

Research programmes

THE OCEANS AND COASTAL AREAS

Programme Plan

April 2005

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Foreword

A new marine programme will be a means of coordinating and profiling national research efforts in this field. It will contribute to greater interdisciplinary and institutional cooperation, and make Norwegian research more interesting for international groups. Integrated problems can be tackled by means of major projects within the framework of such a programme. A new marine programme will also improve the efficiency of investments and of the use of the research infrastructure needed to monitor our huge ocean region. A new marine programme, based in part on existing programmes financed by the Research Council of Norway, will need to include topics that encompass the scientific knowledge needed to develop the creation of value and industrial development in the marine sector.

This Programme Plan will form the basis of the annual action plans for the programme.

1. Background

The research programme entitled “Oceans and the Coastal Areas” will be set up by the Research Council of Norway’s Division for Strategic Priorities, and will run from 2006 until 2015. The budget of the programme will be in the region of NOK 100 million per annum. The programme is management oriented in that it is intended to generate basic knowledge for future ecosystem-oriented and precautionary-based management of marine ecosystems, at the same time as it will aim to contribute to greater creation of wealth from the resources of the sea and the coast. It will be essential to identify interfaces with industrially oriented programmes that will be established by the Division for Strategic Priorities and with free project support and basic research programmes in the Division for Science. The Programme will support basic and applied research and user-guided projects.

Knowledge of the sea and marine research have occupied and continue to occupy a central position in Norwegian research. Our relationship to the ocean means that it is natural for us to support strong, broadly based scientific communities capable of generating new knowledge about central processes in the coastal zone and the marine environment. Knowledge of this sort will form the basis for sustainable management and use of the resources of the sea and the coast. Responsible use of the coastal zone and the marine environment and its resources, and strengthening of the basis of industrial activity in the future, depends on better knowledge of the biological diversity of our marine and coastal zones. A new marine research programme will have a special responsibility for the further development of existing knowledge and for bringing new perspectives, know-how and methods to science, management and industrial activity.

Marine research is developing rapidly on an international scale. Many nations have realised the value of possessing a broad knowledge base in marine science. If Norway is to reinforce its international position and, in the long run, establish itself as a leading international centre of marine expertise, considerable resources and efforts will be required for a broadly based, long-term build-up of competence in this field.

An understanding of the coastal zone and the marine environment are central cultural elements for a knowledge-based coastal nation with Norway’s marine traditions. The development of marine expertise thus possesses a value in its own right. Likewise, Norway, as a major coastal nation, bears responsibility for ensuring that large areas of our oceans are managed in such a way that the structure, function and productivity of the ecosystems are maintained. Such management will protect the diversity of marine biology as well as providing a basis for the long-term sustainable creation of wealth based on marine resources. At the same time, international experience shows that the research breakthroughs that form the basis of wealth creation can seldom be planned, often arising as the unexpected results of broadly based, high-quality basic research. For this reason, Norway’s marine research should focus primarily on quality and scientific innovation in a long-term perspective. At the same time, there will be a need for shorter-term research aimed at concrete challenges in management and wealth creation.

A new research programme in the marine sector could encompass large parts of ongoing marine programmes and projects financed by the Research Council. A new programme

could, in the first instance, offer better utilisation of the results of ongoing projects based on the following programmes: MARE, Fisketek, BeMatA, the Monitoring Programme, ProFo, Proof and Biological Diversity. Somewhat further into the period of the Programme, as these current programmes come to an end, there will be ample opportunity for significant synergy effects. Efforts on coastal zone research could be included from the beginning, depending on the budgetary situation.

An integrated effort in the shape of a new marine research programme will justify investments in new infrastructure at the same time as it offers efficient utilisation of such investments in the form of work-sharing in the use of expensive equipment, coordination of field studies, and joint processing of data and time series.

Many of the research problems associated with the ocean and the coastal zone are general, or are of interest to countries with which we share our ocean regions. Impacts on the environment in other parts of the world may have direct consequences the situation in the sea nearer home, for example in the case of long-distance transportation of contamination, climate change, or a lack of raw materials with which to feed Norwegian farmed fish. There is also a great deal of experience and knowledge to be acquired from, and exchanged with, other coastal countries, both among our traditional partners, developing countries and countries whose economies are in transition. In order to ensure the relevance and quality of Norwegian research in this field, international research cooperation is essential. The importance of internationalisation should be emphasised and it should also encompass problems that make Norwegian research groups and our research infrastructure interesting for international cooperative efforts.

Much of the basis of marine creation of wealth depends on access to, and an understanding of, external markets and of the implementation of the obligations of Norway and other countries via international agreements and conventions, for example in the World Trade Organisation (WTO) and the Food and Agriculture Organisation (FAO). These also include the UN's Millennium Goals, whose ambitions include halving world poverty by 2015. Exchanges of knowledge and technology in the marine sector could be among Norway's most important contributions to achieving this goal.

The thematic basis of the Programme will be deeper knowledge of the ecosystems of the ocean, the resources of the coast, in addition to the development of technology, methodology and models for ecosystem-based management. Human impacts caused by external pollution, via acute emissions or leaching from dumping sites or contaminated sediments, long-term effects of discharges from offshore activities, introduced and/or toxic species, as well as the effects of fisheries and the consequences for changes in area use will all be focussed on. Ecosystem approaches are a central means in the Norwegian government's aims for integrated management of our ocean regions, as expressed in White Paper no. 12 (2001 - 2002), "A Clean and Rich Sea". The White Paper offers overarching aims for an integrate ocean environment policy, and describes tools and processes for the development and implementation of such a policy. Several of the measures proposed by the government in the White Paper will require significant research efforts.

The ocean and the coastal zone have a high rate of biological production which provides the basis for our rich fishing and aquaculture industries. Human beings are increasing their level of activity and extending their impact everywhere in the ocean and on the

coast. We are influencing both oceanic-atmospheric relationships and deep-sea sediments. As far as the precautionary principle is concerned, more extensive use and greater impacts will have to be followed up by greater efforts to understand the marine environment and to implement sustainable management measures. The new insight that we need applies both to how nature affects itself (natural environmental variation) and how nature and society affect, and are affected by, each other. Such insight is demanded of us in respect of current and forthcoming international agreements. Basic research on the marine environment and marine resources is a prerequisite for continued development of the marine industry in Norway. Looked at in terms of research tasks related to settlement patterns, coastal culture, conflicts of interest, Norwegian and international legislation, regional policy, industrial and social economics and other cultural and social science research issues, it is essential to stress marine-related cultural and social research.

Many of the developments that have taken place in research in the natural sciences have come about as a result of technological findings in quite different fields. This is also true of marine science. An example can be found in acoustic measurement methodology, which can be improved and further developed so that it will be capable of being utilised for much more than its typical current applications. There are major challenges involved in looking at new technological solutions that will be essential for ecosystem monitoring purposes. For sustainable management purposes, species and size identification are key concepts, for which there is a need for further technology development.

In order to ensure that we have sufficient competence in marine research and management there will be need for a significant increase in the number of postgraduate students, post-docs and for the financing of established scientists in marine environment and resources research. The Oceans and the Coastal Areas Programme will stimulate cross-disciplinary cooperative projects which will lead in the long run to an increase in the creation of value. In this connection it is also important to leave ourselves open to curiosity-driven research.

2. Objectives and sub-goals

The principal objective of the Programme is to encourage creative marine environmental research of high international quality. A broad understanding of our marine environment will be of great value to a knowledge nation such as Norway in its own right, at the same time as it will form a basis for long-term management of the marine ecosystems and their resources as a basis for wealth creation, at both national and international level. The Programme will bring about basic competence development through studies related to specific conditions in Norwegian waters and in order to strengthen the integrated understanding of the structure, function and species diversity of the ecosystem.

The main aims of the Programme are:

- to reinforce Norway's position as a leading nation in marine ecosystem-related research.
- to be a central contributor to the process of generating more knowledge of the marine environment.
- to provide a research-based foundation for long-term integrated management and a basis for wealth creation based on marine resources.

The sub-goals of the Programme are the following:

- To generate new basic knowledge of the structure, functions, driving forces, sub-processes, species diversity and types of nature found in marine ecosystems.
- To generate new knowledge of human impacts on marine ecosystems via the addition and effects of pollution, and to contribute knowledge capable of acting as a basis for measures to clear up pollution from land-fills and sediments. It will also be necessary to focus on the effects of introduced species on the flora and fauna of the coastal zone.
- To increase our knowledge of the long-term effects of petroleum industry emissions to the sea.
- To acquire knowledge and tools capable of contributing to integrated ecosystem-based management of the ocean and the coast, and to conflict resolution between various societal interests and between nations.
- To obtain knowledge that will contribute to the foundations of great wealth creation from marine resources.
- To sharpen the focus on methods, models and technology for generating new ecosystem knowledge and to develop a methodology for the adoption of knowledge based on experience.
- To stimulate international research cooperation and exchanges of knowledge.

