone swept over the delta. Although the coming of the cyclone was known, practically no preventive action was taken which could have saved at least some of those who died, because of weaknesses typical for poor countries: lack of plans and means to mount a rescue operation. The post-disaster situation was further exacerbated by starvation of those who survived the onslaught of the cyclone.

Problems

2.85 Climate change is an historic fact and inevitability, regardless of man's influence on its direction and rate. The argument is often put forward that people have survived climate change in the past and will continue to do so. However to talk merely of survival as a species is to evade the issue of the degree of social disruption and human suffering that have attended regional climate fluctuations in recent history and, presumably, at times in the more distant past. That the drought-induced famine in the Sahel in the early 1970s did not threaten to extinguish the human race is no consolation to the thousands who died. Today the absolute magnitude of human misery that could be caused by climate change is much larger than it ever was because the human populations in virtually all regions of the world are much larger than ever before. Far more people would be affected by any given regional climate change, and there is not likely to be any room in adjacent regions into which they could flee.

2.86 It is clear that climate change and sea level rise will have major effects on all countries and that the areas which are likely to be most profoundly affected are the low-lying islands and coastal zones of the world, where more than 70 percent of the world's population currently lives. The environmental problems associated with the potential impact of expected climate changes may prove to be among the major environmental issues facing the marine and adjacent coastal areas in the near future.

2.87 Although it is difficult to predict accurately the magnitude, significance and spatial distribution of specific climate change impacts on land-use practices, natural ecosystems, physical processes and socio-economic activities, it is nevertheless possible to state that in general there will be profound and sweeping changes. Aside from impacts on the structure and functioning of natural ecosystems, the impact will be diverse and significant to all sectors of human activity, and in particular will affect freshwater management, agriculture, fisheries and forestry.

2.88 Predicted changes in temperature, precipitation, radiation budget, as well as in patterns of atmospheric and oceanic circulation will alter the spatial distribution of primary and secondary productivity in both the land and ocean environment. Such changes will result in long-term changes in resource availability and use by different societies. For example, the potential effects of long-term climatic variations on fisheries resources is well illustrated by the well documented example of the decline in cod populations off Greenland in the early Middle Ages, and their replacement with fully arctic ecosystems.

2.89 The frequency, intensity, location and duration of extreme meteorological events, including hurricanes, storm surges, droughts and rain storms, if increased as predicted by some experts, will cause additional stress on societies and reduce their ability to achieve sustainable development, by endangering their lives, by destroying their shelters, communication infrastructures and industrial installations, and by reducing their food security.

2.90 The rise in sea level will inundate coastal lowland areas, erode beaches, exacerbate flooding and increase the salinity of soils and groundwater, river, estuaries, lagoons and aquifers.

2.91 A global rise in the mean sea level of up to 20 cm would not, in itself have a significant impact, except locally. However, relative changes could be as much as five times this value due to subsidence, groundwater extraction and sediment compaction. More severe problems can be expected if sea level rise exceeds the anticipated increase, or if the rate of increase exceeds the capability of sensitive coastal ecosystem to respond by successful adaptation to the new conditions.

2.92 Changes in climatic patterns could alter the abundance and geographic distribution of various disease-producing organisms. The degree to which such organisms and the organisms that transport them (vectors) thrive is governed by such environmental conditions as temperature and moisture, in terms of both averages and extremes. Changes in climate therefore might give certain of those organisms access to human population that have no prior evolutionary experience with them and hence little or no resistance to them. Alternatively, such changes might remove checks on the abundance of organisms preexisting in an area, to the extent that a previously minor hazard becomes a plague. This is true of pathogens that attack crops and trees, as well as those that attack people.

2.93 Climate change, superimposed on population pressure, and on the serious global mismatch between resources, population and consumption, imperils the sustainability of socio-economic development throughout the world. In most cases the impacts will be felt most severely in regions already under stress, mainly in developing countries.

2.94 Factors not related to climate change may in the future in many cases far exceed the importance of the direct impacts of climate-related changes. Nevertheless, even in such situations, factors like the rate of population growth and human migration patterns, will increase the vulnerability of societies to climate related stress, which may trigger impacts of catastrophic proportions.

2.95 Environmental problems are already critical in many parts of the world, and the potential impacts of climate change will exacerbate current problems. Without prompt remedial action, such problems will increase, rendering sustainable development an unachievable goal in many countries. In addition, a failure to address these problems now, will make future responses to climate change and sea level rise more difficult and in some cases even impossible.

Remedies

2.96 Although uncertainties about the range of expected climate change is relatively great, the probability and the magnitude of the risks involved are also very high. Therefore it is prudent to undertake, as a precautionary measure, actions which may diminish the risks from undesirable effects.

2.97 The response to the predicted climate changes, aside from policies and measures to eliminate or reduce their causes which are not considered in this document, should be based on a strategy consisting of the following elements:

- (a) assessment of the potential impact;
- (b) awareness building;

- (c) consideration of options for response policies and measures;
- (d) refinement of predictions;
- (e) implementation of response policies and measures; and
- (f) monitoring of changes.

2.98 A considerable wealth of information has been already accumulated about the potential impact of expected climate changes on natural, social and economic systems. However, this information is mainly on the level of generalities and only a few well documented site-specific analyses have been made. Since the effect of climate changes will be highly specific for each locality, further work should primarily concentrate on analysis of the impacts on well defined areas which are considered particularly vulnerable. Such site-specific analyses will contribute to the refinement of global, regional and national analyses by providing the indispensable detailed factual information derived from concrete case studies.

