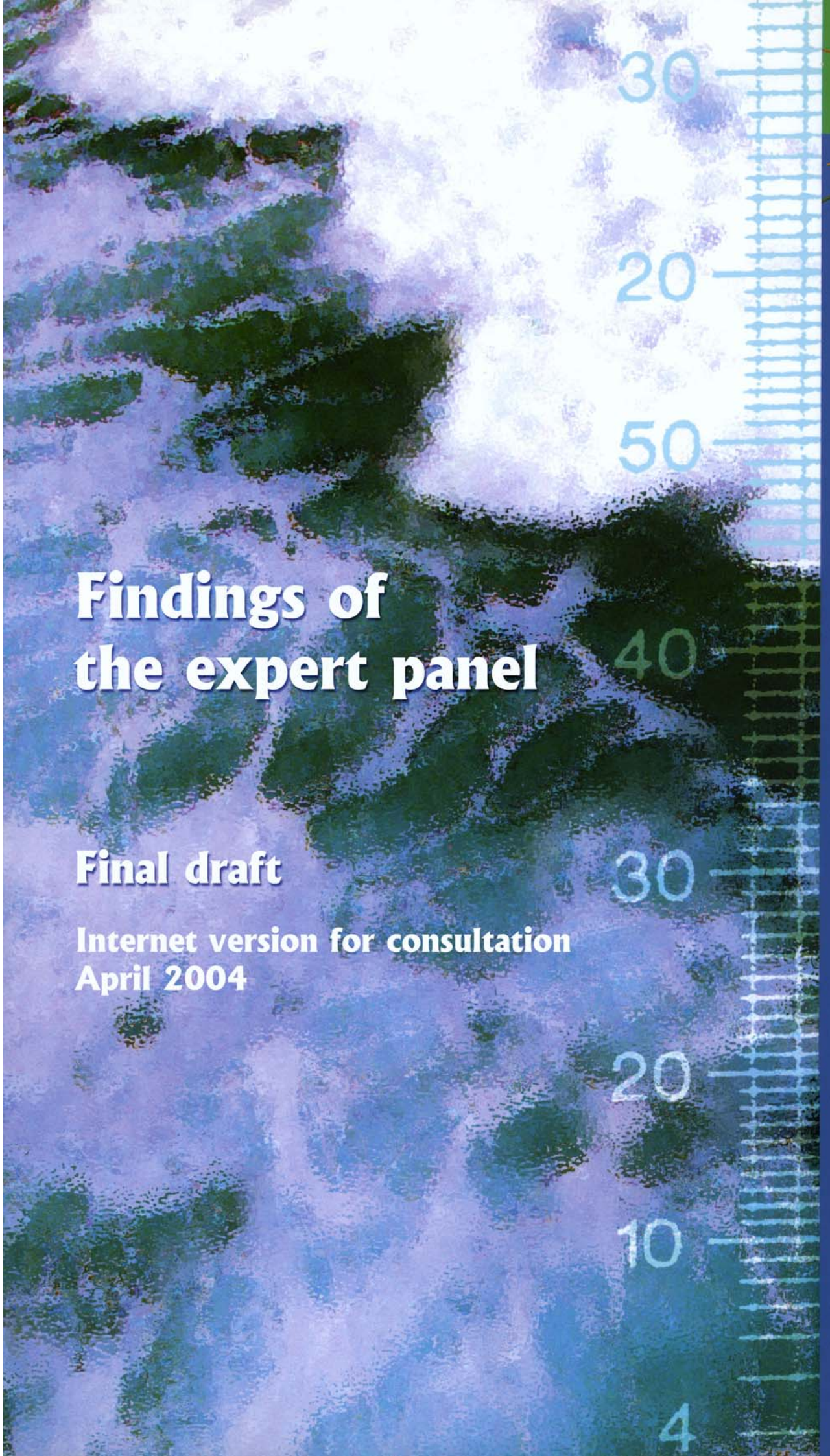

Findings of the expert panel

Final draft

Internet version for consultation
April 2004

THE BELGIAN NORTH SEA PROGRAMMES: 1970 - 2002

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1970 - 2002

Findings of the expert panel

- Final draft -

March 2003

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Voorwoord

Sinds meer dan 30 jaar initieert en ondersteunt het Federale Wetenschapsbeleid wetenschappelijke programma's met betrekking tot de studie van het Noordzee-ecosysteem. Deze programma's hebben tot doel de kennis van dit ecosysteem te verbeteren en een duurzaam beheer en exploitatie ervan te stimuleren. Alhoewel de institutionele context sinds 1970 aanzienlijk is veranderd, waren en zijn deze acties een essentieel element in de ondersteuning van het onderzoek binnen dit domein.

Om de efficiënte en de impact van zijn programma's te verbeteren, laat de Programmatorische Federale Overheidsdienst Wetenschapsbeleid deze door buitenlandse experts evalueren. Voorliggend rapport "Belgian North Sea Programmes 1970 – 2002" biedt, rekening houdend met de actuele internationale en nationale context en de structuren van het Belgisch marien onderzoekslandschap, een kritische analyse van de verschillende onderzoeksprogramma's die gedurende deze periode werden gestart.

Als Federaal Minister van Wetenschapsbeleid stel ik vast dat de bevindingen van het evaluatiepanel positief zijn zowel wat betreft de programma's zelf als de inbreng van de betrokken onderzoeksteams.

De experts hebben bovendien meerdere aanbevelingen geformuleerd voor de verdere ontwikkeling van nieuwe acties en programma's binnen het domein van de mariene wetenschappen. Tot deze behoren de uitbreiding (geografisch en thematisch) van de onderzoeksgebieden, de versterking van de coördinatie tussen de verschillende nationale actoren, de versterking van de internationale samenwerking, de ontwikkeling van een coherent nationaal beleid betreffende het beheer van mariene gegevens en het versterken van de valorisatieactiviteiten.

De deskundigen benadrukken het belang van een nationaal virtueel netwerk voor marien onderzoek. Dit netwerk moet een maximale synergie toelaten tussen de verschillende actoren betrokken bij het marien onderzoek en bij het Noordzeeonderzoek meer in het bijzonder. Dit netwerk moet ook de internationale zichtbaarheid verbeteren van de onderzoeksinspanningen, die door het Federale Wetenschapsbeleid ondersteund worden. Een dergelijk initiatief vereist een aangepaste beheerstructuur, bij voorkeur onder de vorm van een multidisciplinaire coördinatiecel.

Zoals in het rapport wordt onderstreept, zal op federaal niveau de Beheerseenheid van het Mathematisch Model van de Noordzee (BMM) – rekening houdend met de diversiteit van de door haar uitgevoerde taken - een belangrijk element van dit netwerk vormen. De BMM, opgericht in 1976, is een onderdeel van het Koninklijk Belgisch Instituut voor Natuurwetenschappen (KBIN), dat, via de Programmatorische Federale Overheidsdienst Wetenschapsbeleid, onder mijn bevoegdheden valt. Als onderdeel van het KBIN beschikt de BMM over een aantal bijkomende troeven: de wetenschappelijke kennis betreffende biodiversiteit, het patrimonium - waaronder de collecties - en de museologische activiteiten, die haar zullen toelaten binnen dit netwerk een belangrijke rol te spelen en haar huidige activiteiten te versterken.

De oprichting van een dergelijk netwerk, dat alle actoren omvat die bij het marien onderzoek in ons land betrokken zijn, is een strategische en organisatorische uitdaging. Ik zal dan ook de dialoog met alle betrokken partijen opstarten met het oog op de uitwerking van een realistisch stappenplan.

Tot slot stel ik vast dat onderhavig rapport een schat aan informatie en discussiemateriaal bevat voor iedereen die bij het Noordzeeonderzoek betrokken is. Het biedt een uitstekend uitgangspunt om toekomstige initiatieven voor te bereiden.

Veel leesplezier,

Fientje Moerman
Minister van Wetenschapsbeleid

Préface:

Depuis plus de trente ans la Politique scientifique fédérale initie et soutient des programmes scientifiques consacrés à l'étude de l'écosystème "mer du Nord". Ces programmes ont pour objectif d'améliorer la connaissance de cet écosystème et d'en stimuler la gestion et l'exploitation de manière durable. Cette démarche était et reste la source principale d'impulsion et de financement de recherche dans ce domaine, même si l'environnement institutionnel a considérablement évolué depuis 1970.

Soucieuse d'améliorer l'efficacité et l'efficience de chacun de ses programmes, le Service public fédéral de programmation Politique scientifique procède à leur évaluation par des experts étrangers. Le rapport "Belgian North Sea Programmes 1970 – 2002" présente, en tenant compte du contexte national et international actuel et des structures du monde scientifique belge en sciences marines, une analyse critique des différents programmes de recherche mis en œuvre pendant cette période.

En tant que Ministre Fédérale de la Politique scientifique, j'ai pu constater que le bilan réalisé par le panel d'évaluation est positif, tant en ce qui concerne les programmes eux-mêmes que l'apport des équipes de recherche impliquées.

Les experts ne se limitent pas à un constat mais proposent un certain nombre de recommandations concernant le développement futur de nouvelles activités et programmes en sciences marines : l'extension (géographique et thématique) des domaines d'investigation, le renforcement de la coordination entre différents acteurs nationaux, la consolidation de la coopération internationale, le développement d'une politique nationale cohérente concernant la gestion des données marines et l'amélioration des activités de valorisation.

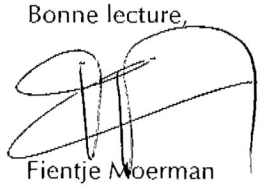
En outre, les experts insistent sur la nécessité d'établir un réseau virtuel national en matière de recherche marine qui devrait permettre une synergie maximale entre les différents acteurs concernés par la recherche marine - en particulier celle de la Mer du Nord – et d'améliorer la visibilité internationale des efforts de recherche consentis par la Politique scientifique fédérale. Un tel édifice requerra une gestion appropriée notamment par le biais d'une cellule de coordination développant une approche pluridisciplinaire.