3. Central R & D tasks

The areas of effort of the Programme are divided into a number of thematic sub-programmes and cross-disciplinary sub-activities, representing two different dimensions (Figure 1). The cross-disciplinary sub-activities are areas of effort that are intended to strengthen the integration and internationalisation of marine research. This involves placing greater stress on method and technology development, strengthened // improved ?? modelling, strengthened cooperation and more efficient resource exploitation. These cross-disciplinary sub-activities are anchored in the strategic guidelines for the Programme. In the first part of the programme period, the cross-disciplinary sub-activities will be related to Marine Ecosystems, Impacts on Ecosystems, Management and Conflict Resolution, and Value Creation. In the longer term, as Long-term effects of discharges to the sea from petroleum activity is phased out as a separate programme and integrated into this Programme as a sub-programme on the same basis as the other programmes, its sub-activities will also be included in this sub-programme.

The five thematic sub-programmes are linked to the Programme's sub-goals. The Programme is made up of the following sub-programmes:

- Marine ecosystems
- Effects on ecosystems
- Long-term effects of discharges to the sea from petroleum-related activities
- Management and conflict resolution
- The basis of value creation.

The Programme will be implemented via the allocation of both small and large well-defined projects, which will preferably include research student and/or post doc. positions. The Programme will also launch major cooperative projects involving several research centres, if such projects will encourage the generation of research results. Attempts must be made to ensure that any such projects are financed as cooperative projects with other programmes and other sources of finance.

The Programme is partly based on a number of ongoing and recently completed programmes and programmes that have had their final call of applications in the Research Council. To a certain extent, these will be continued as sub-programmes in the new Programme.

The sub-programmes will be allocated their own specific budgets. In order to meet the scientific goals of the Programme, an action plan for the Programme will be drawn up. The action plan will be sub-divided at sub-programme level, and it will be updated on an annual basis.

The following description of the Programme is intended to contribute to the generation of project applications for specific problems that are closely related to the objectives of the Programme. Several of the areas of effort are closely interrelated, and are reflected in the two-dimensional structure of the Programme. Projects that cover several of the thematic sub-programmes and one or more cross-disciplinary activities will thus be natural candidates for support.

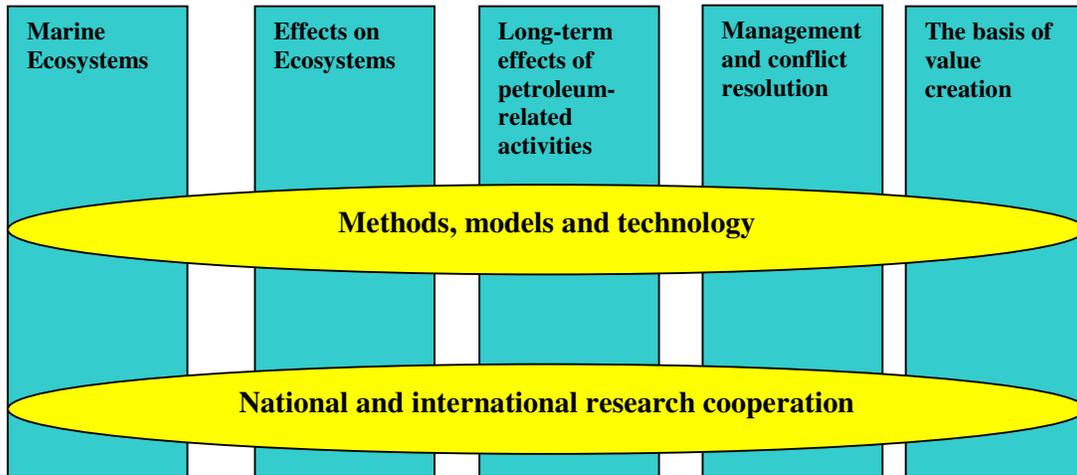


Figure 1: The two-dimensional nature of the Programme

The order of presentation of the areas of effort which follows does not imply any particular prioritisation.

Cross-disciplinary activities

In order to ensure its quality, efficiency and adequate relevance, the Programme has also been organised to include two cross-disciplinary activities. These deal with the development of the necessary methods, models and technology, and with the more efficient utilisation of expertise and resources by stressing national and international research cooperation.

The organisation of the Programme into thematic sub-programmes and cross-disciplinary activities will be brought out clearly in announcements of the Programme. The Programmes will be designed in such a way that funding will be allocated to both small and relatively large projects within each thematic sub-programme. Project funding will also be distributed within the two cross-disciplinary activities, as long as the projects are relevant to one or more of the thematic sub-programmes. The Programme will thus encourage several scientific group to cooperate in each project at the same time as it stimulates cooperation with relevant international contacts.

I. Sub-programme: Marine ecosystems

The objective of this sub-programme is to acquire new basic knowledge of the structure, functions, driving forces, sub-processes, species diversity and types of nature found in marine ecosystems.

The research involved in this sub-programme will have a broad profile, and is intended to strengthen marine research in such areas as systematics, taxonomy, ecology,

population biology, genetics, physiology, biodiversity, ecological modelling, oceanography and marine chemistry. More knowledge is needed about the importance of the coastal zone for oceanic stocks of commercially important species and of the importance of these species for the coast, as well as knowledge of physical, chemical and biological interactions between the ocean and the coast. There is also a need for more knowledge of ecosystems and the marine food chain in connection with management and bio-economics. Fundamental processes of decisive importance for the functioning of the ecosystem need to be identified. The knowledge generated by this sub-programme will form the basis of the other sub-programmes, particularly projects related to the development of models. The objective of the authorities regarding ecosystem-based management will require a widely ranging new knowledge about ecosystems. Knowledge of this sort will be necessary if we are to be able to provide the authorities with relevant credible advice about the sustainable use of resources and products from the ecosystems, in such a way that their structure, functions and productivity are maintained.

The thematic areas of effort are the following:

a) From organisms to ecosystems - driving forces and sub-processes

focusing on the structures and functions of, and anthropogenic effects on, ecosystems in our marine regions and on acquiring basic knowledge of the physical, chemical and biological driving forces and sub-processes that influence marine ecosystems.

Better understanding and management of the living marine resources in our ecosystem will require more knowledge of how physical, chemical and biological factors affect these ecosystems. For example, it will be necessary to acquire knowledge of how ocean climate provides a framework for the production of phyto- and zooplankton, which in turn are controlling factors in the migration, growth and recruitment of fish stocks. Another example is better knowledge of how marine mammals and fish stocks mutually influence one another. Similarly, there is a need for more knowledge of the benthic components of marine ecosystems.

b) Biological diversity

focusing on acquiring knowledge about the extent, condition and development of biological diversity as a basis for ecosystem-based management.

Descriptions of natural variations in biological diversity will help the development of greater competence in taxonomy. More knowledge is needed to enable us to understand how climatic change and the effects of various kinds of human activity affect biological diversity. It is essential to know how viruses, bacteria and disease bring about changes in biological diversity. It is also important to generate knowledge of how foreign species are spreading and affecting our marine ecosystems.

c) Operational ecosystem models

focusing on the development of data-operational model systems for our coastal and ocean regions.

If we are to be able to utilise new knowledge about ecosystems quantitatively in order to predict how resources will develop under the influence of various climatic (bottom-up) or catch scenarios (top-down), it will be necessary to develop data-driven operational model systems for our ocean regions. We will be similarly need to be able to predict the development of the status of threatened, vulnerable or rare species and habitats. Such model systems will have to be designed to combine information from the lower reaches of the systems (physical pressure) with data about the systems' top predators (catches made by human beings and predation by marine mammals).

There is a need to develop habitat and ecosystem models for the coastal zone. Modelling the likely occurrences of habitats, natural conditions and natural variations in these factors will require the development of habitat and ecosystem models for the coast.

d) Characterisation of types of nature

focusing on acquiring knowledge of relationships between benthic geotopes and biotopes, and on how fluxes of gases and liquids from the seabed affect the oceanic biosphere.

Seabed habitats, and the relationship between geotopes and biotopes, have been the subject of little research in our ocean regions. Traditional ecosystem research has largely ignored the importance of substrates and substrate-related processes for benthic and partly pelagic organisms. In recent years, research has begun to reveal the relationship between the substrate and coral reefs, but such relationships are still unknown for a number of organisms. Knowledge of the role of benthic habitats is of great importance for our understanding of benthic communities such as coral reefs, seaweed forests, etc, and for the role played by such communities in marine ecosystems. Benthic habitats can probably also be utilised as indicators of changes in living conditions and animal communities. Research on the characterisation of benthic nature types could make an important contribution to MAREANO - the programme that is planned as a publicly accessible Internet structure based on distributed databases, and which will be able to bring together information about our marine regions and associated types of nature, resources and human activities and impacts.