2.99 These assessments should be based on the best available existing knowledge and insight into the problems relevant to expected climate change, and should cover:

- the possible effects of the sea level changes on marine and coastal ecosystems (e.g. deltas, estuaries, wetlands, coastal plains, coral reefs, mangroves, lagoons);
- the possible effects of temperature elevations on the marine and coastal ecosystems, with special reference to economically important species and sensitive habitats;
- the possible effects of climatic, meteorological, physiographic and ecological changes on the socio-economic structures and activities (e.g. settlements, human health protection, traditional activities, indigenous cultural and social values, industry, tourism, transport, communications, trade, freshwater management, fisheries, aquaculture, agriculture); and
- areas, systems and activities which appear to be most vulnerable to the expected impacts.

2.100 No assessment should be considered satisfactory unless it contains a set of specific and concrete recommendations for measures which may be taken to mitigate or eliminate the effects of the impact.

2.101 Along with the sectoral experts the potential "users" (i.e. policy makers and managers) should be also involved in the preparation of the impact studies. Early public participation is highly desirable. The assessments should not be prepared "for them" but "with them".

2.102 Climatic conditions are generally taken for granted and considered as immutable. However, climate changes will affect all sectors of society. Therefore policy makers, managers, the business communities and the public at large should be better informed about the crucial role of climate in the life and development of a country and about the risks which may be ahead with the predicted climate change. Only a well informed society can appreciate the necessity to invest financial and intellectual resources into measures which may be needed to counter the effects of climate changes.

2.103 The results and conclusions of climate impact studies, and particularly the recommendations based on them, should be expressed clearly, unambiguously and in a form easily understandable by the prospective users of the information. The studies should not contain irrelevant material, i.e. material which is not being used for supporting the conclusions and recommendations of the study.

2.104 Climate conditions and fluctuations in these conditions are a major factor determining socio-economic development. Climate change may compound the present day problems of many countries and may have important implications on the sustainability of its development. Timely development of suitable policy options and response measures which may mitigate or avoid the negative implications of climate change is justified for that reason alone. Therefore one of the central goals of the proposed strategy is the identification of such policies and measures.

2.105 The available response policies and measures should be considered on the basis of impact assessments and in the framework of national integrated coastal zone management plans, as a special aspect of these plans. The development of policies requires on the part of policy makers a good understanding of the underlying science and a weighing of the scientific uncertainties associated with the prediction of climate change and its likely impacts. Therefore the formulation of response policies also requires a continued dialogue between scientists and policy makers.

2.106 Response measures contemplated as extension of response policies should primarily aim at increasing the social and economic wellbeing and resilience of the society concerned. They may include changes in land use planning; contingency plans for dealing with climate-related emergencies; reinforcement of coastal structures; raising artificial barriers; protective measures for freshwater reservoirs; development of alternative agricultural and fisheries practices; restricting development in vulnerable areas; exchange of information, expertise and technologies with other countries; etc.

2.107 Our current ability to predict regional and local climate changes with any degree of certainty is inadequate. It is imperative that more accurate predictions of local climate and sea level changes are developed if the uncertainties concerning

the magnitude and rate of their potential impacts are to be reduced. The current inadequacies of existing climate models and scenarios, specifically those which would reveal regional and local specificities, are the consequence of the presently insufficient data on which more precise and specific models could be built and a better insight gained into the changes we may have to expect.

2.108 There is no other way to reduce the present uncertainties in the models than by strengthening the research related to climate, climate change and sea-level rise, and by increasing the information on the processes governing the climate, of which oceanic processes are of critical importance. Research on oceans will provide quantification of important feedback loops in climate processes, and an improved data base of oceanic parameters is considered indispensable for operational climate forecasting.

2.109 The full participation of developing countries in activities related to improved climate change forecasting is an imperative. The achievement of this goal will require a massive and sustained flow of scientific and technological expertise towards the development of the intellectual resources, technical and institutional capacity of the developing countries.

2.110 The potentially serious consequences of climate change, including the risk for survival in low lying small island States and in some low-lying coastal areas of the world, are sufficient reasons to begin implementing response measures even in the face of significant uncertainties. By timely anticipatory action some of the most adverse consequences may be diminished or mitigated. The lack of full scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation whenever or wherever there are threats of serious irreversible damage.

2.111 Action should be pursued in a phased and flexible manner, on the basis of medium and long-term goals and strategies, and taking advantage of scientific advances and technological developments to meet both environmental and economic objectives. Initial emphasis should be on actions that would be economically and socially beneficial for other reasons as well.

2.112 The response measures should not be applied in isolation from the broader national integrated coastal zone management plans. A sectoral approach would be counter-productive since in environmental management it increases compartmentalization of skills, knowledge and data, and prevents their integration in action which requires a multi-disciplinary approach.

2.113 Through bilateral and multilateral co-operative programmes adequate and additional financial resources should be mobilized to assist developing countries and the best available

environmentally sound technologies should be transferred to them expeditiously on a fair and most favourable basis.

2.114 The present observational systems for monitoring climate or climate-related changes are inadequate for operational and research purposes, although the study of the nature and impacts of climate change greatly depends on systematic monitoring and research of ocean/atmosphere interaction and oceanic processes on global and regional scales. Of special concern is the inadequacy of observation systems in large parts of the southern hemisphere.

2.115 Studies of the frequency of extreme events (temperature anomalies, high and low precipitation events, storm surges and hurricanes) are needed to assist in the prediction of the probability of their occurrence and to detect whether or not the frequency, location and intensity of such events are changing in relation to mean climate conditions.

2.116 Improved data collection and management systems, and a full and open exchange of national, regional and global data are needed, for their use in model and scenario verification and in environmental planning. Data should be available at no more than the cost of reproduction and distribution.