Au niveau fédéral, ainsi que le souligne le rapport, l'unité de gestion du modèle mathématique de la mer du Nord (UGMM) constituera un élément essentiel du réseau proposé, vu la diversité des tâches gérées par cette unité. L'UGMM, créée en 1976, fait partie de l'Institut Royal des Sciences Naturelles de Belgique (IRScNB) qui relève de mes compétences via le Service public fédéral de programmation Politique scientifique. Sa présence au sein de l'IRScNB lui procure des atouts complémentaires tels que l'expertise scientifique en matière de biodiversité et de patrimoine dont les collections et les activités muséologiques, qui lui permettront de jouer un rôle important dans ce réseau virtuel et de consolider ses actions actuelles.

L'édification d'un tel réseau qui rassemble tous les acteurs de notre pays concernés par la recherche marine est un défi stratégique et organisationnel. J'entamerai donc le dialogue en vue d'élaborer un plan de travail réaliste.

En conclusion, ce rapport est une source d'informations et de débats pour l'ensemble des acteurs concernés par la recherche marine de notre pays et il offre ainsi une opportunité unique de mieux construire les initiatives futures.

Bonne lecture,



Fientje Moerman
Ministre de la Politique scientifique

INTRODUCTORY NOTE

This is a crucial moment for Belgian marine research. For over 30 years the Federal Government has been funding research on the North Sea: should it continue to do so and in what form? The present evaluation addresses these fundamental questions.

Reflection on governing oceans and coast

"The success of ocean and coastal management depends largely on three basic elements, namely information, knowledge, and a structure for decision-making. Information provides a description of the developing situation at a time and scale appropriate to the process or event taking place. Knowledge encompasses a sufficient understanding of the processes and complex interactions to make the necessary decisions and to give strategic directions to government. The decision-making structure should conform to the scale of management being applied and the processes involved. It may be as small as a community addressing local conflicts of marine activities or involve national legislation, regional agreements, or global conventions."

Source: OCEANS 2020: Science, Trends, and the Challenge of Sustainability (ed. Field, Hempel and Summerhayes, under the sponsorship of IOC, SCOR and SCOPE, 2002).

The panel wishes to thank the staff at the Belgian Science Policy and the consultants Gerard den Ouden and Dominique Vinck for their assistance in collecting and producing all relevant information. Project leaders and members of the Programme Steering Committee are thanked for the valuable information they provided in the interviews, in particular for the openness of their views.

Brussels, March 2003

CONTENTS

ANNEXES

EXECUTIVE SUMMARY

Belgium is a maritime state with territorial waters that cover a strategic and heavily utilised part of the North Sea and has a highly developed and vulnerable coastal margin. Marine research is thus essential to provide the necessary science base for sound policy decisions by Government in fulfilment of national and international obligations. To this end the Belgian Federal Government initiated the first of six marine research programmes in 1970 called *Project Sea*. The government is to be congratulated in its foresight in promoting catchment, estuary and offshore research in an integrated way using mathematical models. This approach was adopted subsequently by many countries. In order to reach decisions on the future direction and support for Belgian research and marine infrastructure, BELSPO commissioned a panel of four foreign experts in late 2001 to evaluate past research and propose a perspective for the future. The findings and recommendations of this review are set out in this report. The panel, supported by a team of two consultants, based its work on project reports, interviews with scientists and policy makers and various documentation made available by BELSPO.

The basic findings of the review and in particular the concept of a 'Virtual Network' were presented by the panel to the Belgian marine science community at the BELSPO symposium 'Sustainable Management of the North Sea: presentation of research results' in January 2002.

Institutional Context, Structure and Dynamics of the Programmes

The report first outlines the national and international dimensions of North Sea research with identification of responsibilities at National, Regional and Community level and obligations to international agreements. An overview is provided of the main research players: universities, federal and regional public institutes, and key supporting infrastructures. Two institutes are highlighted, the federal Management Unit of the North Sea Mathematical Models (MUMM) and the Flanders Marine Institute (VLIZ). The MUMM as a department of the Royal Belgian Institute of Natural Sciences is unique in Belgium and possibly in the world as a blend of a scientific bureau advising federal authorities on Belgian marine policy, representing the government in European and other international conventions and fora, a developer and manager of operational models, an operator of major infrastructural support (research vessel *Belgica* and monitoring aircraft), a national oceanographic data centre and finally a research institute. Flanders recently established VLIZ to co-ordinate Flemish contributions to marine research and policy, to manage the RV *Zeeleeuw* and to host an ocean data centre.

The 6 phases of North Sea research supported by the Federal Government since 1970 are outlined in Section 3 (p. 30). Over such a long period it was inevitable that the level and form of government support to marine research should fluctuate in response to changing patterns of national and international priorities. *Project Sea* emphasised interdisciplinarity and networking with a focus on modelling. In institutional terms, its most important result was the creation of MUMM in 1976. In infrastructural terms, another spin-off, on a longer term, was the construction of RV *Belgica.* Government support for research declined substantially in the next two phases of the *Concerted Research Actions* leading to a loss of interdisciplinarity, isolation of teams and a brain drain of researchers to other countries. The *Impulse Programme Marine Sciences* reversed the trend, introducing a centrally defined research concept, and a further substantial increase in funding occurred with the adoption of SPSD-I, as a response to the Rio Conference of 1992. In the on-going phase of SPSD-II, North Sea research is

embedded within a general strand on Global Change, Ecosystems and Biodiversity, and the focus is on integration of natural and socio-economic science.

In Section 6 an analysis of 'programme dynamics' is presented including budgets per phase and per year and participation of research institutes and affiliation of research teams per phase. Despite the promotion of networking in *SPSD* researchers do not interact sufficiently and are not given enough opportunities to do so in the form of BELSPO-sponsored meetings. The performance of BELSPO in programme management is on the whole adequate, although less so with regard to the dissemination of results. The level of scientific and political interactions between BELSPO and other players on the Belgian scene (the Royal Academy and various government bodies) is far from optimal. This deficiency, among other negative consequences, hampers the development of a long-term vision for Belgian marine science. Such a plan is needed to help institutions develop research strategies and stabilise staff.

Project Analysis and Data Management

The review panel evaluated 72 projects. The subjects covered were: ecotoxicology, ecosystem dynamics, eutrophication, hydrodynamics, marine geochemistry, marine geophysics, sedimentology, structural and functional biology and socio-economics. One page reports on each of the projects are attached as Annex 5. The general standard of the project reports was high in *Project Sea*, declined in the *CRAs* and improved again in *SPSD* although format, size and quality varied widely.

As a whole the project reports reflect work of a high scientific quality, although there is considerable variability between phases and research groups. Much of the research is solid, but not innovative especially after *Project Sea* and until *SPSD*. In many cases the projects have provided important Belgian input into priority research and policy issues at European, North Sea Ministerial, OSPAR and international levels. Some of the projects have had a considerable international impact and in a few cases set the scene for similar work in other North Sea states. Unfortunately, the impact of the considerable research effort summarised in the project reports has been lower than it should have been as the publication output in international peer-reviewed journals from many of the projects was, with a number of notable exceptions, low. Nevertheless, a few groups have publication records in international journals that are equal to the highest scientific productivity at an international level.

Storage of research data in a computerised database is an essential requirement of modern research and as a source of information needed to construct and validate models. There are clear problems with data management in Belgium with a duplication of National Oceanographic Data Centres (NODC) affiliated to UNESCO's Intergovernmental Oceanographic Commission (IOC). The IDOD database system developed at MUMM with *SPSD* funding only became operationally on-line in November 2002. The data managers have had difficulty obtaining data from SPSD projects and the system does not contain data from other Belgian research or from earlier BELSPO programmes. There is some duplication with the NODC system operated by VLIZ and there are opportunities for collaboration, standardisation and possible merger of the two NODCs.

Future Prospects

Since the launch of *Project Sea* in 1970, Belgium has made a significant political, financial and moral investment in marine science, by means of research programmes and support for infrastructure. While this effort has understandably been focused primarily on the North Sea, it has extended beyond in response to political commitments and opportunities for

international co-operation. Compelling reasons for keeping marine research alive in the country include: a) Belgium's international commitments on the North Sea, one of the most heavily used and exploited seas in the world; b) The need to continue to gather necessary data to monitor coastal and offshore waters; c) Prospects for partnerships offered by the EU Framework Programmes with its concept of a European Research Area (ERA).

A substantial part of the Belgian effort must remain national. It should be extended to encompass the catchment areas of major rivers that flow through the country and bring pollutants into the sea. Catchment research is in fact required in order to meet the provisions of the EU Water Framework Directive of 2000. In order to address modern challenges of operational forecasting (patterns of sea currents, wave climate, contamination levels, coastline evolution...), a long-term commitment from policy makers, covering in the order of 10 years, is a necessity.

The panel has formulated a number of recommendations for the preparation and management of a future research programme. The subdivision into strategic and targeted actions used in *SPSD* can in essence be retained. A greater participation of the scientific community than is the case at present, is needed in the formulation of future research programmes through use of interactive workshops. Proposals from scientists would be formulated within the general framework first advertised by BELSPO. A 'road-map' (or 'sea chart') is needed to provide a long-term overview of funding opportunities and milestones. Mechanisms for international co-operation in projects and use of shared research infrastructures should be investigated.

Due to the complexity of North Sea and catchment processes, and the multiplicity of actors involved on the scientific scene, it seems advisable to establish a Scientific Advisory Council at programme level. Measures also need to be put in place to improve the functioning of Programme Steering Committees.