The seabed is the interface between the water column, sediments, sedimentary rocks and bedrock. Geological processes provide a continuous flux of liquids and gases to the water column, creating a potential basis of life for chemosynthetic organisms. Some of these emissions represent extreme marine environments, which are of interest for bioprospecting. Others are natural sources of hydrocarbons, which are brought into the marine environment and contribute to "natural pollution". It is also known or has been postulated that processes of this sort make an important contribution to the ecosystems on and close to the seabed.

II. Sub-programme: Effects on ecosystems

The aim of this sub-programme is to generate new knowledge about anthropogenic impacts on marine ecosystems via the introduction of contaminants, and to contribute

knowledge capable of acting as a basis for cleaning up contaminated dumping sites and sediments. It will also be necessary to focus on the effects of introduced species on coastal flora and fauna.

Human beings are increasingly active in, and are extending their influence everywhere on, the marine environment. Land-based activities are also having effects on the coastal zone via the addition of various types of contaminants. In many harbour and fjord areas, leaching from earlier deposits of environmental toxins in land-fill sites and sediments can be so serious that it has been necessary to offer advice to limit seafood consumption. Human impacts on the sea and the coastal zone have long been on the increase, and we can only expect that this process will continue. In terms of the precautionary principle, these increases in use and impact will need to be met with greater efforts to understand the marine environment. As a consumer and exporter of marine products, Norway has a strong interest in maintaining the “clean” reputation of its marine regions. Given this background, basic research on the marine environment is a prerequisite for the continued development of Norway’s marine industrial sector.

a) Clean seas and environmental toxins

focusing on the necessity of generating new knowledge about how anthropogenic environmental toxins occur, are spread and are accumulated in marine food chains from near and remote sources.

The export of safe seafood from our part of the ocean requires that we should be able to document that our seas are clean. Concepts such as “clean environment” and “clean seas” must be based on monitoring and documentation of sources that are capable of impoverishing and having negative consequences for the fishing industry.

There is a need to be able to document the level, dispersal and accumulation of known environmental toxins (PBBs, dioxins, mercury, PAHs, etc.) and of new toxins such as brominated and fluorinated compounds in marine nutrient chains, as well as for more knowledge about the effects of these toxins and of radioactivity. This research should be given a sharper focus as a basis for the management of natural resources. As far as radioactivity is concerned, the results of Norwegian participation in the EU’s Radiation Protection Programme have furnished us with new knowledge about the dissemination of isotopes in the environment and their ecological effects, as well as decision-support systems in the event of accidents, and we recommend that this collaboration should continue.

Environmental toxins often occur in “mixtures” and it is natural that these should exist simultaneously. The effects of such mixtures may be additive and be synergetic, leading to more serious effects than the individual components would be expected to have. This is also true of mutual interactions between factors, such as the effects of environmental toxins and other types of pollutants or impacts (e.g. eutrophication, climate). Research on multi-effects is a topic that will require serious efforts, and integrated projects, in which sources, transport and effects are put into an integrated perspective, should be prioritised.

It is important to have a contingency system that will enable us to put measures into effect when health and environmentally hazardous substances become the more or less

unexpected centre of attention. In this connection, there is also a need for models capable of telling us something about the likelihood that a given new substance has particular effects, on the basis of comparisons with similar substances and dispersal models.

Major research programmes have been carried out on the effects of environmental toxins on individuals and individual populations in the Arctic and the Antarctic, but we still require better knowledge of their effects at community and ecosystem level. This will be particularly relevant in connection with the International Polar Year (IPY) in 2007 - 2008.

b) Marine eutrophication

focusing on the need for better knowledge regarding the transport, dispersal and effects of nutrient salts over distances or interfaces (e.g. soil - lakes - sea).

Studies of relevance to marine eutrophication and transport from fresh-water to the sea have become more relevant as a result of the EU Water Directive. There is a great need for research in this field, where fjords and inshore waters are affected by run-off from the land, from rivers and groundwater, from the atmosphere and via ocean currents, and where the effects appear to be multiple and serious (e.g. dead seaweed forests, oxygen depletion, etc.). The time is in for moving from purely descriptive studies to goal-oriented research aimed at developing a first-generation eutrophication model for the coastal zone.

Additions of nutrient salts can lead to increased algal growth. The natural species composition is altered and more organic particles are produced in the water. High particle density leads to insedimentation of the benthic flora and fauna and affects visibility (which is of importance, for example, for fish vision). There is a great need for better integration of contamination research at system level. Ecological aspects will be core issues in research on many types of pollution, but societal aspects that affect economic and recreational conditions will also be affected.

c) Environmental toxins from contaminants, dumping sites and sediments, cleaning-up operations and measures

focusing on the dispersal, enrichment and effects of concentrations of environmental toxins in our harbour areas and coastal zones.

Diffuse additions of environmental toxins from contaminated sediments make it necessary to offer advice regarding limiting the dietary consumption of seafood from several Norwegian fjords and harbour areas. In order to provide a solid scientific basis for such dietary advice and other measures, more work in this area of research is needed.

There is a particular need to strengthen our knowledge base where this is relevant and is needed to implement clean-up measures for contaminated dumping sites and sediments. It is essential to acquire a better understanding of the chemical and biological processes that take place in sediments, and of sediment and particle transport in water masses. The ecological relevance of measures and cost/benefit analyses can provide us with environmental-economic guidelines for prioritising measures. There is a need to

improve our knowledge of value creation and the social benefits related to pollution and clean-up measures, i.e. the economic effects of environmental toxins and measures to eliminate them.

A national effort has been launched to clean up harbours and land-fill sites, and this involves major investments. This effort demands greater insight into plans for measures, alternative solutions and the environmental and societal consequences of such measures, in order to ensure that the most appropriate measures are put into effect. The ecological foundations of alternative sets of measures should be put into sharper focus.

d) Noise

focusing on the question of whether noise produced by seismic surveys and other sources of sound can affect the behaviour and distribution of fish and marine mammals.

There have been a number of conflicts between traditional fisheries and the offshore industry, and the authorities still lack sufficient knowledge to enable them to put appropriate measures into effect to limit the possible negative effects of such sources of noise. Modern military sonar may have indirect lethal effects on marine mammals. It may be necessary to place restrictions on the use of such instruments. The Programme should produce more knowledge about these problems.

e) Introduced species and diseases

focusing on mapping the distribution of introduced species and studies of how these affect the flora and fauna of our coastal zone.

Apart from habitat destruction, the introduction of organisms foreign to local environments is regarded as the most important cause of the sharp reduction in global species diversity. The transfer of species from one area to another is taking place on a particularly large scale due to vessels taking ballast water on board in one harbour and discharging it in another. A number of major algal blooms, which among other effects have caused serious losses to the aquaculture industry, are believed to be due to introduced algae transported in ballast water. Fouling on ships' hulls and fishing gear is another introduction vector, in addition to the introduction of new aquaculture species and other species that accompany these species. What most of the species that are introduced to new areas have in common is their potential ability to displace naturally occurring species, thus altering the ecosystem. The most important goal is to prevent new species from becoming established, while it is also important to map the distribution of introduced species and to study how these are affecting the flora and fauna of the coastal zone.

III. Sub-programme: Long-term effects of emissions to the sea from petroleum-related activities (PROOF)

The objective of this sub-programme is to increase our knowledge of long-term effects of discharges from offshore activities.

Knowledge of this sort is essential if the authorities are to be able to guide the development of offshore activities and coordinate the exploitation of oil and gas resources with other uses and with protection of the marine environment. It is essential that the total impact on the marine environment should not lead to changes in marine ecosystems.

The research programme “Long-term effects of emissions to the sea from petroleum-related activities” (PROOF) started in autumn 2002, and will continue as a sub-programme under “Oceans and the Coastal Areas”. The sub-programme will cover prioritised research tasks in this area until 2008. The sub-programme will then be considered for continuation as a separate sub-programme or for integration into the other sub-programmes. The annual budget is planned to be around NOK 20 million, and this should also be its general budget level under the new Programme.

Long-term effects are defined as effects on more than one generation of organisms, or more than a single natural cycle of a system. Such effects may include chronic effects of substances that persist for long periods of time in organisms or ecosystems, or the long-term effects of substances that have a short persistence in the environment, via their effects on central components of the ecosystem, such as production, reproduction, genetic material, or the structures of populations and communities.