2.117 The problems reviewed above are to a large extent the reflection of the weak institutional infrastructure in developing countries which prevents them from participating as full partners in climate-related research and observations. The lack of funds and experts are the underlying causes of this weakness and massive assistance would be needed to remedy the present situation.

2.118 For the time being no comprehensive, globally co-ordinated programme exists for monitoring climate-related changes relevant to the marine and coastal environment. Without such programme no improvement can be expected in the present assessment of the expected climate change impact or in the prediction of its future course. Therefore the launching of a long-term global monitoring system for coastal and near-shore zone observations is proposed as a possible contribution to and part of the Global Climate Observing System (GCOS) recommended by the Second World Climate Conference. The goal of the system would be to monitor changes in physical and biological parameters and to provide data, analyses of trends and forecasts on global changes with special reference to those associated or attributable to the impacts of expected climate changes.

2.119 The proposed programme would require a long-term funding commitment and global collaboration, because no country or group of countries can tackle the problem alone. Due to the nature of the programme, and to ensure due respect to national sovereignty, commitments of Governments would be necessary for the participation of their national institutions.

Tools to achieve goals

(this section is still incomplete)

Data management

2.120 Although the lack of "raw" data is less serious than usually perceived, weak and scattered databases should be strengthened and consolidated. However, their improvement should not be sought through enlargement by uncritical collection of additional, frequently irrelevant "data", but by creation of specialized data banks organized to match the real needs of the users, with emphasis on a more efficient use of existing data, on quality control of data, their analysis and interpretation.

3 MANAGEMENT OF OPEN OCEANS

(section yet to be developed)

4 RESPONSE TO ENVIRONMENTAL EMERGENCIES

4.1 Maritime or shore-based accidents which result in pollution of the marine and coastal environment, although of minor significance in the global context, can create serious local ecological and economic disasters and even imperil the health of local populations. Annually about 10.000 accidents occur, involving the spill of oil and other harmful substances into the marine environment, some of them of quite considerable size (e.g. approximately 240.000 barrels of oil were spilt in the 1990 Exxon Valdez tanker accident). Failure of coastal sewage treatment plants or waste treatment plants at coastal industrial installations are even more frequent, although they result in less dramatic and visible consequences. The occurrence of large scale industrial accidents of the Bhopal and Chernobyl type can not be excluded in the future.

4.2 Speedy reaction to such accidents is a prerequisite for success of remedial measures, which may involve:

- removal of the source of pollution (e.g. a leaking tanker);
- containment of pollutant (e.g. closing of discharges from faulty waste treatment plants, surrounding the floating oil by booms);
- clean-up operations (e.g. removal of floating oil or oil stranded on the beaches;
- protection of ecologically sensitive areas, habitats and species (e.g. by protective barriers against floating pollutants, removal of endangered species);
- protection of vital industrial installations (e.g. water inlets of desalination plants); and
- protection of population (e.g. by restricting the use of recreational beaches and of contaminated food, by relocation of endangered populations from contaminated areas).

4.3 The ability to deal effectively with emergencies caused by maritime or land based accidents will depend firstly on national response capabilities. National contingency plans have to be developed as special pollution control measures for a successful response to accidents, and the institutions in charge of activating and co-ordinating the emergency response should have the necessary authority and means to do so.

4.4 Special efforts should be made to ensure the prompt transmission of information on maritime and land-based accidents or emergencies which may have transboundary effects or which threaten human health, the integrity of the marine and coastal environment, and potential resource use. The existing bilateral

and multilateral arrangements for notification of maritime emergencies should be reinforced and new arrangements should be promulgated in geographic areas not covered by existing agreements.

4.5 The existing international agreement dealing with response to environmental emergencies, unless they already include provisions for development of multilateral (regional, sub-regional or bilateral) contingency plans, for mutual assistance and compensation for incurred losses, should be broadened in this sense. Comprehensive agreements should be developed in geographic areas not covered by such agreements.

4.6 While most maritime and shore-based accidents result from failure of normal operational activities and procedures, as shown by recent events, hostilities between countries may lead to very serious environmental problems with considerable impact on the economy, ecological systems and public health of the affected countries. The magnitude of the problems is considerable: the 1983 damage at Nowruz and Ardeshir oil fields resulted in a spill of about 1.5 - 2.0 million barrels of oil and the 1991 war in the Gulf released probably the same, if not even larger amounts of oil, covering hundreds of km² of sea surface, contaminating practically the entire coasts of several countries, and causing an unprecedented ecological and economic damage.

4.7 Such war-related emergencies can not be foreseen easily and therefore there are usually no specific contingency plans which could be activated as response measures. Another aspect of these types of emergencies is that their impact may be felt also by countries which have not been involved in the hostilities and thus are merely the "innocent victims" of events which they have not provoked. A mechanism, including a fund, would have to be created for international response to assist such countries, and the assistance should not only be in the form of response to the acute manifestations of the emergency, but should also envisage a long-term rehabilitation programme for the damage caused by the emergency.

5 INPUT FROM SCIENCE

(section yet to be completed)

5.1 Rational long-term policies and management decisions for the protection and development of oceans and coastal areas can be based only on facts collected, analyzed and interpreted according to strict scientific criteria. Systematic scientific research and observations in the fields of natural, social, economic and political sciences is the right path to a correct diagnosis of the present environmental problems; to an understanding of the natural processes underlying and determining the present conditions and foreseeable changes in that environment; and to the appreciation of the social, economic and political factors which may have to be taken into account in defining the long-term developmental goals.

Research

5.2 Although the amount of data collected up to now and the insight available to natural sciences are generally sufficient for proposing actions which may be needed for sustainable management of the oceans and coastal areas, many "grey areas" and uncertainties remain to be solved.