Not to be forgotten is the 'Human Dimension'. Belgian scientists do not communicate well enough: improvements could be achieved through use of informal workshops and the creation of a Belgian Marine Society on the model of similar Societies in other European countries. Public awareness, dissemination and exploitation of research results are other issues that deserve careful scrutiny because ultimately the health of seas, and of the North Sea in particular, should be of concern to every Belgian citizen. Finally, special attention should be focused on the problems of young researchers: how to facilitate short-term mobility across national borders to improve their training, how to help them integrate into the Belgian scientific community on completion of their education and training.

Proposed Virtual Network

Almost all countries in NW Europe have national oceanographic institutes, situated on the coast, that are recognised internationally as a window for their marine science. A centre of excellence of this type does not exist in Belgium. If established, it could provide the essential connecting agent and element of continuity that appears to be missing at present. Acting as a hub for linkages with universities and other institutes from all over the country, it could have an educational role, be attractive for SMEs in technology and act as a field study centre for university courses.

The concept proposed is that of a ‘Virtual Network’ with links throughout Belgium and supported by a central core unit acting as a Belgian Oceanographic Institute (BOI), to be established either in Ostend or possibly bilocated in Ostend and Brussels. The Virtual

Network would comprise the following partners: Universities, Federal and Regional Research Institutes, Federal and Regional Research Vessels, Small and Medium-Sized Enterprises (SMEs), Museums, Aquaria, the Navy, and Federal and Regional administrations. As an integral part of the Virtual Network the core unit or BOI would be a co-ordinating centre and provide a range of facilities for Belgian marine science and education. A key aspect is that the BOI should provide a facility for use by University Departments and other research institutes. It is suggested that the BOI should be made up of the following 7 parts: a National Centre for the co-ordination of marine monitoring, a national Field Studies Centre for Marine Science, Accommodation for visiting students and scientists, a National Marine Library, a Visitor Centre, associated small museum and lecture theatre, a National Oceanographic Data Centre and Laboratories.

The BOI would not undertake research on its own initiative so that it would not be perceived as being in competition with the other partners in the Virtual Network. Starting from a small co-ordinating office, the 'Institute' could be developed over a number of years by progressive transfer of appropriate existing units, a number of which already exist in Ostend. Existing Flemish Institutes in Ostend would need to re-examine and adapt their priorities and aims to the benefit of Flemish and Belgian marine science in general. There might be considerable practical and financial advantages if some of the units in the BOI were formed by the merger of parts of existing Belgian, Flemish and French-speaking organisations such as the MUMM and VLIZ datacentres.

It is proposed that an institution/secretariat should be established with an equivalent role to VLIZ in co-ordinating, promoting and acting as a public face for the science of French-speaking researchers. Linked to the BOI this would provide a powerful and visible sign of the contribution of the French-speaking Community to Belgian Environmental Science.

Through the co-ordination role of the BOI, improved linkages between different university units are likely to develop. The BOI is intended to provide universities with joint and shared national facilities. Universities are most likely to benefit from the creation of the Field Studies Centre and the associated lecture theatre and laboratories.

Because of the existing political structure in Belgium we recognise that there are a number of problems that would need to be surmounted to establish a BOI on the Belgian coast. However, the Panel is of the view, based on historical precedents and Belgium's role in North Sea science, that such a permanent BOI is long overdue. An ideal location is available in Ostend in the vicinity of the old fish market; a prime development location that is not likely to remain available for long. The nearby location of existing federal and Flemish marine institutes and the proposed development of a small French-speaking sister 'institute' to VLIZ would give Belgium a marine science complex appropriate to its maritime traditions and interests. This site could certainly prove attractive to other national or even international organisations. An alternative option could be to bilocate the BOI in Ostend and Brussels, taking advantage of existing facilities of RBINS and MUMM. A Virtual Network could act as a window for Belgian Marine science and a catalyst for research and technological development in the 21st century.

This evaluation has produced a balanced pattern of strengths and weaknesses. They are summarised in section 7 under the headings: Science policy, Visibility of Belgian North Sea research, Scientific quality and applicability of results, Communication of project output,

Creating the conditions for partnerships at federal/regional and international levels, Spin-off in research infrastructure, National collaboration, Project output and international impact.

A final section of the report lists the main recommendations of the panel.

1 INTRODUCTION: SETTING THE SCENE

The purpose of this introductory chapter is to set the scene for the evaluation of the research actions that were carried out by Belgian researchers within the framework of the Belgian North Sea Programmes 1970-2002. The case and institutional context for North Sea research will be outlined as well as the need for the current evaluation and how it was organised.

1.1 The case for North Sea research

The North Sea is situated on the continental shelf of Northwest Europe and is open to the Atlantic Ocean in the north, to the English Channel in the south, and to the Baltic Sea in the east (Figure 1.1). The climate is dominated by westerly winds from the North Atlantic with a variety of other wind directions and speeds, a high rate of cloudiness, and a relatively high precipitation compared with other marine areas. Surrounded by densely populated and highly industrialised countries the catchment area of the North Sea extends well into central Europe. It is an area of great economic importance and as a consequence is heavily impacted by human activities. Two of the world's largest ports are located on the North Sea coast, one being in Belgium (Antwerp). Some coastal regions and especially industrialised estuaries have concentrations of contaminants that are above background levels for the North Atlantic, in particular the Scheldt estuary. Agriculture and other industries are the source of inputs of various nutrients and hazardous substances transported by the major rivers. Contaminants are also sourced from dredged material and atmospheric inputs. Nutrient levels are high, especially in the southern coastal part of the North Sea. Specific data on the North Sea and its basin are presented in Box 1.1.

The Belgian coastline is only 66 km long, but quite representative of conditions along the southern and eastern coast of the North Sea between Calais and the German Bight. The land is low (flat coastal plains) and often lined with sand dunes, the sea is shallow but subject to important tides, and the coastal margin[1] is impacted by conflicting uses from industry, agriculture, fisheries, traffic, extraction of sand and gravel, energy production, accompanying activities such as pipeline laying, dumping of dredged material, waste disposal, conservation and, of course, recreation. In coastal waters, high concentrations of energy, sediments and nutrients stimulate both biological productivity and a wide diversity of habitats and species. The reproduction and nursery grounds of most fish and shellfish species of economic value are in the coastal margin and a significant proportion of the catch of these species comes from this area, which accounts for almost half of the jobs in the fisheries sector. A substantial part of the coastal plain of Belgium was beneath the sea within the last 1,000 years and is potentially vulnerable to a rise in sea level. Flooding is thus a threat in areas of reclaimed coastal land.

The quality of North Sea coastal waters is a major cause for concern. Oil slicks and algal blooms are current illustrations of the fact that coastal communities frequently suffer the consequences of events or developments occurring inland or offshore and therefore beyond their control. Everywhere in the world, human settlement of coastal margins/zones and utilisation of their natural resources since early times has created unique forms of rural and urban landscapes, reflecting cultures centred on trade and largely oriented towards the

[1] Since LOICZ (*Land Ocean Interactions in the Coastal Zone*) defines the coastal zone as the area between 200 m above and 200 m below sea level (http://www.nioz.nl.loicz), this would include more than half of the territory of Belgium and most of the North Sea. In order to avoid confusions, we shall refer hereafter to the coastal margin which comprises the coastline and the near-shore area.

outside. In most parts of Europe, unfortunately, urbanisation, agricultural and industrial developments have considerably reduced the biological diversity and cultural distinctness of the landscapes.

These known problems are likely to be compounded in the future as a result of observed trends in environmental and socio-economic conditions. Recent research shows that climate change could involve a rise in sea level of several millimetres per year, equivalent to up to 1 metre in the next hundred years and an increase in the frequency and intensity of coastal storms. The combined effects of these two phenomena will have serious repercussions, such as major floods. At the same time, the expected growth, in tourism in particular, will increase human pressure on natural, rural and urban coastal environments.

Given the present-day emphasis on the notion of sustainability, it is essential to balance human activities with efforts to preserve the natural functioning of the North Sea ecosystem into the future. Main threats include:

- disruption of the structure and functioning of the natural ecosystem by overfishing;
- effects of climate change on North Sea ecosystems and processes;
- pollution of air, water, biota and sediments by inputs from land, dumping of dredged materials and shipping;
- eutrophication and algal blooms, as a consequence of various inputs from land;
- disruption of habitats by shipping, dredging, leisure, fishing and military operations.

In order to carry out their national and international duties in the North Sea (see Section 1.2), public authorities need an adequate science base. This notion is now well understood. And yet, despite a research effort that has been going on for decades in many countries, large areas of uncertainty still exist to this day on basic processes of ecosystem functioning, on ecosystem responses to anthropogenic pressure, on socio-economic impacts of ecosystem change and human activities. Key areas of uncertainty include: possible impacts of climate variability, reliable information on sources and inputs of nutrients and hazardous substances, interrelationships between nutrient sources and eutrophication, effects of hazardous substances on organisms, multi-species interactions between fish stocks and harmonisation of approaches to monitoring (Quality Status Report 2000 Region II Greater North Sea [2]). Such uncertainties preclude any reliable effort at forecasting trends. The successive North Sea research programmes of the Belgian government have clearly recognised this challenge.

1.2 Institutional context of North Sea research

1.2.1 Belgium

Between 1970 and 1993, Belgium underwent a series of institutional reforms which transformed the country into a federal state divided into three regions (Flemish, Brussels Capital and Walloon regions) and three linguistic communities (Flemish, French and German-speaking Communities). Decision-making powers in Belgium are no longer exclusively in the hands of the Federal State, but have been progressively transferred to the Regions and Communities, each of them exercising their public competences independently in different fields. Scientific research policy is one of the fields that, since 1980, is implemented by all

[2] The QSR 2000 was made by OSPAR (see Section 1.2.2): it gives an assessment of the environmental quality of the North-East Atlantic to which the Greater North Sea belongs.