The marine areas off the coast of Norway have a high rate of biological production and provide the basis for a rich fishing and aquaculture industry. The offshore industry uses more than 1000 different chemical products in greater or lesser amounts and compositions in various phases of its activity. Emissions from this sector can affect fish larvae or other stages in the life-cycle of fish and other organisms in marine food chains. It is of decisive importance that discharges from petroleum activities should not have negative effects on our rich fish resources, nor on the quality of fish as food for human beings. Scientific documentation of possible long-term effects of petroleum activity on fish resources can only be characterised as inadequate. The expansion of offshore activities to deeper areas of the sea, to arctic regions and to areas close to the sensitive coastal zone makes it particularly important to identify and satisfy the need for knowledge about the long-term effects of discharges from this type of activity.

Discharges from offshore activities may impact the marine environment both on the seabed and in the water column. This may be due to either the content of chemicals or the physical properties of the components of such discharges. Some of the substances in such discharges are rapidly broken down and will therefore have effects within only a limited area around the point of release, while others are more persistent and are capable of affecting larger areas for long periods of time. Operational discharges are those that are produced in connection with planned activities such as drilling and production. Discharges to the water column may be due to either drilling (water-based drilling fluids) or production (produced water), while discharges to the seabed are primarily the result of drilling operations. Discharges to the sea include oil, chemical products, radioactive compounds and heavy metals. The most important source of discharges of oil and heavy metals is produced water, while the largest discharges of chemicals come from drilling operations.

More light needs to be shed on the following problems:

a) Effects in the water column

focusing on the effects of produced water, drilling fluids and acute discharges on what are believed to be vulnerable marine species following chronic exposures to low concentrations. There is also a focus on the effects of individual and interacting components on marine organisms in the water column and the bioavailability, bioaccumulation, biodegradation and trophic transport of components.

b) Special research tasks in the Arctic

focusing on the sensitivity of arctic ecosystems to oil and chemicals from the offshore industry and the natural degradation of pollution components in the water column and ice-covered waters.

c) Links between research and monitoring activities

focusing on the development and testing of new methods for providing early warning and monitoring of long-term effects in the water column, optimisation of monitoring programmes for the offshore industry and the adaptation of monitoring programmes so that their data can also be used in impact studies and as prognosis tools.

d) Long-term effects of acute emissions

focusing on long-term effects of acute discharges to the water column (to be studied in connection with operational discharges of oil) and the long-term effects of oil in the shore zone.

e) Ongoing discharges of drill-cuttings

focusing on the bioavailability, bioaccumulation, biodegradation and transport of components of drilling fluids and cuttings, and the development of steering tools for assessments of the risk of environmental damage following discharges of drilling cuttings components.

We also refer to the separate action plan drawn up by the board of the PROOF programme, which could form the basis of priorities for the future.

IV. Sub-programme: Management and conflict resolution

The objective of this sub-programme is to generate knowledge that will be directly applicable for decision-makers, so that decisions can be taken on the basis of robust data.

In order to protect the natural conditions and resources that form the basis of long-term value creation in Norway, including the conditions and perspectives of the Sami, marine

ecosystems need to be managed in such a way that their structure, function and productivity are maintained. The marine and coastal areas that surround Norway represent different ecosystems. For this reason, it is important that harvesting of resources should be based on the best available knowledge of these ecosystems.

a) Effects of harvesting on marine resources and the environment

focusing on acquiring knowledge of how harvesting marine resources can affect the development of these resources and of ecosystems.

It will be necessary to contribute to the development of cost-effective methods capable of combining data from scientific surveys and information from commercial fisheries with new basic biological knowledge in the construction of realistic analytical tools and models in population dynamics. Unexpected changes in the evaluation of stocks and their productive capacity may be a sign of weaknesses in the methodological foundations employed in resources management. The implementation of new technology and knowledge of resources assessment and management, with an associated reduction in uncertainty, could produce significant economic benefits, and is necessary for future adaptation to the requirements of international conventions and guidelines. In this connection, there are several central elements: these include improving the basis of our knowledge for dynamic, sustainable resources utilisation, simulating a renewal of biomass measurement methodologies, developing more realistic population dynamics models and stimulating the establishment of better systems for resource assessments with associated reference points and uncertainties, generating knowledge and developing tools for evaluating the effects of commercial harvesting, or its absence, on the marine environment, increasing the utilisation of classical (edible) marine resources, fishing down the food web, and evolutionary alterations in species as a result of high fishing pressure over a period of time. We must also leave room for discoveries of new organisms and compounds with the potential for exploitation in the future. Harvesting species of whose distribution, growth rates, etc., we have little knowledge, could at worst lead to the extinction of the species.

Apart from this, it is important to improve our knowledge of the effects of harvesting marine species on biodiversity in the ecosystems in which harvesting is taking place. Three main areas are of obvious interest in this respect: the effects of fishing on benthic habitats, on species that are taken as by-catch and on the genetic make-up of fish stocks.

A better understanding of the processes and dynamics involved in commercial and leisure fishing is important if we wish to be able to discuss their effects on the ecosystem. Fisheries are constantly changing, and catch capacity is larger than we need for sustainable harvesting of the resources of the sea. New knowledge of how fish are distributed in time and space is essential if we are to be capable of saying anything about real catch out-take and other environmental effects. Knowledge of this type will provide us with a good foundation for providing specific advice about ecosystem-based management.

b) Responsible fishing practice

focusing on how ecosystem-based management means that fisheries must be sustainable and must be carried out in a way that does not damage other components of the ecosystem.

Many current fishing methods do not satisfy such measures of responsible fishing. Bycatches and discards of unwanted catches, as well as negative environmental effects, are very common. R & D aimed primarily at developing methods for reducing discards and environmental effects will therefore be a priority task in the future.

Example of important research tasks include the development of trawl gears and techniques that will be more selective in terms of sizes and species, that are easier to tow and that inflict less damage on the seabed; net technology which can target particular species and sizes better than today; and fish-capture technology for the conventional fleet that pays more attention to ecological and ethical considerations than does gear in current use. Documentation of the effects on resources and the environment of potential innovations will also require research.

c) Environmental quality objectives

focusing on ecosystem approaches, which is a new strategy for the management of our ocean areas and which will require a significant development of the operational management framework.

This will require the development of quantitative indicators at individual, species and population level, which, in conjunction with indicators of important life-styles and other areas of particular biological or ecological value, reflect the state of the ecosystem. On the basis of these results, it will be possible to set environmental quality goals that will enable the authorities to carry out resource utilisation assessments and other activities in the light of integrated ecosystem considerations. A significant amount of research will be needed to develop unified, functional ecosystem indicators and to define points of reference from an ecosystem perspective.

d) Management processes

focusing on encouraging projects that attempt to put the knowledge of coastal fishermen into a scientific context, as well as projects that attempt to analyse the effects of different management models.

Organisations should be encouraged to show greater interest in studying in more depth the grounds for the advice provided by the research community. Norwegian fishermen possess invaluable experience-based knowledge, which is insufficiently drawn on in the context of research. There is a need for a knowledge base for the development of good models and processes for integrated planning and management in this area.

e) Conflicts of interest

focusing on the fact that a rising level of activity in the coastal zone brings in its wake conflicts of interest concerning alternative uses of coastal resources.

The coastal zone is characterised by a wide-ranging set of interactions between natural systems and cultural, social and economic patterns of use in mutually dependent interplay. Interaction between the biological basis of industrial activity, cultural remains and environments, and the social and economic organisation, make up an important field of knowledge. The dynamic character of the coastal zone means that there is a high

degree of unpredictability, and any measures that are put into effect will be subject to a high degree of risk. This situation offers challenges to both management and knowledge generation.

The exploitation of marine ecosystems involves conflicts of interest related to such situations as the use of land and sea areas for industrial and societal activities in the coastal zone, the allocation of quotas for harvesting live marine resources to various national rights-holders, and the determination and allocation of quotas for the harvesting of live marine resources among coastal states and multi-national associations (e.g. the EU). Unresolved allocation problems at international level can easily lead to overexploitation of valuable resources. There is a growing recognition that such problems of allocation lack consequence analyses based on risk assessments.

An aim will be to develop methodologies for dealing with conflicts of interest related to the management of marine resources. The sub-programme will cover both international conflicts of interest and conflicts arising between different interest groups and rights-holders at national level. It will focus on conflicts and conflict resolution on the following areas:

International management regimes

Overcapacity in the global fishing fleet is the driving force behind conflicts over resources. Conflicts over the allocation of resources make it difficult to establish stable, durable solutions. Fishing on the high seas beyond the 200 mile limit is still not subject to control, and although a global framework has been established it has proved difficult to implement it effectively. International environmental regimes affect the conditions for managing and exploiting coastal resources that may find themselves in conflict with traditional usages and management practices. Through the development of marine legislation, Norway has been given jurisdiction over large areas of the ocean, and there is a need to strengthen the legislative research environment.