5.3 The following could be listed as priority research areas in the field of natural and technical sciences:

- (a) impact of ozone layer depletion on primary productivity of the oceans, and on intertidal and coastal ecosystems, including coastal agriculture;
- (b) changes in ocean circulation patterns which may result from expected climate changes and their impact on fisheries;
- (c) tolerance of some ecosystems (e.g. mangroves, coral reefs) to the expected rate and magnitude of sea level and temperature elevations;
- (d) improvement of technologies for treatment of industrial and domestic wastes; and
- (e) systematic research on the toxicity and other biological effects of new substances being introduced into the marine environment.

5.4 In view of the interdisciplinary character of the developmental issues, a number of research areas would have to be strengthened in social, economic and political sciences in order to improve the understanding of the causes of the present problems and the capabilities for integrated management of the marine and coastal environment, and their resources. Areas in which research would have to be intensified include, in particular:

(a) the formulation and testing of the applicability of methodologies related to planning of sustainable development, such as:

- environmental impact assessment;
- environmental accounting;
- cost-benefit analysis of environmental protection measures;
- comparative analysis of alternative development options;
- risk assessment and management; etc.

(b) studies on possible fiscal incentives which may be used in control of environmental degradation.

Monitoring / observations

Status

5.5 Since the early 1960's there has been a considerable interest throughout the world in systematic monitoring of the changes in the marine and coastal environment. Most of the measurements and observations carried out in the past were parts of national and regional programmes. There were only a few truly global monitoring programmes, such as the IOC co-ordinated Marine Pollution Monitoring Pilot Project (MAPMOPP) which dealt with oil pollution of the oceans.

5.6 The eight ongoing programmes monitoring the sources, levels and effects of marine pollutants in the framework of the UNEP co-ordinated Regional Seas action plans can be also considered as parts of an almost global programme, due to their extensive geographic coverage (117 coastal states) and harmonized methodology.

5.7 In 1976 a Comprehensive Plan for the Global Investigation of Pollution in the Marine Environment (GIPME) was prepared by IOC. The Plan, now co-sponsored by IOC and UNEP, is being implemented through its regional components.

5.8 Other global programmes involving observation of various phenomena relevant to the management of the marine and coastal environment include:

- the Sea-Air Exchange Programme (SEAREX) initiated in 1977;
- the Geochemical Ocean Section Survey (GEOSECS);
- the Mussel Watch which recently entered into an operational phase and will initially deal with organochlorines;

- TOGA;
- WOCE;
- IGOS;
- GLOSS;
- DBCP;
- WWW.

5.9 Attempts were made, since the mid-1970's to develop an Integrated Global Ocean Monitoring (IGOM) programme but the programme's conceptual basis would still have to be developed.

5.10 Although the programmes listed above provide some data needed for the management of oceans and coastal areas, none of them has been designed with that specific purpose in mind. Therefore two additional programmes have been recently developed and proposed for implementation:

- (a) the Long-term Global Monitoring System of Coastal and Near-Shore Phenomena Related to Climate Change (MoSCC); and
- (b) Global Ocean Observing System (GOOS), as one of the bases for the Global Climate Observing System (GCOS).

5.11 The monitoring and observation programmes co-ordinated by United Nations bodies are considered as parts or contributions to the United Nations Global Environment Monitoring System (GEMS) and EARTHWATCH.

Problems

5.12 The evidence is at hand about changes in near-shore waters and coastal zones due to man's influence. There is also every reason to believe that the ocean is now changing in response to climate changes over the last few hundred years. It can be expected to change further and faster as anthropogenic influences become increasingly marked.

5.13 The presently available information on oceans is insufficient to meet the demands posed by the protection of the oceans and by the rational management of their resources. This information is even less adequate to provide clarifications and answers to questions raised in connection with the global climate change. For example, the socio-economic impacts of fluctuations in fisheries resources, and of episodic environmental threats, such as tsunamis, cyclones, storm surges and El Nino type phenomena are readily appreciated but their anticipation is inadequate as a long-term management tool.

5.14 Due to their different primary goals and rationale, none of the present ocean observing systems can provide effectively and on a routine basis, multi-purpose long-term observations of the oceans on a time-scale of several decades, needed for the protection of the oceans and for rational management of their resources.

Remedies

5.15 In order to fill the gaps in information needed for better management of the oceans and coastal areas, including their resources, it is recommended to launch the two programmes mentioned in paragraph 5.10.

5.16 GOOS, which would provide long-term routine observations of the oceans on the time-scale of several decades, was recommended by several meetings of scientists. Several intergovernmental bodies, including the UNCED Preparatory Committee, confirmed this view, and the Second World Climate Conference (Geneva, 29 October - 7 November 1990) asked for its development as one of the base for the Global Climate Observing System (GCOS). The central goal of the proposed GOOS is to meet the needs of operational ocean forecasting and of long-term ocean climate monitoring, as a component of an earth observing system.

5.17 MoSCC was developed with the help of competent experts by the secretariats of UNEP, IOC and WMO in response to the needs felt in connection with the programmes designed to cope with the expected impact of predicted climate changes on coastal and near-shore environment.

5.18 From the start GOOS and MoSCC should be developed and co-ordinated within the general framework of the United Nations' GEMS and EARTHWATCH. Delaying the development of GOOS and MoSCC would result in a corresponding delay in obtaining an indispensable predictive mechanism, with associated economic and environmental impacts as potential consequences.

5.19 In spite of the inadequacies of the present observing systems from the standpoint of the management of the oceans and coastal areas, they should be strengthened and their results used as inputs into GOOS and MoSCC. The latter can be achieved only by improved co-ordination, both on national and international levels, between national and international organizations dealing with the various components of these systems.