Figure 1.1 Map of the North Sea basin
(Source: ODIN Norway)

Box 1.1 North Sea facts

North Sea basin:

North Sea bordering countries	Belgium, Denmark, France, Germany, Netherlands, Norway, Sweden, UK
Other countries of the North Sea basin	Czech Republic, Luxemburg, Slovakia, Switzerland
Population	184,000,000
Drainage area	850,000 km²
Main rivers in the catchment area	Elbe, Humber, Meuse, Rhine, Scheldt, Seine, Thames, Weser
Annual river water input	325 km³ directly and 470 km³ via the Baltic Sea
Average annual flow of sea water from the North	41,000 km^3
Average annual flow of sea water from the South	3,150 km^3
Average annual precipitation	425 mm

Economic data:

Annual fish catch (1995)	2,900,000 tonnes
Annual shellfish catch (1995)	250,000 tonnes
Average annual maritime traffic	500,000 vessels
Average annual number of navigation accidents	150
Number of oil and gas platforms (1996-1998)	475
Length of pipelines	10,000 km
Annual gas production (1996-1998)	167,700,000,000 m^3
Annual petroleum production (1996-1998)	285,300,000 tonnes
Annual extracted sand and gravel (1996)	40,000,000 m^3
Annual discharge of dredged matter (1996)	90,000,000 tonnes

Physical data:

Length north-south	960 km
Width east-west	580 km
Surface area	750,000 km²
Volume	94,000 km³
Average depth	95 m
Maximum depth	700 m (Norway)
Length of the Belgian coast	66 km
Surface area of Belgian continental shelf	3,600 km²
Depth of Belgian waters	20-30 m
Average temperature in winter	6°C
Average temperature in summer	17°C
Salinity	34 to 35 ppm
Annual flow of matter in suspension	50 to 65,000,000 million tonnes
Tide difference	0 to 8 m

Sources: MUMM; OSPAR Quality Status Report 2000

these three political levels. The Federal Government undertakes research on matters that fall within its area of general competence, including research that contributes towards international and supranational commitments, and funds research programmes requiring execution at national or international level. Science-related matters are handled by the following federal departments:

- The Belgian Science Policy (BELSPO, under the authority of the Minister for Economy, Energy, Foreign Trade and Science Policy): involvement in co-ordination and programming at federal level, preparation and execution of various research activities that belong to the federal competence or to the Communities/Regions (the latter via co-operation agreements).
- The Ministry of Foreign Affairs, the Ministry of National Defence, the Ministry of Social Affairs, Public Health and Environment, and other offices of the Ministry for Economy, Energy, Foreign Trade and Science Policy

The Communities have competence for research related to education and culture. The Regions have competence for research related to the economy, energy policy (excluding nuclear), public works, the environment, transport, and others.

In Flanders, the Community and Region are merged into the Ministry of the Flemish Community that structurally funds scientific research and researchers at universities and higher education colleges, and makes policy on science and technology innovation. The Science and Innovation Administration (AWI) deals with e.g. policy-making, co-ordination, national and international agreements. Similarly, these tasks are performed in the French Community via the Directorate General for non-obligatory Education and Scientific Research (DGENORS) under the Minister for Higher Education, and in the Walloon Region via the Directorate for Technologies, Research and Energy (DGTRE) under the Minister for Economy, Small and Medium-Sized Enterprises, Research and New Technologies.

Other Ministers of the Federal Government, Flemish Government, French Community and Walloon Region undertake their own sector-specific science policy actions and may also fund studies. The Brussels-Capital Region, via the Research and Innovation Office (SRI-DOI) stimulates participation in international programmes on scientific and technical research. The German Community makes science policy through the Minister for Education and Training, Culture and Tourism.

A significant proportion of the Belgian North Sea research effort was and still is focused on the understanding of natural and anthropogenic impacts on the environment. In matters of environmental protection, the Federal Government has competence for pollution at sea and marine nature conservation. Other marine subjects are dealt with through co-operation agreements between the Federal State and the Flemish Region.

Responsibility for a co-ordinated planning and implementation of a national policy on the North Sea and preparing Belgium's view at international meetings, particularly with regard to OSPAR and the Ministerial North Sea Conferences (see Section 1.2.2), is shared by the Federal and the three Regional Governments, by means of a Steering Committee for the North Sea and Oceans (SCNSO) that belongs to the Coordination Commission for International Environmental Policy (CCIEP) which was established in 1995.

The federal authorities' competences and rights extend to the low water line and are related to specific zones of the North Sea: territorial sea, continental shelf, Exclusive Economic Zone

(EEZ) or fishery zone. Belgium established its EEZ by the 'Act concerning the Exclusive Economic Zone of Belgium in the North Sea' of 22 April 1999. It also adopted the Act on protection of the marine environment and ocean space under Belgian jurisdiction dated 20 January 1999.

In matters of sustainable development policy, which is clearly presented in the BELSPO's programme 'Scientific Support Plan for a Policy on Sustainable Development' (SPSD, see Section 3), the federal authorities are advised by the Belgian Federal Council for Sustainable Development (FCSD)

Apart from the regular North Sea programmes, the BELSPO has other means to support scientific research on the North Sea and surrounding areas, e.g. with its programmes 'STEREO' where one of the objectives is to study coastal regions and 'Global Change and Sustainable Development'. At regional level, North Sea research is also funded by agencies such as the National Scientific Research Fund in the French-speaking Community (FNRS), the Fund for Scientific Research (FWO) and the Institute for the Promotion of Innovation through Science and Technology (IWT) in Flanders. In addition, universities also use their own means to carry out marine research.

1.2.2 International dimension

A series of international structures (organisations, conventions, co-operations, forums) have been established over time to discuss and manage issues of common interest which arise from the transnational character of marine waters. In this section of the report, we review the bodies and conventions that impact directly on the North Sea.

NORTH ATLANTIC :

ICES

Founded at the turn of the 20th century, the International Council for the Exploration of the Sea (ICES) has since then played a major role in co-ordinating scientific assessments on the health of the North Sea and North Atlantic, particularly with regard to the level of fish stocks, and in promoting research on these issues. These activities include adjacent seas such as the Baltic Sea and North Sea. ICES acts as a meeting point for a community of more than 1,600 marine scientists. The Council was formed by 8 European countries (Denmark, Finland, Germany, the Netherlands, Norway, Sweden, Russia, and the United Kingdom) and now has a membership of 19 countries (Belgium joined in 1903). As well as filling gaps in existing knowledge, the scientific information is also developed into unbiased, non-political advice. ICES has a Memorandum of Understanding with the European Commission to provide statistics on fish stocks that serve the definition of the European policy on fisheries.

OSPAR

Until 1998, the Oslo Convention (Convention for the Prevention of Marine Pollution by Dumping from Ships and Aircraft, 1972) and the Paris Convention (Convention for the Prevention of Marine Pollution from Land-Based Sources, 1974) provided the regulatory framework for the protection from pollution in the maritime area of the North-East Atlantic, including the North Sea. The Convention for the Protection of the Marine Environment of the North-East Atlantic ('OSPAR Convention') replaced the earlier Conventions in 1998. Its members are: Belgium, Denmark, the Commission of the European Communities, Finland, France, Germany, Iceland, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

OSPAR has responsibility for conducting scientific research, co-ordinating data, and advising governments on the appropriate regulation of wastes entering the air and from the land. It helps to set procedures for state-driven regulation, provides a forum for specialist intergovernmental task forces, and serves as a focal point for monitoring subsequent actions. Areas of interest are the following: protection and conservation of ecosystems and biological diversity; hazardous substances; radioactive substances; eutrophication; environmental goals and management mechanisms for offshore activities. The members are required to undertake and publish at regular intervals joint assessments of the quality status of the marine environment and of its development. These assessments should also evaluate the effectiveness of measures taken or planned for the protection of the marine environment, and identify priorities for action. In 1993, an assessment of the environmental quality of the North Sea was produced as a Quality Status Report (QSR). The QSR 2000 covers the whole of the North east Atlantic and is based on five regional reports (Arctic Waters, Greater North Sea, Celtic Seas, Bay of Biscay and Iberian Coast, Wider Atlantic). Belgium co-ordinated the chapter on Chemistry in this latest report.

Ministerial North Sea Conferences

In the early 1980s, the perceived slow progress in reducing pollution of the North Sea resulted in a series of ministerial conferences attended by the environment ministers of nine states within the North Sea catchment (Belgium, Denmark, France, Germany, Netherlands, Norway, Sweden, Switzerland, United Kingdom), as well as other interested parties (e.g. the European Communities and non-governmental organisations). Initiated in Bremen in 1984, these Ministerial Conferences have subsequently convened at three-year intervals. It was thought that a political declaration from a North Sea perspective would stimulate and promote ongoing work within the existing international conventions (e.g. Oslo and Paris Conventions and International Maritime Organization's (IMO) Convention on shipping issues).

ICES and the Oslo and Paris Commissions were requested to establish a **North Sea Task Force (NSTF)** aimed at setting up an extensive monitoring master plan which would provide the various North Sea bordering countries with a responsibility for a specific area. The NSTF was also tasked with producing a major state-of-the-art review of the North Sea published in the form of a Quality Status Report in 1993 (see above). The work of this group was subsequently subsumed into OSPAR.

The focus of the Ministerial Conferences is to develop measures to protect and enhance the environment of the North Sea. The Ministers have promoted an integration of fisheries management and environmental protection and conservation measures based on an ecosystem approach. The North Sea states have achieved good results in their joint efforts to reduce pollution and to protect North Sea ecosystems. Some examples of partly or fully implemented commitments are: a ban on the dumping and incineration of waste at sea; reduction of inputs of phosphate by 50 %; cessation of all inputs of hazardous substances within one generation (by the year 2020); a ban on the dumping of offshore installations; a ban on the application of Tributyltin (TBT).