Resources management and allocation; user and quota rights

In the field of ocean and coastal resources management, the question of participation has been a central topic of debate. In the course of time there has been a development in the direction of involving more and more interests. A complicating element is the introduction of regionally based management models. Closely related to this are conflictual questions regarding the allocation of quotas and quota rights. With the strong growth in the use of the natural resources of the coast for industrial purposes, combined with measures for protecting and maintaining the natural features of the coast, conflicts are bound to arise, and there is thus a need to develop models capable of preventing such conflicts.

Sea ranching and releases of various species

The Sea Ranching Act allows crustaceans such as scallops and lobsters to be released into the sea. Such releases will place limitations on alternative uses of relatively large areas. This raises the question of alternative uses of scarce productive resources. Exclusive recapture rights for both wild and released individuals of the species concerned have the potential to arouse conflicts between various interests.

Management of coastal areas.

The rising level of activity in the coastal zone means that the availability of suitable areas is in the process of becoming a limiting factor in marine value creation. The fishing industry in particular is experiencing growing pressure from activities that hinder, or are disadvantageous to, fishing as such.

There is a significant need for a better understanding of how to deal with conflicts over area use in the coastal zone, particularly in acquiring an overview of area development and “bit-by-bit” management, the relationship between land and sea, (run-off, activities, protection and industrial development) and the development of basic marine information (depths, sediments and types of nature) for industrial, planning and management purposes. There is a need for better knowledge of local and regional effects of different types of use and protection, and of the effects of regional coastal zone planning on use of the coastal zone.

The Framework Water Directive

The EU’s Framework Water Directive forms a superstructure over existing regulations (including other EU directives) and provides guidelines for an integrated water management policy for Europe as a whole and in individual countries. Norway is implementing the Framework Water Directive as part of the EEZ Agreement. The Water Directive covers the coastal zone out to a distance of one nautical mile from the low-water line (approx. 100,000 km²).

V. Sub-programme: The basis of value creation

The aim of this sub-programme is to improve conditions for marine value creation.

Sustainable management is a necessary but not sufficient condition for marine value creation. The potential for increased value creation lies in part in more socially rational harvesting of marine resources and partly in making the catch and processing phases of the fishing industry more efficient, as well as generating new products based on marine resources. This sub-programme too will focus on the conditions and perspectives of the Sami people.

a) Socio-economically rational harvesting

focusing on promoting a wider understanding of interactions between human beings and marine resources.

Via the development of methodologies including social economic aspects of marine resources management, as well as management strategies and the social consequences of such strategies, a more holistic basis for increasing the value creation of our fisheries will be sought. In this connection, it is important to generate basic bio-economic knowledge and modelling tools for the establishment of bio-economic single- and multi-

stock models. It will be necessary to develop models that incorporate important economic aspects, and that outline the consequences of different catch levels, catch patterns, fleet capacity, choice of regulatory tools and market-based regulatory regimes, and to improve our knowledge of the consequences of different management strategies, at both national and international level.

In order to ensure that management strategies are sustainable, the models should be capable of being utilised to analyse the consequences of different harvesting intensities (catch out-takes). For fish stocks that are harvested by several countries, the consequences of cooperative and non-cooperative management regimes ought to be analysed, e.g. by means of game theory.

b) Under-exploited species and harvesting species lower in the food chain

focusing on acquiring better knowledge for harvesting species lower in the food chain.

There is a need for knowledge regarding the potential for value creation via such harvesting. One example of this is the use of crustaceans that feed directly on algae without any form of feed additives. Underexploited resources may have significant potential for value creation. Here there is a need for knowledge as well as for determining the extent of such resources, and for the development of suitable catch technologies.

The aquaculture industry is expected to grow significantly in the near future, which means that the pressure on marine feedstuff resources will also grow. Unexploited marine resources of the order of magnitude that will be needed to meet the aquaculture industry's feed requirements are to be found only at lower trophic levels. Harvesting further down the food web has a number of ecological advantages, in that we remove food resources just where production is greatest. It is also expected that the content of organic environmental toxins that accumulate in the food chain will be lower. We lack basic knowledge about production and about the ecological consequences of a commercial fishery for zooplankton and micronekton for species higher in the food chain. Commercial harvesting of zooplankton and micronekton in our waters cannot be set in motion before we have surveyed the resource base and established a management regime in accordance with sustainable principles and based on ecological management models. In order to achieve maximum catch rates, new catch technologies will have to be developed. Bio-economic multistock modelling will be an important tool for clarifying whether harvesting will be profitable, on the basis of the resource base, density, availability, catch costs, market conditions, etc., and the extent to which harvesting would be profitable when weighed up against the alternative in a multistock context, i.e. to allow the plankton to become food for species at higher trophic levels. Methods of handling catches and processing feed should be developed in controlled studies. In collaboration with the new Aquaculture Plan, the suitability of plankton as food should be studied via controlled growth studies.

c) Marine bio-prospecting

focusing on contributing to active searches for new bioactive components and substances in marine resources that have a potential for commercialisation.

In this context, it is important to develop competence with the aim of establishing a suitable legislative framework for marine bio-prospecting in order to ensure that organisms, genes and substances are commercially exploited in a sustainable manner. In order to ensure that developments in this field take place in accordance with the principle of sustainability, (where components/bio-activities are demonstrated in vulnerable or threatened species or biotopes), we should search for methods of production based on recombinant DNA technology.

d) Value-creation in coastal communities

focusing on understanding how local and regional production systems, coastal culture, knowledge systems and entrepreneurial spirit are the premises for development and innovation.

More research is needed in order to increase our insight into the interaction between naturally and culturally-based industry and local and regional social and economic organisation. Studies of the coastal infrastructure, including transport, and the role that this plays in value creation, are also needed.

It is important that the management decisions taken, which will also be of relevance to future value creation in coastal communities, should be based on the best possible foundation of knowledge. Key research questions will include what characterises sustainable coastal communities and what is needed to maintain the knowledge base and innovatory capacity of the coast as a prerequisite for value creation. It will be necessary to maintain and develop the infrastructure, including sustainable transportation and logistics systems. Another central aspect is the interplay between cultural environments and local and regional identities, local and regional organisation and the value creation that is related to this interplay.

e) Bio-habitats and habitat restoration

focusing on producing an overview and knowledge of marine habitats.

Knowledge of this sort is a prerequisite for sustainable management of the coastal zone, not least where the prospects of combining nature conservation and resource utilisation, with emphasis on the precautionary principle, are concerned

There are knowledge challenges related to the development of management models that will contribute to the protection of the subsea landscape, with its diversity of habitats, while permitting the sustainable utilisation of living resources by methods that do no harm to the seascape. It will also be necessary to acquire management knowledge that will contribute to ensuring species diversity by conserving habitats or biotopes.

f) Toxic algal blooms and algal toxins

focusing on the necessity for improving our knowledge of the pelagic ecosystem, including algal blooms, that in most cases will be the most important tool for understanding toxic algal blooms.

Toxin-producing microalgae may offer threats to both the aquaculture industry and to natural flora and fauna. For explanations of toxic blooms it is seldom sufficient to have

specific knowledge of a toxic plankton alga. General taxonomic knowledge that will enable new problem species to be identified as they appear will also be essential.

Algal toxins are an important limitation on the development of a Norwegian shellfish industry. We need more knowledge of threshold values and differences in the uptake of various algal toxins in shellfish, and of when the algae will develop toxins in the shellfish. It will also be necessary to know more about the distribution of toxic algae on the coast of Norway, and about warning systems.

Similarly, the sub-programme will be open to projects capable of studying the prospects of manipulating or controlling algal production in fjord systems in connection with the farming and detoxification of shellfish.

VI. Cross-disciplinary activity: Methods, models and technology

The objective of this activity is to sharpen our focus on methods, models and technology in order to acquire new knowledge of ecosystems and develop methodologies for adopting experience-based knowledge. In order to achieve the aims of the programme this will be organised in the form of a sub-activity that cuts across the other sub-programmes, so that the results of the sub-programmes can readily be incorporated in integrated tools for observing, manipulating or modelling the characteristics, long-term consequences and management and value-creation aspects of ecosystems.