5.20 For logistic and technical reasons much of the observations and monitoring undertaken in the framework of both GOOS and MoSCC would be organized as a set of closely coordinated regional programmes carried out according to a common methodology and purpose by the national institutions of the participating countries.

5.21 The results of the observations and monitoring carried out through both proposed programmes, together with the results

obtained through previous and other studies, would be needed:

- as the rational basis for development of policies, measures and practices for environmentally sound management of the marine and coastal environment; and
- to improve the presently inadequate forecasts of emerging problems.

5.22 Numerous human activities, critical for the future socio-economic development of all countries, would benefit from the predictions which could be expected from GOOS. The scale of predictions (in time and space) and the beneficiaries of these predictions could be summarized as follows:

- (a) synoptic/mesoscale (10 days/100 km - hourly/10 km): marine and general weather forecasts; fishing operations; ship routing; coastal protection, management and development; oil and gas recovery operations; oil spill clean-up; pollution and waste disposal management; search and rescue; ocean dredging.
- (b) seasonal/annual scale (1 year/100 km - monthly/100 km): transportation; energy industry; agriculture.
- (c) decadal scale (10 years/ocean basin - yearly/100 km): long term energy production and coastal protection; long-term development planning.
- (d) centennial scale (100 years/global ocean): policies on greenhouse gas emissions; detection of carbon dioxide uptake and of global ocean warming; climate modelling; climate change predictions.

5.23 The main goals and objectives of MoSCC are:

- (a) to contribute to the global, regional and national efforts to assess climate change and the environmental and socio-economic impacts of this change;
- (b) to contribute to the development and implementation of policies and measures designed to mitigate the undesirable effects of the expected impacts;
- (c) to identify short and long-term changes in the variables and phenomena monitored and to forecast where possible the magnitude of future changes;
- (d) to obtain the data required to test models relevant to climate change in coastal and near-shore areas;
- (e) to serve as a timely warning mechanism for threats which may be associated with anthropogenic and climate change impacts in coastal and near-shore areas;
- (f) to facilitate international and intergovernmental co-

operation in monitoring, assessing and anticipating environmental threats related to the impacts of climate changes;

5.24 Obviously the costs of the proposed programmes, but also the benefits from them, would be very high due to the number of involved institutions, the equipment needed (including ships and the most sophisticated remote sensing techniques), the requirements for management of large volume of data (some of it "on line"), the needs of training of experts in developing countries, and the demands posed by the co-ordination of the whole system. These costs would have to be met through in-kind contributions and through a special fund, expected to be supported mainly by developed countries.

5.25 The operational details of both programmes still have to be developed. Nevertheless it seems reasonable to suggest that before embarking on such ambitious programmes an intergovernmental agreement, formalized through a legally binding protocol, should be signed as a guarantee for a long-term political and financial support.

Forecasting

5.26 Damage to oceanic resources, or problems arising from the use of polluted resources, has usually taken place unpredictably. Such surprises as the Minamata Bay incident, the fluctuations of the El Nino event, the bleaching of corals in the Caribbean and Pacific regions, the mass mortality of seals along the North Sea, and outbreaks of algal blooms in eutrophicated coastal waters, were beyond the predictive capabilities of environmental scientists at the times of their occurrences. The respective roles of methyl mercury and DDT have been discovered only as a consequence of tragic and irreversible events. Present predictions are not much better since they are largely based on experience from analogous situations rather than on good scientific insight and understanding of environmental processes.

5.27 Uncertainties surrounding the potential effects of certain important group of marine pollutants are still very great. For instance, annually megatons of synthetic halogenated hydrocarbons are added to the surface waters of the oceans. If these substances follow the water movement in mixing with the deep oceans, they will be transferred within decades to zones below the mixed layer, where they may remain for thousands of years, i.e. for the residence time of the persistent naturally occurring organic molecules. Science can not determine, at present, the level of organohalogenes which might result in irreversible damage to deep oceanic ecosystems.

6 EDUCATION AND PUBLIC AWARENESS

6.1 The capability of a country to deal with its environmental problems depends to a large degree on enlightened citizens ready to accept solutions which at first glance do not seem to be in their best interest. The lack of such enlightened public in many countries stems from inadequate emphasis in most of the current education curricula on the importance of the marine and coastal resources and from neglected possibilities offered by public awareness campaigns.

6.2 Educational curricula in most countries do not contain sufficient material on development and associated environmental problems. The fact that the children and adolescents are easily influenced in their formative years and are receptive to the idea of environment protection is not exploited adequately. The need for the protection of the marine environment is a subject which could be easily communicated with suitable examples. In selection of the examples the interdisciplinary character of the issues related to marine and coastal environment should be duly reflected.

6.3 Increased public awareness is potentially among the most powerful tools for producing a better appreciation of the problems facing the marine and coastal environment, and for mobilizing support from broad segments of population for the necessary societal decision-making which may be needed to protect that environment and its resources. Better understanding of basic environmental issues and of their relevance to development is an important stimulus for stronger political action and environmental protection.

6.4 The information provided to the general public and the media should be factually always correct and presented in easily understandable form. The causes and magnitude of environmental problems, of associated health risks, and of eventual economic consequences of the planned environment protection measures should be presented in a balanced way. The popular perception, widely held in most countries, that untapped and limitless resources are still available for development and that new technologies will easily solve the problems of resource depletion, should be confronted with sobering realities. Such approaches will stimulate public participation in the implementation of the measures, even those which at first glance may seem unpopular. Deceiving the public with incomplete, biased and misleading information does not pay in the long run because it will destroy the credibility of those in charge of environment protection.