EUROPE :

European Union (EU)

In the early years of European-led research (1970's), marine topics were addressed in the **Environment Research Programmes**. With the advent of the **Marine Science and Technology Programme (MAST)** in 1989, marine research gained in importance and visibility. It remained significant under the 5th Framework Programme (FP5) despite the

disappearance of thematic programmes (MAST, Environment) in the concept of 'key actions', such as 'Sustainable marine ecosystems' and 'Global change, climate and biodiversity'. Belgium has taken and is still taking an active part in these European initiatives. Belgian teams have thus entered a number of valuable partnerships with European groups, especially but not exclusively from other North Sea countries. The topics covered with Belgian participation included process studies and modelling; biogeochemical cycles, eutrophication and algal blooms; geology and ecosystems of the North-East Atlantic margin; deep sea benthos, biodiversity; coastal zone sedimentology and coastal engineering; data management. In FP3-5, about 15 projects were co-ordinated by a Belgian research institute.

Local and regional Belgian authorities have also participated in the European Community (EC) Demonstration Programme on **Integrated Coastal Zone Management (ICZM)** which ran between 1996 and 1999 with the support of the EC TERRA and LIFE funding instruments of the European Regional Development Fund (ERDF). The North Sea area is also covered by the EC Interreg (Interregional Cooperation) Programme which, financed under ERDF, aims to stimulate interregional co-operation in the EU between 2000-2006. One of its objectives is to help Member States and their regions co-operate on a pro-active approach to common problems, including those linked to water resource management caused by floods / drought.

Other co-operation schemes in Europe

The **Conference of Peripheral Maritime Regions (CPMR)** brings together 146 Regions from 26 European countries. It promotes a balanced development of the EU with a view to strengthening its economic, social and territorial cohesion, by:

- studying together with EU, national and regional institutions how to implement a Europe-wide polycentric development model;
- ensuring that EC policies with a high territorial impact include this dimension in the best possible way. They are thus led to focus their activities on issues such as regional policy, research and innovation, enterprise, transport and maritime development, the environment, coastal zone management, fisheries, rural development and agriculture, etc.;
- developing interregional co-operation within 7 large European geographical entities (Baltic, North Sea, Atlantic, Mediterranean, Black Sea, Balkans, Islands) and also outside Europe. The Province of West-Flanders is represented in the North Sea Commission.

Bilateral co-operation in research between Flanders and the Netherlands

The Scheldt estuary is situated both in Belgium and in the Netherlands. The tidal freshwater area and the low-salinity brackish area are on Belgian territory, the high-salinity brackish area and the marine part of the estuary are Dutch territory. The estuary opens into the North Sea in the border region of the two countries.

Both Belgium and the Netherlands independently started research projects in this estuary. Collaboration began to grow from about the end of the 1960s when ecologists from Ghent University joined cruises organised by the institute at Yerseke that is now called the Centre for Estuarine and Marine Research of the Netherlands Institute of Ecology. This collaboration gradually expanded and has become more extensive. Belgian groups from mainly UGent, IN and Antwerp University have worked in the Dutch estuaries, partly on contract to the Dutch National Institute for Coastal and Marine Research (RIKZ). Thus close contacts were established with the RIKZ at Middelburg, the Centre for Estuarine and Marine Research (CEMO) at Yerseke, and the Centre for Shellfish Culture of the Netherlands Institute for Fisheries Research (RIVO) at Yerseke, which had their own research projects in the Scheldt estuary. This collaboration was reinforced by a number of joint research grants obtained from

the EC. Also the appointment of Belgian scientists at these Dutch institutes and Dutch researchers in Belgium strengthened the contacts.

This bottom-up co-operation finally resulted in a top-down approval in 1996 when the Dutch Minister of Science proposed to his Flemish colleague to set up a formal collaboration between CEMO and a number of Belgian institutes. 1.8 million Euro was made available for this co-operation. Plans were developed to build a 'Flemish' wing at the Yerseke institute; at a late stage however, these plans were cancelled for Flemish internal political reasons.

A later initiative was a joint programme by the Flemish 'Fonds for Wetenschappelijk Onderzoek' (Fund for Scientific Research) and the Netherlands Organisation for Scientific Research (NWO), the funding organisation for fundamental scientific research in the Netherlands. The programme aims at sustained collaboration in (ecological) scientific research in the Scheldt estuary and the adjoining coastal zone. The budget amounts to 1.8 million Euro (Netherlands) plus 2.2 million Euro (Flanders). The programme runs from 2001 to 2005; the first call for proposals occurred in 2001

UNITED NATIONS (UN) :
The **Intergovernmental Oceanographic Commission (IOC) of UNESCO** was founded in 1960. Belgium was a member at the start. At present, the IOC focuses on four major themes:

- to develop, promote and facilitate international oceanographic research programmes to improve our understanding of critical global and regional ocean processes and their relationship to the sustainable development and stewardship of ocean resources;
- to ensure effective planning, establishment and co-ordination of an operational global ocean observing system to provide the information needed for oceanic and atmospheric forecasting, for oceans and coastal zone management by coastal nations, and for global environmental change research;
- to provide international leadership for education and training programmes and technical assistance essential for systematic observations of the global ocean and its coastal zone and related research; and
- to ensure that ocean data and information obtained through research, observation and monitoring are efficiently handled and made widely available.

The International Oceanographic Data and Information Exchange (IODE) of IOC was established in 1961 to enhance marine research, exploitation and development by facilitating the exchange of oceanographic data and information between participating Member States and by meeting the needs of users for data and information products. The IODE system forms a worldwide service oriented network consisting of DNAs (Designated National Agencies), NODCs (National Oceanographic Data Centres), RNODCs (Responsible National Oceanographic Data Centres) and WDCs (World Data Centres – Oceanography). In Belgium, MUMM (Management Unit of the North Sea Mathematical Models) hosts the NODC and VLIZ (Flanders Marine Institute) the NODC for Flanders. During the past 40 years, IOC Member States have established over 60 oceanographic data centres in as many countries. This network has been able to collect, control the quality of, and archive millions of ocean observations, and makes these available to Member States.

The United Nations Agencies IOC, WMO (World Meteorological Organisation), UNEP (United Nations Environment Programme) together with the International Council of Scientific Unions (ICSU) established the **Global Ocean Observing System (GOOS)** in 1991. GOOS is a permanent global system for observations, modelling and analysis of marine and

ocean variables to support operational ocean services worldwide. It aims to provide accurate descriptions of the present state of the oceans, including living resources; continuous forecasts of the future conditions of the sea for as far ahead as possible; and the basis for forecasts of climate change. Established in 1994, **EuroGOOS** is an Association of European agencies and institutions active in the above fields that currently has 30 members in 16 countries (MUMM is the Belgian member). Its two main objectives are:

- to foster the collaborative development of local operational systems designed to provide end-users in the public and private sectors with environmental information they need about the seas around Europe and in more distant regions where there are special European interests;
- to provide a concerted European input to the global monitoring and analysis system which will give information about the changing state of the open ocean needed by local operational systems wherever they exist.

The **International Maritime Organization (IMO)** is the specialized agency of the United Nations responsible for improving maritime safety and preventing pollution from ships. It was established in 1948 at the same time as the UN was formed and entered into force in 1956. **Belgium** joined as a member in 1951. With its 169 member states, IMO has established a series of conventions of which the following deal with the marine environment:

- The most important convention regulating and preventing marine pollution by ships is the IMO International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). It covers accidental and operational oil pollution as well as pollution by chemicals, goods in packaged form, sewage, garbage and air pollution.
- IMO's Intervention Convention affirms the right of a coastal State to take measures on the high seas to prevent, mitigate or eliminate danger to its coastline from a maritime casualty. The International Convention on Oil Pollution Preparedness, Response and Co-operation (OPRC), 1990 provides a global framework for international co-operation in combating major incidents or threats of marine pollution. A protocol to this convention covers marine pollution by hazardous and noxious substances.
- IMO also has Secretariat responsibilities for the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972 ('London Convention').

The commitments of Belgium in the North Sea are in effect related to policies defined at UN level. With its action plans, **United Nations Environment Programme (UNEP)** has stimulated regional co-operation around the management of a number of Regional Seas. While the North Sea is not included in the UNEP package of action plans, it does share with other regional seas the problems resulting from anthropogenic pressure, and is brought under OSPAR which interfaces with UNEP in the NE Atlantic-North Sea area.

Attempts have been made through the years to regulate the use of the oceans in a single convention that is acceptable to all nations. This effort finally culminated with the adoption of the 1982 **United Nations Convention on the Law of the Sea (UNCLOS)**, which has gained nearly universal acceptance since its entry into force on 16 November 1994. Belgium ratified the Convention in 1998. The Convention provides, for the first time, a universal legal framework for the rational management of marine resources and their conservation for future generations. There are six main sources of ocean pollution addressed in the Convention: land-based and coastal activities; continental-shelf drilling; potential seabed mining; ocean dumping; vessel-source pollution; and pollution from or through the atmosphere.

United Nations involvement with the Law of the Sea has expanded over the years as awareness increases that not only ocean problems are interrelated but global problems as a whole. Already, the 1992 **United Nations Conference on Environment and Development (UNCED)** placed a great deal of emphasis on the protection and preservation of the environment of the oceans in harmony with the rational use and development of their living resources, thus establishing the concept of 'sustainable development' embodied in Agenda 21, the programme of action adopted at the Conference.

Two other conventions relevant for the North Sea should be mentioned as well. The oldest is the Convention on wetlands of international importance especially as waterfowl habitat, concluded at Ramsar (Iran) in 1971. Currently, 135 states have signed the **Ramsar Convention** [3], among which all North Sea states and the European Community. It aims at protection and wise use of wetlands, including marine areas less than 6 meters deep. Relevant wetlands in Belgium are found along the Scheldt estuary and also include some shallow offshore areas.