Method development will require efforts across a relatively broad spectrum, from the development of practical tools and research facilities, via the evaluation of new statistical tools to more basic new ways of shedding light on relevant thematic problems. It will be necessary to develop theories and to draw on contributions from specialists. In several of the thematic areas, it will be necessary to develop new methods or to adopt tools that we still do not master or have not yet adopted. This will also be a useful means of further developing the ability of the authorities to monitor the marine environment. New methods of statistical analysis of long time-series should be adopted, for example in order to evaluate the hidden potential of existing data series and statistics. Research groups in possession of long time-series must actively involve statistical and mathematical expertise.

Quantitative population dynamic modelling must be strengthened in order to better understand and rank the importance of a number of potential mortality factors. Methods that describe mechanistic relationships on the basis of experimental approaches will be given priority, in order, among other aims, to obtain more generally applicable results. The development of improved models of production and general overviews that describe the size, or at any rate, the relative significance, or individual mortality factors and influences in all phases of the life cycle, will be an important goal of the Programme.

Important collections of biological material and data can be found in our universities, museums and research institutes. Further processing and analysis of this material using new methods would be capable of improving our insight. It would take many years to obtain new data-sets, since series of 20 years or more are desirable if we wish to obtain a good picture of a situation. Only modelling enables us to distinguish between important and minor factors, and to understand how stocks are threatened or have been developing in a seriously negative direction.

a) Observation technology

focusing on new, more efficient observation methodology which will improve the knowledge that underlies sustainable fisheries management.

The safe, sustainable management of important fish stocks demands good knowledge of how stocks develop. Such knowledge can be acquired both from scientific fishery-independent observation methods and from methods based on data acquired in the course of fishing operations. In this connection, it will be important to develop sampling tools and methods that provide us with an accurate picture of the stocks that are being harvested. Technological progress in ICT enables us to build more, and more precise, sensors, multibeam and multifrequency systems and better signal-processing systems. New observation systems should be capable of being adapted to applications on board research or fishing vessels, autonomous underwater vehicles or stationary platforms.

b) Mathematical and statistical methods

focusing on mathematical/statistical methods.

The use of new or less well-known mathematical or statistical methods could be of importance for related problems that cut across the individual sub-programmes. The use of modern methods based on geostatistics may be suitable for both marine stock assessments and mapping environmental toxins. The programme will encourage generic methodological projects, such as those that attempt to reveal basic biological laws of nature that apply to several species.

c) Mapping and monitoring biological diversity

focusing on condition reporting

Condition reports on biological diversity - national and international - will make major demands of technology if we are to be capable of covering our huge marine regions. New methodologies and technologies that will increase the area that can be covered therefore need to be developed.

d) Abiotic modelling

focusing on special modelling, resuspension, diffusion and advection of environmental toxin deposits in dumping sites and sediments.

Generating new knowledge of the effects of environmental toxin deposits in dumping sites and sediments will require resuspension, diffusion and advection from these structures to be modelled.

e) Fisheries technology

focusing on the concept that continued efforts in fisheries technology is capable of making a significant contribution to the development of responsible fisheries management practices while offering the fishing industry benefits in terms of value creation. This will be a matter of creating new general conditions for responsible, sustainable fisheries.

In the future, Norwegian fisheries will need to be able to document that they are observing the overarching objectives for responsible fishing, and further efforts must be made to reduce bycatches and unintended fish mortality, at the same time as the negative ecosystem effects of fishing are minimised. Ethical aspects of harvesting natural resources, in parallel with a sharper focus on quality and stable deliveries of raw materials from the fisheries, will require the development of new, less harsh, fish-capture methods and new sales models for the coastal fleet.

VII. Cross-disciplinary activity: Research cooperation

The objective of this cross-disciplinary activity is to contribute to greater national and international cooperation and exchanges of knowledge.

There is a trend in science in the direction of an ever higher degree of specialisation, in which no individual researcher or national centre of expertise any longer has a complete overview of all the scientific aspects of marine science. The scientific challenges facing us thus demand cooperation between institutes and with the university sector, as well as a large degree of international cooperation. This will also make a contribution to better, more efficient utilisation of competence, equipment and research facilities. There is also a need to develop cross- and multidisciplinary research projects in which specialist groups collaborate. The philosophy of the Programme offers major challenges in the fields of developing efficient methodologies, cooperation and coordination at national and international level. It is also important that the Programme should result in an improvement in recruitment to this field of research and to the development of at least one Centre of Excellence in Research.

The Programme will interface with other Research Council programmes, such as Aquaculture - a Growth Industry, Petromaks, Norklima, Landscape in Change and the new programmes Norwegian Food from the Sea and the Land and Industrial Development Based on Surface Resources . Industrial Policy for Agriculture, Fisheries and Aquaculture, which are currently under development.

The fishing and aquaculture industries should be invited to co-finance projects in which they have common interests. In the long run, it may also be appropriate to cooperate with anti-poverty programmes that are currently under study.

In certain cases, the Programme will consider joint advertisements and joint projects with other programmes. In such cases, it may be possible to set up inter-programme groups to evaluate and prioritise applications, while the final decisions are left in the hands of the Programme Board or boards.

National collaboration

One of the strategic guidelines of the Programme is to encourage a greater degree of scientific cooperation among Norwegian research groups, and it will prioritise large-scale projects that involve inter-institutional collaboration. The planning group envisages that such cooperation and delimitation vis-à-vis other programmes will help to ensure that research funding is utilised as efficiently as possible. The definition of scientific problems and questions of project funding can be coordinated between several programmes. Research centres will also be encouraged to consider such cooperation and sharing of responsibility.

Generally speaking, the Programme's projects ought to receive funding from other sources than Oceans and the Coastal Areas, and efforts should be made to increase funding and to find other financial partners.

International collaboration

International collaboration is essential if we are to be able to deal with many of the knowledge challenges faced by marine science. The Programme wishes to build on the good traditions of international collaboration that exist in marine research, and to further develop these via collaboration on projects.

The international aspects are therefore well-developed in marine management and research, being incorporated in international agreements and conventions, and in the context of research cooperation and networks for exchanges of knowledge at institutional and individual level. Both the international perspective and an awareness of tendencies and research results in other countries are of decisive importance for the development of knowledge in this field. European cooperation benefits us all, given our many cultural and historical similarities and shared climatic features.

However, knowledge development must also be viewed in relationship to research groups in other countries.

A number of Norwegian marine science research groups are already of international standard, and this is a natural consequence of Norway's position as a marine science nation. One of the Programme's objectives is to further reinforce this position.

Global and regional priorities

Marine products have gradually become highly international commercial products. While global marine production doubled from 1961 to 1999, international trade in fish products increased ?? by xx % in the same period, not least because these are the

principal export products of a number of countries in the southern hemisphere. Fish have become the most important item of food exports from developing countries. Due to weak institutional infrastructures and management organs in such countries, these important fisheries are vulnerable to over-exploitation and environmental threats. Norwegian research can contribute to the development of local knowledge and a better understanding of the effects of the activity of the Norwegian fisheries sector in other countries.

Marine products are also the most important source of animal protein, particularly for the poorest parts of the population in many developing countries. Norway has committed itself at the UN to participate in the international fight against poverty. One of the areas in which we are best able to contribute, thanks to our scientific competence, is precisely in the fisheries sector, for example by transfers of knowledge and technology.

However, this will require the development of research-based knowledge of natural and social conditions in individual countries and of international regimes and agreements. In this connection, it is important to collaborate with local research groups. The research that is carried out must take into account, and develop, methods and technologies that can be applied under local conditions, such as stock estimations that are relevant to small-scale fisheries, local management regimes and coastal zone planning.

Better knowledge of conditions in the southern hemisphere is also needed from the point of view of Norway's own interests. In the course of the past 20 years the consumption of fish products in developing countries has increased seven times as much as in the industrialised world, a trend which is expected to continue. This represents an important market potential for the Norwegian fishing industry, not only in the shape of new markets for fish products but also for fisheries-oriented technology and knowledge.

The challenges facing marine research tend to vary in different coastal and ocean regions, and this situation must be reflected both in terms of how topics are prioritised and in the choice of ocean regions in which the research is to be done. In connection with the International Polar Year 2007/2008, it ought to be possible to coordinate a few projects with Norwegian participation in this event. However, these projects would need to be within the existing framework of sub-programmes and cross-disciplinary activities, and should preferably be of such a nature that they would cover research activities in both the Arctic and the Antarctic.

4. Development of competence

The Programme Board will prioritise basic competence development via recruitment. There is a serious need to recruit marine scientists. The Programme's recruitment measures will primarily target doctoral students and post-docs, and female students will be prioritised. Funding for stays abroad for Norwegian scientists are also a possibility as part of major projects, in order to increase the extent of international competition. The Programme's recruitment plan is in accordance with the aims of the Research Council's action plan for recruitment. Measures to be adopted may include personal fellowships, or recruitment positions may be incorporated into larger projects.