6.5 The non-governmental organizations (see section 7) and the information media can and should play a major role in raising public awareness about the inseparable link between the socio-economic development and the protection of the environment. The

media, particularly the mass circulation tabloids, regretfully tend to concentrate on "disaster stories", often presented grossly exaggerated and without placing the stories in an appropriate context. Therefore, greater efforts should be made by environmentalists, development planners and managers to cultivate links with media and thus ensure a more accurate and responsible reporting on critical developmental and environmental issues.

6.6 The freedom of the media to criticise their governments' developmental and environmental policies, strategies and measures, as well as to express concern over specific environmental problems, is still seriously restricted in many, particularly developing, countries. Such approach of some governments to public information is in the long-run harmful and counter-productive, and its usefulness should be reconsidered.

7 STRENGTHENING OF NATIONAL INSTITUTIONS

7.1 The existence of national institutions with clear mandates and capabilities to deal with environmental problems is the essential prerequisite for a country's successful attempt to deal with these problems. Two basic type of institutions are necessary:

- (a) governmental institutions in charge of developing national policies for the protection and development of the marine and coastal environment in the framework of general national development plans and of co-ordinating the implementation of these policies; and
- (b) governmental or non-governmental institutions actively involved in the implementation of national policies.

7.2 Although considerable progress has been achieved during the last decades, the capabilities of most countries are still generally insufficient to deal with the full complexity of the assessment of the problems facing their marine and coastal environment and with the rational management of their resources.

7.3 In many areas of the world, particularly in enclosed and semi-enclosed seas, an important stimulus and support for strengthening and development of national institutions and mechanisms was provided through numerous international programmes and agreements.

7.4 The existing institutions and structures charged with the co-ordination of national environmental policies are in many cases too fragmented and deal with the problems as sectoral issues, rather than as parts of a coherent national policy. They usually lack adequate authority to regulate and enforce environmental policies, or to influence national economic strategies on which ultimately rest the protection and development of marine and coastal environment.

7.5 Institutions responsible for national environmental policies, such as ministries of environment, should not work in isolation from national structures responsible for the formulation and co-ordination of national development plans. Their work should not be seen as sectoral but as an essential contribution to the national efforts ensuring the country's economic development on a sustainable basis. A mechanism should be formalized in each country ensuring that the environmental dimension of national development plans is not neglected.

7.6 The scarcity of trained personnel is one of the major impediments. The formulation of policies for effective environment protection and management requires considerable interdisciplinary and sectoral expertise. Countries without such expertise have to rely on foreign advice on matters which require a deep understanding of national socio-economic development

aspirations and traditional cultural and social values. As a consequence, the advice, although theoretically and technologically sound, frequently results in unsuitable solutions which, if applied, may cause considerable harm.

7.7 The variety and level of specialized sectoral and interdisciplinary scientific and technical expertise needed by national institutions expected to implement national environmental policies is inadequate in most developing countries. The capabilities of these institutions should be strengthened by long-term plans for development of such expertise and acquisition of equipment needed for their work.

7.8 Adequate funding of national institutions dealing with environmental issues remains one of the key problem and therefore a greater share of the national budgets should be allocated to the development and support of such institutions. Without solving this problem, no progress could be achieved in improving their capabilities to organize and implement a rational, environmentally sound management of the coastal and marine resources.

8 NON-GOVERNMENTAL ORGANIZATIONS

8.1 Non-governmental organizations (NGOs) interested in the protection of the marine and coastal environment are growing in number and strength. In some countries they represent a strong public voice and wield considerable political influence.

8.2 NGOs may play an important role in promoting or opposing development plans and environmental policies. National administrations, as well as regional and international organizations should treat them as potential allies rather than certain adversaries. Therefore, NGOs should be kept well informed about the planned development and environmental policies and measures, and about the underlying scientific, technical, social, economic and political rationale for these policies and measures.

9 BUSINESS AND TRADE COMMUNITIES, FINANCIAL INSTITUTIONS

(section to be expanded)

9.1 Business, trade and financial sectors are the backbone of national and transnational economic development. Therefore they should be associated with the formulation of economic and environment protection policies through frequent consultations and through their active involvement in the process leading to the formulation and adoption of these policies. High priority should be given to their participation particularly in countries where they operate relatively free from the administrative control by governments.

10 INTERNATIONAL CO-OPERATION

10.1 Although the problems of the oceans remain global in nature, there are significant regional differences in their causes and magnitude. Therefore, without neglecting the global scope of the problem, regional co-operation seems to be one of the most promising avenues leading to pragmatic solutions to problems specific for a group of countries sharing the same natural environment, such as an enclosed or semi-enclosed sea. Taking into account the positive experience with existing regional programmes and agreements, these should be further strengthened and the development of new ones should be promoted, particularly in regions where co-operation between the neighbouring countries is a precondition for the solution of the region's common problems.

10.2 The original focus of regional programmes was on marine pollution control. However, following the realization that marine pollution is predominantly a mere symptom of problems on land, these programmes are increasingly seeking solutions through national and, as far as appropriate, regional integrated coastal zone management planning, including protection and management of marine and coastal living resources. The concepts of land- and sea-use, and of appropriate zoning combined with clear allocation of "users' rights" to space and resources, are gradually becoming the essential elements of such planning. National and regional economic and environmental models and scenarios for the future development opportunities are being introduced as the basis for coastal zone management plans.

10.3 The weakness of national institutions is a serious impediment for effective participation of many countries in international programmes designed to protect and develop the marine and coastal environment. The strengthening of presently inadequate indigenous national capabilities is a long and arduous process and many disadvantaged countries, if they are to join effectively the international efforts to mitigate environmental problems, require massive international assistance. Assistance to disadvantaged countries should not be seen only as a mandatory part of aid packages but also in the best self-interest of donors of such aid.