The **United Nations Convention on the Conservation of Migratory Species of wild animals (CMS)** was agreed at Bonn in 1979. It now counts 80 parties including all North Sea states and the European Community. It aims at international collaboration for the protection of species of wildlife crossing international borders during their lifecycle. This is achieved through Agreements, two of which are important for the Belgian North Sea. The Agreement on the Conservation of Small Cetaceans in the Baltic and North Seas (ASCOBANS) has been signed by all North Sea states (except Norway). It entered into force in 1994. The African – Eurasian Waterbird Agreement (AEWA) entered into force in 1999; it covers 117 countries. It has been signed by all North Sea countries and the European Community, although the Community, Belgium, and France still have to ratify. The aim is to improve the conservation status of bird species through joint research projects and measures with regard to hunting, fisheries, pollution, and habitat protection.

1.3 Evaluation of BELSPO-funded North Sea research 1970-2002

Belgian federal support for North Sea research was initiated in 1970. After more than 30 years of funding and periodic adaptations of programme contents and support mechanisms, it was realised that the time has come to evaluate past programmes. A debate is developing within the political and scientific circles of the country on the way in which future Government support should be implemented. In order to reach a decision, authorities need to be informed on the value of the research carried out to date. Accordingly, BELSPO commissioned a panel of four foreign experts to evaluate the scientific results and the management of Belgian North Sea research since 1970. Specific issues to be addressed were the appropriateness of the various Programme schemes carried out, their impact and the effectiveness of their implementation.

The evaluation of the North Sea Programmes consists of: (1) a general scientific assessment of the projects financed by the BELSPO, in order to verify the coherence with the objectives of the programme; (2) a general examination of programme management; (3) recommendations for implementation of future BELSPO programmes.

[3] Convention on Wetlands, signed in Ramsar, Iran, in 1971, is an intergovernmental treaty which provides the framework for national action and international co-operation for the conservation and wise use of wetlands and their resources (http://www.ramsar.org).

The evaluation of the individual **projects** had to address the following questions:

- What are the outcomes of the research activities in the short and medium term in the areas of decision-making and further fundamental research, and how are these disseminated and exploited?
- Are the research teams operating at a national or international level of scientific excellence and if so, can this be attributed to the programme support?
- In case of networks, are the research teams complementary and / or multidisciplinary?

The experts evaluated all the projects financed by BELSPO since 1970 on the basis of their final reports and took note of the research proposals of the most recent phase (SPSD-II). Key issues included: a) compliance with BELSPO objectives; b) pertinence of scientific questions; c) quality of science; d) output (publications and impact on the international community); e) international collaboration.

The evaluation of the **programmes** had to pay specific attention to:

- The relevance of each programme and its selection of projects within a national and international context.
- The impact in terms of support to the political decision-making process, and further fundamental research.
- The performance and management of the programmes.

The panel was supported by a team of two consultants, whose main tasks were: liaising with BELSPO; collecting relevant documentation (general and specific information, calls for proposals, project reports and publications); preparing reference documents, based on BELSPO internal documents and publications and on project contracts (programme history and dynamics, project data); carrying out and transcribing oral interviews of all project co-ordinators, members of the Programme Steering Committee, the Royal Belgian Academy of Sciences and BELSPO programme staff; helping the panel design the evaluation methodology and meeting miscellaneous requests.

The panel held three meetings at the BELSPO in Brussels between October 2001 and February 2003. Members communicated extensively by e-mail and telephone. Preliminary findings and recommendations were presented to authorities and to the Belgian scientific community on the occasion of the conference on Sustainable Management of the North Sea Brussels, 21-22 January 2002. A first draft of the report was issued on the BELSPO web site for comments in April 2004 and the panel would like to thank all those who took the trouble to respond. Based on comments received, the final version was submitted in May 2004.

2 EXISTING STRUCTURE OF BELGIAN MARINE SCIENCE

2.1 Overview of main research players

The main organisations that perform or logistically support BELSPO-funded marine research on the North Sea are scattered widely across the country (Table 2.1). A distinction is made into laboratories that are established as Federal, Flemish or Wallonian institutions. There is no Federal Oceanographic Institute sited at a coastal location. Numerically the majority of the organisations involved in research belong to university departments; among the remaining organisations, the majority are public research institutes, a few are private (Table 2.1).

Table 2.1 Overview of the main institutes active in BELSPO-funded North Sea research

Organisation type	Name	Community		Region		Federal
		Flemish-speaking	French-speaking	Flanders	Wallony	
Universities	KULeuven	●				
	UGent	●				
	UA	●				
	UCL		●			
	ULB		●			
	ULg		●			
	UMH		●			
	VUB	●				
Public research institutes	DVZ [1]	●				
	IN	●				
	RBINS					●
	MUMM [2]					●
Private research institutes	ECOLAS			●		
	MAGELAS			●		

[1] Regionalised since 2002
[2] Belonging to RBINS since 1997

Note: Abbreviations of institutes are given in Annex 1

Basic, but often incomplete, information on the location, staffing and research disciplines was compiled in 2002 by ECOLAS on commission from BELSPO in a report entitled 'Feasibility study concerning the Belgian participation in GOOS and in particular to its regional component EuroGOOS'. A complete overview of institutes active in marine research and services was given.

Institutes that have been or are active in the BELSPO North Sea programmes and their web sites can be found in Annex 1 of the present evaluation report. Many web sites are considerably out of date. In consequence of these deficiencies we strongly recommend that a national, web based, database of Belgian marine researchers and research units should be established and maintained by BELSPO on its own web site, although it is acknowledged that relevant information already exists at VLIZ through its Integrated Marine Information System (IMIS) database (see Annex 2). Such a system needs to be hierarchical so that the relationships between different units and researchers can be clearly seen.

2.2 Public research supporting institutes

In addition to the actors listed in Table 2.1, there are a number of other agencies active in supporting Belgian marine research.

2.2.1 Federal institutes

Management Unit of the North Sea Mathematical Models (MUMM)
At the end of *Project Sea* various modelling initiatives were incorporated into a 'Mathematical Model of the North Sea' and the Belgian government decided to establish and fund a unit to validate and further develop these models in operational mode. MUMM was established in 1976 and incorporated in 1997 by Royal decree into the Royal Belgian Institute for Natural Sciences (RBINS). From its establishment MUMM has played a key role in the development of Belgian marine science. MUMM is unique in Belgium, and possibly the world, as a mixture of a scientific bureau advising and representing the federal government on Belgian marine policy, a developer and manager of operational models, the operator of key national infrastructural support such as the *Belgica* and monitoring aircraft, the location of the National Marine Database and a research institute.

MUMM leads the Belgian delegation at various European and international fora, e.g. ICES, OSPAR, IOC-IODE, EuroGOOS, Ministerial North Sea Conferences, ICZM. At national level, MUMM chairs the Steering Group of the North Sea and Oceans (a subgroup of the Co-ordinating Committee for International Environment Policy) that brings together the competent federal departments and the Regions.

When MUMM was established, it employed 7 people: at present it employs ~50 of whom 15 are state employees and the remainder are on short-term contracts. In addition to the supervision of the operational logistics and cruise programme of the *Belgica*, and of offshore aircraft monitoring, the unit is divided into several areas of work: Marine environmental management; Monitoring of the marine environment; Hydrodynamic and ecological modelling; Database management; Research.

Marine environmental management
The MUMM acts as a national interface co-ordinating and advising on almost all matters to do with the marine environment, including pollution, marine emergencies such as ship strandings and conservation. On these marine environmental issues, the representational activities of the unit are as Belgian delegates to international conventions/agreements such as OSPAR, Bonn [4], London [5], MARPOL [6], ASCOBANS [7], to North Sea Ministerial Conferences, in discussions for the preparation and implementation of EU Directives such as

[4] The Bonn Agreement (1969) is an international agreement by North Sea coastal states, together with the EC to offer mutual assistance and co-operation (providing manpower, supplies, equipment and scientific advice at short notice) in combating marine pollution, and to execute surveillance as an aid to detecting and combating pollution and to prevent violations of anti-pollution regulations (http://www.bonnagreement.org).

[5] Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, held in London in 1972 (http://www.londonconvention.org/London_Convention.htm).

[6] The IMO International Convention for the Prevention of Pollution from Ships, held in 1973 and 1978.

[7] Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (http://www.ascobans.org).

the Water Framework Directive [8], to the Marine Environmental Protection Committee of IMO and at meetings organised by the United Nations. The unit also participates in the international data management scheme (International Ocean Data Exchange, IODE) of IOC and in the ICES Working Group on Marine Data Management (WGMDM). MUMM is involved in the formulation of national legislation to cover agreements made at international level. It is also the competent national body to authorise the use and spraying of dispersants and other chemicals to combat oil spills or other pollutants at sea. For the Ramsar Convention, MUMM supervises responsibilities for the offshore sandbanks that have been designated as a marine area of international importance for sea birds

A specific policy role with respect to marine management is outlined in the Royal Decree of establishment, giving MUMM "competence to define, negotiate, execute and evaluate Belgian marine environmental policy". This wide-ranging responsibility differs from procedures in most other countries where government ministries have this role.

Monitoring of the marine environment

The MUMM and in part the Sea Fisheries Department (DVZ) take samples and undertake analyses for suspended sediment, nutrients, chlorophyll and a wide suite of contaminants in air, water, sediment and biota on routine monitoring cruises of the *Belgica*. Similar measurements are taken at the freshwater/marine interface of Belgian rivers flowing into the North Sea. Much of this work is undertaken as part of the OSPAR Co-ordinated Environmental Monitoring Programme (CEMP) and as input to develop and validate MUMM models. The monitoring results are gathered at national level in the MUMM database and then passed at international level to the database of the International Council for the Exploration of the Sea (ICES). Quality control of all laboratory procedures is central to this work and MUMM is a participant in the EU initiative QUASIMEME [9].