Follow-up of doctoral students and research fellows

In order to meet our goal of a stronger position in marine science, the Programme will strongly support the recruitment of doctoral students and encourage their development into competent, independent research scientists. One aspect of this effort should be the organisation of annual meetings for doctoral students, with financial support provided by the Programme. At these meetings, students should be encouraged, and given the opportunity, to present their projects. This will give them some training in presenting their own research results. Focus should also be placed on research students' working conditions and on the support they receive from their supervisors.

5. Strengthening scientific groups and other links

Multidisciplinary projects are made up of a number of different disciplines, whose contributors provide their scientific input in a relatively isolated manner. Cross-disciplinary collaboration implies that contributors from various disciplines work closely together with such a degree of integration that they contribute to each others' disciplines. An example might be that of a statistician who is to develop a populations dynamics model for marine species, while a biologist who possesses solid statistical knowledge contributes to the development of the statistical model. The Programme should set aside some funding to stimulate cross-disciplinary cooperation, for example by prioritising projects which take this aspect into account. This is important, not least because the focus of the Programme is on ecosystem-based marine resources management.

Basic and applied research

Research in this programme, which is dedicated to coordinating marine science, must balance a focus on applied problems against an anchorage in its own overarching objectives and the need for an integrated, long-term approach to the need for knowledge. The following factors are essential if we wish to ensure that the research carried out reflects the highly demanding principal objectives of the Programme:

- To develop an improved understanding and interest among research groups in problems that reflect the challenges of resources management as set out in the programme plan.
- To encourage the optimal choice of research design, theory and methods for dealing with the problems. Support for the development and testing of new methods may be appropriate in certain areas, when this is properly justified.
- To make it clear how research can contribute to the identification, understanding and solution of problems.
- To show how knowledge generation can help us attain our goal of integrated, long-term management models and solutions.
- To encourage curiosity-driven research - this is capable of leading to research breakthroughs of great practical importance and may be of long-term importance for management and value creation.

Research quality

The research financed by this Programme must be of high scientific quality. This should be based on the quality criteria employed by the Research Council, and expert evaluations will be utilised in the processing of applications. International, impartial experts will be employed, possibly coming together in the form of expert groups. All applications are to be written in English. Good knowledge development depends on a structured interaction between scientific systematisation based on known theories, methods and criteria, and the creative exploration of problems that demand a different, or cross-disciplinary, understanding, where there may be a lack of well-established theory. As far as the evaluation of applications is concerned, emphasis should be placed on originality and relevance as well as scientific solidity, and solidity should be weighed up against risk and potential. The Programme covers disciplines that have a long tradition in Norway. There are a number of strong research groups that include internationally recognised scientists in many of the subjects covered by the Programme, but in certain fields there is a need for a phase of competence development. This requirement can be satisfied by means of various measures, such as different project durations, extended financial budgets to allow cross-disciplinary challenges to be faced, and a range of recruitment measures.

Long time-series and monitoring

Long, quality-assured data series are of decisive importance for research on climate change, the environment and ecosystems. They are also essential for the management of the environment and our marine biological resources. This means that Norway needs to have high-quality monitoring programmes, with adequate scientific credibility and the best possible geographical coverage.

In 2001, the Research Council established three working groups to evaluate “conservation-worthy” long time-series of particular importance for research. The Research Council, the authorities and the research sector wished to have an overview of existing data series and to help ensure that the most important series would be available to cross-disciplinary research programmes. It is important to concentrate the attention of the political authorities on the importance of long time-series. The Programme should promote the use of long monitoring series and encourage the development of new monitoring methods and technology.

Availability of data and post-testing of results

Ecosystem-based thinking makes important demands of the individual researcher in “restructuring” from his or her own speciality to a more multidisciplinary orientation. In order to encourage such a restructuring process, there needs to be reasonably easy access to the data that underlie the research results produced by the Programme, so that interested parties can work on the data and see, for example, whether they obtain identical results.

6. Information and communication

The Programme will draw up its own plan for information and communication. This will be needed if we are to raise the level of interest in and understanding of the importance of marine research for the conservation and sustainable use of the ocean and the coastal zone. More information about the research results ought to improve the spirit of cooperation among the players in this field. All projects should have a focus on good information and communication plans. At the end of the project, all projects will be required to submit fact sheets that present their results at a popular level.

The results of the activities of the Programme will first and foremost be made available to scientists, public- and private-sector authorities, politicians, organisations and the general public. The Programme will:

- supply the authorities with new knowledge concerning the sea and the coast
- ensure a greater degree of scientific communication and cooperation among scientific groups in order to promote the production of knowledge
- play an active role in improving the exchange of information between research, the authorities, politicians and organisations
- raise the profile of research as a policy tool and, in particular, identify the recruitment requirements of the field
- help to make research in a field that is already arousing a great deal of interest among the general public even more popular.

The efforts of the Programme to reach relevant target groups will be divided into two parts: the work done in individual projects and the work done at central level by the Programme Board or the administration. The Programme touches on several current problems that concerning our society as a whole. Good communication with different user groups, both public-sector and private, will be a prerequisite for the success of our efforts in information and communication. Communication with users must be a continuous process carried out via the work done in projects and the Programme.

We must try to ensure that:

- project managers are given the opportunity to develop their skills in project work and that the processes of communication and information are given due weight in projects
- project information is used as a basis for the efforts of the Programme as a whole to synthesise and communicate its work
- the Programme has its own active web-site
- various types of network, meetings and conferences, special-subject meetings, start-up conferences for new projects, user-oriented conferences, etc., are organised.

Conferences

The Programme should support the holding of conferences/symposia/workshops, particularly when these are of a multi- or cross-disciplinary nature. The Programme itself should organise conferences at least every second year, at which scientific problems are discussed and/or research results are presented.

7. Result goals and result indicators

In order to illustrate the extent to which the aims of the Programme have been reached, a series of result goals and result indicators will be drawn up. The Programme's action plan will concretise and quantify the indicators with goal figures and milestones. The following aspects will be central features of this effort:

Result goals	Result indicators
High research quality <ul style="list-style-type: none"> • Produce R & D results and technology platforms • Develop internationally visible 	<ul style="list-style-type: none"> • Publications in peer-reviewed academic journals • Publications in other academic and professional journals

<p>research groups that are leaders in their fields</p>	<ul style="list-style-type: none"> • Presentations at international peer-reviewed conferences • Keynote speeches and chairmanships at international conferences • Membership of international scientific committees
<p>Improve recruitment of research scientists</p> <ul style="list-style-type: none"> • Development of personnel with a high degree of competence in the scientific fields of the Programme 	<ul style="list-style-type: none"> • Number of submitted doctoral theses financed by the Programme: by gender • Number of doctoral students financed by the Programme • Number of post-docs financed by the Programme • Completed M.Sc. dissertations related to projects in the Programme
<p>Links across types of research, scientific disciplines and sectors</p> <ul style="list-style-type: none"> • Strengthen interactions between basic research, applied research and industry-oriented research • Promote cross-disciplinarity • National leadership and coordination of research in the fields covered by the Programme 	<ul style="list-style-type: none"> • Number of cross-disciplinary projects in which researchers from different disciplines participate • Number of projects in which several institutions and disciplines participate • Examples of project activity in which basic, applied and industry-oriented research interact
<p>Basis of industrial development</p> <ul style="list-style-type: none"> • Build up research groups with industrially relevant expertise • Encourage interactions between basic and industrially oriented research, obtain synergies and produce cooperation with other parts of the industrial policy system 	<ul style="list-style-type: none"> • Number of co-financed projects with FHF • Number of companies participating actively in projects • Examples of Innovation Norway following up research projects financed by the ?? Programme // the Research Council by supporting innovative activities • Development of new types of fishing gear
<p>Contribute to new insight of significance for society and to better resources management</p> <ul style="list-style-type: none"> • Contribute to knowledge development for policy design • Contribute to the solution of societal problems • Contribute to obligations incurred under the terms of international agreements 	<ul style="list-style-type: none"> • Examples of where the Programme has meant something for the authorities in terms of facing societal and environmental challenges • Changes in regulations on the basis of newly acquired knowledge • Degree to which the objectives of agreements have been met
<p>Strengthen international cooperation</p> <ul style="list-style-type: none"> • Act as a bridgehead for greater 	<ul style="list-style-type: none"> • Advertisement as a result of ERA-Net