Legal instruments

Status

10.4 For centuries the international law of the ocean space reflected largely the political and economic interests of two predominant uses of the sea, namely navigation and fishing. Only during the last 30 years has international law started to recognize that the world oceans are more than shipping lanes and fishponds and may need to be protected and regulated as an

integral natural resource, for a wide spectrum of multiple and potentially competing uses. This important change in the legal perspective, from "use-oriented" to "resource-oriented" approach, became the essence of the new ocean legal regime and gradually encompassed the "protection", "conservation", "management" and "development" of the "marine and coastal environment" and their "natural resources".

10.5 The first legal instrument developed and adopted in this new spirit was a regional agreement (Bonn agreement, 1969) which dealt with protection of the marine environment from pollution. It was followed by other regional agreements of a similar nature (Oslo convention, 1972; Paris convention, 1974; Helsinki convention, 1974). All these agreements were the product of direct negotiations between interested parties, without the involvement of the United Nations system.

10.6 The United Nations system has been associated with many of the global codification efforts related to the protection and development of the marine and coastal environment and of their resources. The results of this involvement are the numerous global and regional agreements and guidelines which today form an impressive international legal regime. A central position in this regime is held by the convention adopted in 1982 as the United Nations Convention on the Law of the Sea (UNCLOS) which radically redefined the relationship between developed and developing countries with regard to the exploitation of marine resources.

Problems

10.7 The existing international agreements are often only slowly implemented. A major reason for non-adherence to, or inadequate implementation of the provisions of these agreements is their deficiency in providing adequate mechanisms for action. They are often seen as an end in themselves rather than as part of wider practical measures for the protection and development of the marine and coastal environment.

10.8 Some other reasons hindering the viability of existing agreements and preventing countries from accepting or making long-term commitment to their implementation include:

- the subject matter of the agreements is insufficiently well defined and not recognized as a problem deserving or requiring joint action by all parties concerned;
- the cost of the joint action is equal to or greater than the cost which would be incurred by individual parties acting separately;
- the provisions of the agreement are not in conformity with the traditional cultural and social values of the parties concerned or with the developmental goals and targets as perceived by individual parties;

- the incentives, primarily economic and fiscal, for adherence to the provisions of the agreements are too weak, if they exist at all; and
- the sanctions for not applying the agreed measures or actions are usually non-existent or ineffective.

Remedies

10.9 International legal instruments should be an integral part of comprehensive plans of action which, besides the legal component comprise environmental assessment (e.g. monitoring and research, evaluation of the state of the environment and resources) and management (e.g. coastal zone planning), together with institutional and financial arrangements supporting the plans of action. They should also provide for preferential treatment of disadvantaged countries, technical assistance and training, liability and compensation for damage, as well as financial aid and transfer of technologies.

10.10 Additional regional agreements designed to protect and develop the marine and coastal environment and to provide the basis for rational resource use are essential, as is the progressive development of international environmental law in areas affecting the marine environment, such as the atmosphere. The utmost care should be exercised in this process in order to ensure the full harmony and complementarity among the existing and new agreements, taking into account also the overall balance of countries' rights and obligations with respect to all ocean uses as established by UNCLOS. Specific fields in which new agreements could be developed, or existing ones expanded and strengthened, are:

- transboundary movement of wastes;
- control of pollution from land-based sources;
- co-operation in cases of emergencies;
- control of pollution from offshore exploration of mineral resources; and
- management of migratory living resources and the living resources of the high seas.

10.11 Land-based sources of marine pollution are only one, albeit one of the most serious threats to the quality of the marine environment, particularly to the near-shore waters. Controlling them involves regulating national activities which are clearly under national jurisdiction, and this sets the issues apart from those treated by existing global conventions. Therefore, the global control of pollution from land-based sources could be envisaged through the development of a global framework agreement for comprehensive protection of the marine environment under national jurisdiction from all sorts of pollution, based

on the experience of UNCLOS and the eight Regional Seas conventions, and as a complement to UNCLOS.

10.12 The suggested global agreements would have to strike a delicate balance between national sovereignty over the coastal zones and near-shore waters, and the countries' regional and global responsibilities. It would reinforce the existing regional agreements by providing a globally relevant framework, and it would foster the development of additional agreements for geographic regions not yet covered by such agreements. It could establish the common principles, guidelines and norms which would have to apply globally in coastal zone management practices, and which could be used for development of regional agreements geared to the specific problems of the regions' countries and to the capabilities of these countries to deal with them. The global agreement could cover issues and principles such as:

- integrated approach to coastal zone management and development planning;
- prevention of marine pollution from all sources;
- zoning of coastal areas, sea- and land-use concepts;
- management of areas requiring special protection;
- management of shared living resources;
- application of concepts of receiving capacity and of precautionary principle;
- prevention of transfrontier pollution;
- contingency planning for environmental emergencies and co-operation in cases of emergencies;
- principles of environmental impact assessment;
- standards for monitoring, reporting and data management;
- mechanisms for exchange of information;
- technical assistance and training;
- co-operative research programmes; and
- institutional and financial arrangements needed to support the co-ordination and implementation of agreed activities.

Funding

10.13 The prevailing practice of international financial institutions, as well as of donor and aid agencies, is to

concentrate on seemingly environmentally-sound projects. However, some of the projects are undertaken under heavy influence of political rather than economic and environmental considerations, due to lack of coherent national development policies or to the weakness of national regulatory and administrative structures. Such projects, although undertaken with the best intentions, frequently turn out to be economically misguided and environmentally harmful investments.

10.14 International aid generally favours country projects carried out in isolation from the wider context of multilateral and global programmes, even when such programmes are backed by legally binding agreements. Such situation frequently hampers the protection of the marine and coastal environment which cannot be effectively achieved without the multilateral co-operation of countries sharing the same problems in space and time.