Monitoring of the coastal waters of Belgium primarily for oil or pollution discharges from shipping is undertaken by MUMM using a chartered light aircraft. This surveillance of the North Sea is undertaken in the context of the Bonn Agreement. Each country organises its own surveillance programme in accordance with the guidelines laid down in this agreement and joint international exercises are carried out several times a year. MUMM has signed an agreement with the Light Aviation School of the Land Force based in Brasschaat (near Antwerp), which places an aircraft (Britten Norman Islander) at its disposal. In 2001 more than 250 hours flying were undertaken on standard survey tracks using a Side Looking Airborne Radar (SLAR). Close to 500 examples of pollution were documented in a ten-year period after 1991 when the surveys first started. The detection rate is poor, no statistics appear to have been published and there is no record of any resulting prosecutions for infringement of international and national legislation. This aircraft surveillance is expensive and there seems little point in continuing unless the courts take a more rigorous line with offenders. The resources and funding for this service could be better used to support other monitoring efforts.

Modelling

The use of mathematical models to understand marine processes, and especially hydrodynamic modelling used in an operational mode to forecast waves, tides and storm

[8] The EU Water Framework Directive (WDF) is a European Community action in the field of water policy focusing on integrated river basin management for Europe (http://europa.eu.int/comm/environment/water/water-framework).

[9] QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring in Europe) was an initiative of the Measurements and Testing Programme of the European Commission.

surges, and establish sources of oil pollution, has been at the centre of MUMM activities since its inception. Three validated operational models are used in real time by MUMM as aids to navigation, in the forecasting and prevention of flooding and in the prevention of pollution. These models were developed under *Project Sea* and are updated routinely as new *in situ* measurement techniques from development research become available. Participation in a number of national and international modelling projects has facilitated these developments.

Data Centre

Field and experimental measurements are an essential requirement for the development and validation of models. Since its foundation MUMM has acquired data at sea (mostly physical) and been involved in its subsequent processing and management. The data obtained by the *Belgica* on its cruises or obtained from MUMM moorings since the 1970s is stored on the real-time Oceanographic Data Acquisition System (ODAS). However, it is only since 1997 that the development of a standard marine environmental database for data sources from routine monitoring, field and laboratory research was initiated at MUMM. This project is funded by BELSPO under the acronym IDOD (Integrated Dynamical Oceanographic Data Management) and is referred to later in Sections 5 and 6. The database mainly contains measurements of contaminants in air, water, sediment and biota. The new system receives, stores, manages and makes available to researchers and others (recently on-line) marine data obtained through research and monitoring activities. The development phase of the database was completed in 2002. It was only in 2000 that MUMM was designated as the host site for the Belgian National Oceanographic Data Centre (NODC) although, for many years, it had been representing Belgium in international inventory and cataloguing initiatives and sending ROSCOP [10] forms (Cruise Summary Reports, CSR) to ICES.

Research

A wide range of research is undertaken at MUMM underpinning all the above headings, and in some cases, pushing forward frontiers through the development of new chemical analysis methods. There is a perceived vision in a number of other institutes and universities that MUMM has a privileged position in accessing funding for this work. A sizeable portion of research undertaken by MUMM is achieved with funds received from outside Belgium (e.g. EU contracts) which has been obtained in open competition. The diversity of research undertaken ranges from 'socio-economic evaluation' to 'underwater robotics'.

Royal Belgian Institute for Natural Sciences (RBINS)

The RBINS is made up of seven departments, several of which, including MUMM, undertake work that is relevant to marine science. Of particular relevance are the large collections of invertebrates and especially molluscs which alone hold about 9 million specimens. These collections include the important marine invertebrate samples that were acquired during the explorations of the North Sea by G. Gilson between 1898 and 1925.

[10] ROSCOP (Report of Observations/Samples collected by Oceanographic Programmes) was conceived by IOC in the late 1960s in order to provide a low level inventory for tracking oceanographic data collected by Research Vessels etc. The ROSCOP form was extensively revised in 1990, and was re-named the CSR (Cruise Summary Report), but the name ROSCOP was maintained. Most marine disciplines are represented in ROSCOP, including physical, chemical, and biological oceanography, fisheries, marine contamination/pollution, and marine meteorology.

2.2.2 Regional institutes

The whole coastline of Belgium is on Flemish soil and there is an understandable strong affiliation of Flanders with the sea. There are in consequence a number of Flemish institutes (VLIZ, AWZ, DVZ, IN) with marine responsibilities, but only one in Wallony (IRMA) which is no longer active.

Flanders Marine Institute (VLIZ)

The new Flemish Institute VLIZ was established in April 1999 to provide a co-ordination and information centre for marine issues in Flanders. It is supported entirely by the Flemish Government and Province of West-Flanders and has recently moved to newly converted premises on the quayside of the old fish market in Ostend.

The formative responsibilities of the institute are: 1. to co-ordinate Flemish contributions to marine research and policy; 2. to facilitate federal and institutional collaboration; 3. to manage and maintain the research vessel *Zeeleeuw;* 4. to build a Flanders marine data and information centre; 5. to develop public awareness of marine issues; 6. to emphasise the contribution of Flanders to marine research.

Flanders has a bilateral agreement with UNESCO and through this VLIZ has developed strong links with the International Oceanographic Data and Information Exchange (IODE) of UNESCO-IOC. Both VLIZ and MUMM are designated as IODE Data Centres: VLIZ in June 2000 and MUMM in September 2000. In November 2002, VLIZ and BELSPO together with IOC-IODE [11] and OBIS [12] organised an international conference on oceanographic data and information management with special attention to biological data.

Management of VLIZ is through a Board of Governors and a scientific committee. The Board includes the Director-General of the Waterways and Maritime Affairs Administration (AWZ) in Brussels, which has a coastal Waterways Division in Ostend. The Scientific Committee includes the Director of DVZ, also located in Ostend, the Director of MUMM, the Director of the Hydraulic Research Laboratory and Hydrological Research Division (Flanders Hydraulics, FH [13]) and representatives from AMINAL (the Flemish Administration for Environmental, Nature, Land and Water Management) and BELSPO. Unfortunately, there is no representation from the French-speaking Community on either committee.

VLIZ has negotiated with AWZ four co-operation agreements that strengthen the role of the institution: 1. To cover costs and management of personnel and the research vessel, 2. For the management of greenhouses for dune experiments, 3. For dissemination of data generated by a real-time monitoring system on the Flemish Banks (data taken by AWZ exists from 1977 and will be retrospectively incorporated into the database), 4. For integrated management of a lagoon in Ostend. Other co-operation agreements are being negotiated with research teams from universities on data banking.

The data centres of several divisions of the Waterways and Marine Affairs Administration (AWZ) of the Environment and Infrastructure Department of the Ministry of the Flemish

[11] Intergovernmental Oceanographic Commission / International Oceanographic Data and Information Exchange

[12] Ocean Biogeographic Information System/Census of marine life (http://marine.rutgers.edu/OBIS)

[13] FH is a division of the Waterways and Marine Affairs Administration (AWZ) of the Environment and Infrastructure Department (LIN) of the Ministry of the Flemish Community (Belgium). FH carries out hydraulic and hydrological research and provides inland and foreign public or private organisations with consultancy services.

Community are being re-organised and will be linked. A link will be established between these data centres and VLIZ to provide a public and academic face for the marine and estuarine environments of Flanders.

Waterways and Maritime Affairs Administration (AWZ)
Since federalisation the Waterways and Maritime Affairs Administration (AWZ) has been part of the Environment and Infrastructure Department (LIN) of the Ministry of the Flemish Community. AWZ is responsible for Flemish maritime ports, navigable waterways and water management, maritime policy development and implementation, operates 50 ships and employs 2,000 people in 125 locations. Two of the divisions of AWZ have a marine focus:

- The Coastal Waterways Division (CWD, Ostend) is responsible for the management of coastal defences, beaches and dunes, the infrastructure of ports and coastal canals and the operation of a hydrometeorological station.
- The Hydraulic Research Laboratory and Hydrological Research Division or 'Flanders Hydraulics' (FH, Borgerhout) works in both freshwater and marine environments, undertaking hydraulic and hydrological studies using scale and mathematical models, and manages the Belgian hydrological measuring network. It is a research centre that provides inland and foreign public or private organisations with consultancy.

Sea Fisheries Department (DVZ)
Originally established in 1962, on federal reorganisation in January 2002 the laboratory came under the responsibility of the Flemish Ministry of Small Enterprises, Traders and Agriculture. Employing 15 staff it undertakes research and gives scientific advice on the sustainable exploitation of living marine resources, the protection of the marine environment and the quality of fishery products. The work of the laboratory is divided into four sections, Biology, Monitoring, Fishing Gear Technology and Products.

Institute of Nature Conservation (IN)
This Flemish Conservation institute, established in 1986, is tasked with undertaking research, managing resources and developing policy on nature conservation issues. While primarily having a terrestrial focus it has a division with responsibility for the coast out to low water mark. It has also undertaken offshore research projects on North Sea birds funded by BELSPO. The Institute is based in Brussels and comprises 120 staff of whom a few are working on the North Sea. Administratively, it belongs to the Department of Environment, Nature-, Land- and Water Management (AMINAL) of the Flemish government and is responsible for the protection of nature and environment in Flanders.

IRMA
The Institute for Marine Research and the Interaction Air-Sea (Institut de Recherches marines et d'Interactions Air-Mer, IRMA) is located within ULg and does not receive any funding from the Walloon government and has been dormant for 6 years.