<p>interaction with international research milieux in the field</p> <ul style="list-style-type: none"> • Emphasise participation in international research cooperation and the development of international networks 	<ul style="list-style-type: none"> • Number of projects undertaken in cooperation with international research milieux • Number of academic publications in collaboration with foreign researchers • Project portfolio of research groups from EU programmes within the field of the Programme • Volume of international funding • Number of students and researchers on long-term stays at overseas research institutes • Number of foreign visiting scientists connected with projects
<p>Emphasise communication of results</p> <ul style="list-style-type: none"> • Active communication that also includes a synthesis of the results of the Programme and recommendations regarding how these can be followed up 	<ul style="list-style-type: none"> • Communication efforts aimed at relevant target groups, including dialogues with funding ministries • Open scientific seminars and workshops • Lectures at scientific meetings • Appearances in the press, radio and TV • Books published • Information and communication aimed at general public • Information and communication aimed directly at schools

8. Funding

The Programme must start off with a budget of NOK 100 million for its first year of operation. The needs for research that have been set out in the Programme Plan demonstrate that significantly greater research efforts will be needed to meet the goals of the Programme. In the course of the first two years of the Programme, its financial framework should be raised to MNOK 150. This is essential, not least in order to profile research related to coastal zone problems. If the Programme is to be able to function as intended, with specific sub-programmes and activities, the financial framework will have to be specified at sub-programme and activity level. The budget for each sub-programme and activity will reflect the relative importance of the sub-programme and activity with respect to the Programme as a whole, while retaining certain guidelines and priorities set by the ministries and organisations which will contribute to its

funding. The PROOF sub-programme is a continuation of the programme entitled “Long-term effects of discharges to the sea from petroleum activities”, with the budget of these two programmes. In the following table, therefore, these two programmes are shown with the amounts of funding which have been the basis of their financial plans. As far as the other sub-programmes and activities are concerned, an allocation of the remaining funding is presented in terms of percentages. A recommended allocation of funding to individual sub-programmes and activities is shown in Table 1.

Table 1: Proposed funding (in MNOK and %) of the “Oceans and the Coastal Region” research programme

Delprogram/delaktivitet	2006	2007	2008	2009	2010	2011+
Marine ecosystems	35%	35%	35%	35%	35%	35%
Effects on ecosystems	15%	15%	15%	15%	15%	15%
sediments **	(15mill)	(15mill)	(15mill)	(15mill)	(15mill)	(15mill)
Management and conflict resolution	20%	20%	20%	20%	20%	20%
value creation	15%	15%	15%	15%	15%	15%
Methods, models and technology	10%	10%	10%	10%	10%	10%
The basis of value creation	5%	5%	5%	5%	5%	5%
Long-term effects of petroleum-related activities (Proof)*	20 mill					

* The programme “Long-term effects of discharges ...” is planned to run until 2008, following which it can either continue as a separate sub-programme or be integrated into the other sub-programmes through the annual action plans.

** If special efforts are to be made on sediment problems, these will form part of the sub-programme “Ecosystem effects” as earmarked funding. Without such growth, research on this topic will form part of the sub-programme.

Funding for the Methods, models and technology and the Research cooperation cross-disciplinary activities, will be taken from the other sub-programmes.

Appendix

The planning group which was given the task of drawing up a plan for the Programme “Oceans and the Coastal Areas”, consisted of the following persons:

Ole Arve Misund, research director, Institute of Marine Research (chair)
Eivind Bergtun, businessman, Bømlo Skjell AS
Marit Dale, teacher, Val Secondary School
Professor Abraham Hallenstvedt, Sandefjord
Per Erik Iversen, senior engineer, State Pollution Control Authority
Bente Jarandsen, adviser, OLF
Jorun Egge, senior lecturer, Department of Biology, University of Bergen
Anna Elisabeth Forsgren, senior lecturer, Norwegian University of Science and Technology
Alf Harbitz, senior scientist, Institute of Marine Research, Tromsø
Kari Nygaard, research manager, Norwegian Institute for Water Research
Håvard Røsvik, chief scientist, SINTEF Fisheries and Aquaculture
Per Sandberg, senior adviser, Directorate of Fisheries
Jostein Skurdal, director, Lillehammer Regional College
Edel Åsjord, adviser, Norwegian Fishermen’s Association

The mandate of the planning group was as follows:

Period, deadline and reporting:

The planning group is appointed for the period of October - December 2004. The deadline for its efforts is December 15, 2004. The planning group reports to the Research Council of Norway in the person of adviser Nina Hedlund.

Important document and scientific input:

- The Research Council’s strategic plan: “A willingness to do research” (VTF)
- Planning document “The Sea - a source of riches”
- Action plans and programme notes from current Research Council programmes: Marine resources, environment and conservation; Fisheries technology; Monitoring marine resources and terrestrial systems; Computational mathematics in applications; Pollution, sources, dissemination, effects and measures; Long-term effects of discharges to the sea by the petroleum industry; Biological diversity; Wild Salmon Programme.
- Planning document for coastal zone efforts
- Relevant White Papers: No. 39 (1998-99) Research at the threshold of a new epoch; no. 43 (1998-99) Conservation and use in the coastal zone; no 24 (2000-01) The Government’s environmental policy and the environmental state of the nation; no. 12 (2001-02) Clean, rich seas.

Remit:

The planning group will draw up a plan, to include principal objectives and sub-goals, which will describe central problems for research which should lie within the field of this Programme. The plan should include proposals regarding the research tasks that it recommends should be given priority within defined budgetary frameworks. The group should attempt to match as far as possible budgets and proposal as regards objectives, sub-goals and relevant R & D tasks. The scientific challenges involved may concern several government ministries: FID, MD, KRD, LD, NHD, OED, UFD, SD, HD, UD, and sector responsibility must form the basis of both funding and scientific focus.

The group is requested to clearly identify those areas in which more research-based knowledge is necessary in the light of the challenges presented by the sea and the coastal zone; their importance for national value creation, the need for integrated long-term management of resources and challenges in an international context.

The groups is requested to draw up central strategies with regard to research in this field, in terms of requirements regarding quality, basic, user-oriented and applied research, multi- and cross-disciplinary research, recruitment and competence development, national and international cooperation, information and communication strategies, etc.

The plan should:

- briefly describe the state of our knowledge and identify the most important needs for knowledge and competence
- describe relevant research tasks. Requirements for research should be prioritised with regard to different levels of funding
- identify areas in which there is a particular need for recruitment and/or a need to build up competence
- identify areas in which it would be desirable and necessary to carry out more multi- and cross-disciplinary research within the field and vis-à-vis other disciplines
- identify areas of particular relevance for international cooperation, particularly with EU countries and other central types of international cooperation.

Template of the plan

1. *Background*

Briefly identify the current scientific status and needs for competence and knowledge of the discipline concerned. Emphasise the specific reasons for doing the research and the challenges in the field - both scientific and societal. Discuss the relationship between the proposed efforts and the Research Council's strategy, efforts in marine research and other important strategic research guidelines.

2. *Objectives and sub-goals*

Define the principal objectives and sub-goals of the research efforts and which industrial and management problems these are intended to solve. The goals must be concrete, testable and communicable. The goals should be related to the specific scientific tasks that the field of research is intended to deal with, and to researcher training, publication, etc. The scientific ambitions involved must be made clear by the goals formulated.

3. ***Central R & D tasks***

Describe the R & D tasks that are central to meeting the goals as set out. The R& D tasks must be prioritised as far as possible and areas of high risk and high potential should be specifically identified. The group should base its priorities on a realistic budget. The assumed annual budgetary level is approximately NOK 90 million within a zero-growth budgetary framework, to which several ministries would be expected to contribute.

4. ***Development of competence***

Suggest areas in which there is a special need for recruitment and competence development, if necessary including suggestions as to measures to meet such needs.

5. ***Strengthening of research groups and various couplings***

Suggest areas in which it is particularly important to involve multi- and cross-disciplinary research as a success factor. Proposals regarding work-sharing among research groups should be considered, and in areas in which this tactic could be relevant, suggest as well how strong groups can be optimised, and how they ought to collaborate. Suggest areas in which cooperation with current Research Council research would be desirable and necessary. Indicate, too, those parts of the research effort that are relevant to international cooperation, vis-à-vis the EU and other central fora for international cooperation.

6. ***Information and communication***

Describe relevant information and communication measures and describe their target groups.

7. ***Funding***

Broadly based thinking should be a feature of the plan, and this should also be reflected in its financial aspects, which should be based on sector responsibility. Identify potential sources of funding for the research tasks proposed; ministries and other sources, and consider which parts of the efforts would be most appropriately funded by which ministry. Draw up a proposal for a financial plan for the Programme on the basis of potential future funding in this field (see also point 3).

The Plan should be a maximum of 30 pages in length. Complementary documentation, special studies, etc., may be enclosed if the planning group finds this to be necessary.