10.15 Bilateral or multilateral co-operative projects related to marine and coastal development or resource utilization should be part of national development plans. In the process of negotiating such projects, countries should identify areas in which their indigenous capacity to address environmental problems and to manage their resources requires enhancement. The cost of strengthening the national capabilities, including the institutional structures related to the projects, should be considered as an integral part of the projects' overall cost. Particular attention should be given to development of national expertise required for environmentally safe implementation and operation of the projects. For example, in bilateral fisheries projects only very few countries monitor fish for health hazards as required by international norms (Codex alimentarius). By such approach these countries are putting a significant portion of their own population at health risk and are excluding their products from potentially lucrative foreign markets.

Information sharing

10.16 Existing mechanisms for information exchange should be consolidated in order to enable a more effective use of the relatively large volume of ongoing information exchange. Whenever necessary, these mechanisms should be reinforced and standardized using widely available modern information processing technologies.

Transfer of technologies

10.17 Industrialized and developing countries have common but different interests and responsibilities for dealing with issues of development and environment. If they are to avoid the potentially disastrous course followed by industrialized

countries in the past, the developing countries need to adopt modern technologies early in the process of their development. They must not go through the evolutionary process of previous industrialization but go directly from status of underdevelopment to efficient, environmentally benign technologies. Unfortunately, the transfer of technologies and practices without due regard for their environmental impact and for the local conditions under which they are expected to operate, is not unusual. Such transfers can easily create more environmental problems than benefits, destroy cultural and social values, and disrupt essential indigenous economic activities. The two extremes are:

- (a) transfer of environmentally unsound and frequently obsolete technologies, often justified on economic ground as cheap and "adequate" for the recipient country's conditions; and
- (b) transfer of the latest and the most sophisticated technologies which may not be the most adequate for the recipient country due to the lack of properly trained local staff or of local infrastructures needed to operate and maintain such technologies.

10.18 The expertise available in many recipient countries is often insufficient to assess the environmental implications of imported technologies, thus exposing these countries to considerable risk. As a rule, technologies prohibited for use in the exporting countries should not be licensed for export.

Training

10.19 A massive and sustained flow of scientific and technical expertise towards the development of the intellectual resources, as well as the technical and institutional capacity of developing countries is a necessary complement to endogenous efforts of those countries. Aside from formal education, which is an indispensable element in the formation of experts, additional training in the practical application of their theoretical knowledge is essential. The possibilities for organizing such training are numerous, ranging from training courses to individual training through association with actual projects carried out under the guidance of experienced professionals.

11 ECONOMIC AND FUNDING CONSIDERATIONS

11.1 The difficult economic situation of many heavily indebted countries is forcing them to reduce public expenditures. This affects investments in environmental protection which is not perceived as urgent. Higher priority is accorded to curative actions applied to problems which may have been avoided, at relatively low cost, had the proper action been taken in time. Preventive action with emphasis on resource conservation as a long-term protection against future economic stagnation from irreversible resource depletion, although economically much more cost-effective, is unfortunately low on the list of priorities.

11.2 There are no exact and reliable methodologies for integrating environmental considerations in every step of economic development planning at the project, sector and national levels, as well as for correcting pricing mechanisms to reflect the cost of damage to the environment and natural resources in the price of goods and services. Such methodologies would still have to be developed and tested, because without finding a realistic symmetry between market mechanisms and environmental costs sustainable development will remain largely an unachievable illusion.

11.3 Distorted and biased pricing policies, as well as taxing and trading policies on both national and global levels, are a serious burden on a healthy development and on the quality of the environment. The effects of low, frequently heavily subsidised prices for energy, water and many industrial products and commodities negatively influence the development and protection of the marine and coastal environment. Such policies encourage excessive use (e.g. water, fertilizer) and provide little incentives for resource recovery (e.g. treatment and reuse of wastewater), or for the application of alternative, environmentally more friendly solutions.

11.4 The development of tourism may result in good economic returns by providing opportunities for employment and foreign exchange earnings. However, most of these opportunities are in environmentally highly vulnerable coastal areas and therefore careful planning is required to avoid irreparable environmental damage which could limit the economic potential for long-term development of the affected areas.

11.5 Budgetary allocations should not be seen as the only source of funds for the protection of the marine and coastal environment. In most countries taxes levied on petrol are used to finance road construction and maintenance. In the same way the "user pay" principle should be applied to finance the development and protection of marine and coastal environment by using at least part of the taxes levied on revenues from activities such as seaside tourism, fisheries, maritime transport and offshore exploitation of mineral resources. Likewise, the use of the coastal waters for discharge of wastes should cease to be free

of charge. Fines collected from polluters of the marine environment should be also used primarily for enhancement of environment protection measures.

11.6 Establishment of special funds, with contributions earmarked for specific purposes (e.g. protection of a natural habitat or an endangered species) is another underused fundraising mechanism. In order to be successful, the fund's purpose, including the expected results of the activities supported by the fund, should be clearly defined in such a way that the results could be perceived by the potential contributors as being either of direct value to them or in the public interest.

11.7 Multinational corporations and foreign investors prefer to site industrial installations in the coastal zones of developing countries in order to take advantage offered by such locations and to avoid strict environmental controls now in force in most industrialized countries. Such situation must be countered by governmental regulations requiring that the cost of adequate waste treatment and disposal, and other environment protection measures, should be part of the overall cost of the investment.

12 INSTITUTIONAL AND FINANCIAL ARRANGEMENTS FOR THE IMPLEMENTATION OF THE PROPOSED STRATEGIES, WITH SPECIAL REFERENCE TO THE POSSIBLE ROLE OF EXISTING UN STRUCTURES AND MECHANISMS

(section yet to be developed)