2.3 An initiative for national co-ordination: the Belgian Biodiversity Platform

The newly created Belgian Biodiversity Platform (BBPF) is an advisory and communication body of the BELSPO for scientific aspects of biodiversity study and conservation. It represents scientific agencies from the federal and regional level and has the following partners: Centre de Recherche de la Nature, de la Forêt et du Bois/DGRNE (terrestrial ecosystems), RBINS (freshwater ecosystems), IN (marine ecosystems) and BELSPO as co-ordinator. It aims at establishing efficient links between scientists in Belgium and abroad and

to promote Belgian biodiversity research in the frame of international trends, conventions and research programmes. It supports interdisciplinary research on biological diversity at national and international levels and intends to promote interactions between biodiversity-related policy and scientific research. Several thematic forums have been set up to enhance applied biodiversity research and to favour information exchange between scientists, field practitioners and policy makers in order to promote sustainable management and biodiversity conservation. These forums take place in close collaboration with the Belgian National Focal Point for the Convention on Biological Diversity, universities, research institutes and NGOs. Three scientific forums have been launched up to now: 'Forest Biodiversity', 'Invasive Alien Species' and 'Freshwater Ecosystems'. A forum on 'Marine Ecosystems' is due to start in the near future.

The BBPF is the Belgian node of the European Platform for Biodiversity Research Strategy under FP5 whose main objective is to improve the effectiveness and relevance of biodiversity research in Europe (28 partner countries).

2.4 The Federal and Flemish research vessels: *Belgica* and *Zeeleeuw*

The oceanographic research vessel *Belgica* launched in 1984 at a cost of 17.5 million euro, has provided essential and sterling support to the Belgian marine science research community for coming up to 20 years. Owned by the state, the ship and its scientific equipment are operated by MUMM on behalf of BELSPO. Planning and logistics for research and monitoring cruises are also the responsibility of MUMM. The ship is operated and crewed around the clock by the Belgian Navy from the naval port of Zeebrugge. The Navy provides an excellent service. With a length of 50.9 m and beam of 10 m the ship has a range of 5,000 nautical miles and a cruising speed of 12 knots and its operational area is therefore restricted to shelf waters normally in the southern North Sea. Most cruises in Belgian coastal waters operate on a Monday to Friday basis, longer periods being spent at sea for more distant exercises. In a typical year the ship spends approximately 200 days at sea. With only one crew this is as good as if not better than achieved by the research vessels of any other European state. The *Belgica* provides a laboratory and operational platform for all disciplines of oceanography and is fitted out with fish, biochemical, chemical and microbiological laboratories with space for specialised containerised facilities. The vessel, which is primarily utilised by universities, costs 10,000 euro per day to operate and is heavily subsidised as users are only charged 5 euro per day. We applaud this considerable subsidy which facilitates Belgium's contribution to marine research. A 7m Rigid Inflatable Boat (RIB), the *Tuimelaar*, is also operated by MUMM for use in coastal waters and as a rapid response boat for emergencies at sea.

Since December 2000 a former pilot vessel built in 1977, the *Zeeleeuw*, has become available for marine research too. The refitting of the vessel in 2000 cost the Flemish Government 760,000 euro and VLIZ 435,000 euro for laboratory and sampling and data acquisition systems. The Fleet Division of the Environment and Infrastructure Department of Flanders owns, crews and operates the vessel. Scheduling and management of the cruise programme and equipment is taken care of by VLIZ. Short term programming (4 month intervals) is operated for maximum flexibility to the needs of scientists and to fill, where possible, any gaps that may occur in the roster of *Belgica*. The annual sea going programme of 193 days is based on a daily schedule (not weekends) returning to Ostend each night. Trips that include a full 24 hours at sea remain possible with a maximum of 5 consecutive days. It would normally not operate far outside Belgian waters, but has a potential range of 1,900 nautical

miles at a cruising speed of 14.5 knots. While of a similar length and beam (respectively 56m and 9m) to *Belgica* the vessel was not originally designed for research, cannot operate heavy gear and is more appropriate for near shore and estuarine work and especially for educational field studies.

It is unfortunate that *Zeeleeuw* for local crewing reasons cannot operate over weekends or during the night as such a facility would greatly reduce pressure and demand for time on *Belgica* and enable *Zeeleeuw* to undertake longer programmes in local waters when *Belgica* is away on long tours as happened with a 42 day cruise last year and will occur again in the programme for 2003. There is ample cabin capacity (24 berths) on board the *Zeeleeuw* for longer tours. The form of the agreement with the Belgian Navy for the crewing of the *Belgica* could be used as a model to be adopted for the *Zeeleeuw.*

A partnership agreement between MUMM and VLIZ has recently been agreed to co-ordinate the operation of the two vessels. Both are deployed as most appropriate to their abilities, equipment and any operational geographical limitations. Good co-operation also exists between the MUMM Fleet Division and VLIZ in the timetabling of the ships to minimise periods when neither ship is available due to maintenance or other reasons and to maximise opportunities to fulfil the seagoing needs of the Belgian scientific community. The panel wishes to emphasise that both vessels are complementary in their windows of opportunity, capabilities, operational areas and respective contributions to marine science, and are certainly not in competition.

3 BELGIAN NORTH SEA PROGRAMMES

3.1 North Sea research until 1970

Belgium has had a long and productive history in oceanographic research starting with the establishment of the first marine biology laboratory in Ostend in 1843 by Prof. P.J. Van Beneden (University of Leuven). The laboratory was apparently well known as it was frequently visited by marine biologists from abroad, but it did not survive for long. One source says it was abandoned in 1859 and another that it remained open for thirty years. It is clear that it was no longer functioning by the late 1870s as the founder's son Prof. E. Van Beneden (University of Liège) obtained a government grant to establish a new station at Ostend in 1883. This station also appears to have had a short history as when Prof. G.F. Gilson (Museum of Natural History at the University of Leuven) needed laboratory space at the coast at the beginning of the 20th century, he used facilities at the premises of an oyster farm in Ostend. A regular course in marine biology was held at the University of Brussels; its promotor, P. Pelseneer, was an internationally recognised authority on molluscs.

Between 1898 and 1913, G. Gilson, successor of Van Beneden, undertook a number of sampling campaigns in the southern North Sea: his collection of more than 14,000 samples is currently being assessed and catalogued for its potential use by modern researchers. In 1914, Gilson also introduced the idea of a national oceanographic research vessel. His department at the Natural History Museum became known as the 'Zeewetenschappelijk Instituut' (Institute of Marine Science) in 1930; it continued after his death in 1944 under the directorship of E. Leloup. Over a period of more than 30 years, the Institute's main focus was the science and statistics of fisheries. It was closed in 1967 because of a lack of funding. From the early 1960s on, its tasks were taken over by the Public Station for Sea Fisheries known as the Sea Fisheries Department (DVZ) of the Ministry of Agriculture. In the same period, the University of Ghent and the Royal Institute of Natural Science initiated research that was related to the ocean. The University of Liège, after Profs. Dubuisson and Distèche's 1968 campaign to the Great Barrier Reef of Australia, set up a research station at Calvi in Corsica which is still in operation. In October 1970, the Institute of Marine Research (Instituut voor Zeewetenschappelijk Onderzoek, IZWO) was established with financial support from the Province of West Flanders and inherited the library of the ZWI. This institute was located in De Haan (1970-1975), Bredene (1975-1995) and Ostend (1995-2000). The IZWO laboratory at Bredene organised the European Marine Biology Symposium in 1975. The activities, library and staff of IZWO were subsumed into VLIZ when the new institute was established in 1999. The final lines of the historical review from which this summary has been produced (Decleir et al., 1990), says 'Only a modern marine biological institute is still lacking in Belgium; this is needed to achieve an equal position to the surrounding countries'.

An active role was also taken by Belgium in the establishment of the International Council for the Exploration of the Sea (ICES) in 1902. E. Dupont, Head of the Royal Museum (now Institute) of Natural Sciences, convinced the Belgian State to become a member. This led to involvement, through Gustave Gilson, in the first extensive collaborative international surveys of the North West European shelf seas by ICES between 1903 and 1914. Leading from the front Belgium organised the First International Conference on the Sea in Ostend in 1926.

Before 1970, marine research activities in Belgium were few and dispersed, and the science was mainly descriptive. Research teams had no incentive to co-operate and as a consequence there was little interdisciplinary work. The picture changed radically in 1970 with the advent

of the first government-funded research initiative. In essence, the programme innovated by aiming at the development of mathematical models, thus opening perspectives for possible applications of science. Between 1970 and the present, 6 phases were funded from the Federal Government of Belgium (Table 3.1).

Table 3.1 The 6 Phases of the Belgian North Sea research programme

Phase	Title of programme	Period	Budget (MEuro)
1	First National Research & Development Programme on the physical and biological environment 'water pollution': 'Coastal sea and estuaries' ('*Project Sea*')	1970 - 1976	4.4
2	Concerted Research Actions 'Interuniversity Action Oceanology'	1976 – 1981	3.4
3	Concerted Research Actions	1982 – 1993	5.3
4	Impulse Programme 'Marine Sciences'	1992 – 1997	4.6
5	Scientific Support Plan for Sustainable Development, Phase I: 'Sustainable Development of the North Sea'	1997 – 2003	10.3
6	Scientific Support Plan for Sustainable Development, Phase II: 'Global change, ecosystems and biodiversity: North Sea'	2002 – 2006	10 *

* The final budget of Phase 6 will be of the same order as Phase 5. Additional 'Calls for proposals' will be issued in June 2003.

3.2 Phase 1 - Project Sea (1970 – 1976)

Although it is difficult to ascribe a precise date for the birth of environmental consciousness in Europe, the process was on its way in the late 1960s. Water quality and water pollution were becoming issues of concern. At a NATO meeting in late 1960's, A. Capart, then Director of the Natural History Museum, suggested that Belgium should take initiatives to address these issues in the North Sea. Until then, research on the physical and biological environment had been descriptive, not process-oriented. It was recognised that an interdisciplinary approach was required to fill gaps in scientific knowledge and enable rational environmental management. At the European level, three research actions were being decided, notably within the frame of the COST (European Co-operation in the field of Scientific and Technical Research) initiative of the European Communities (EC). Belgium participated in two of these intiatives which started in 1972 (COST 61A 'Research into the physicochemical behaviour of SO_2 in the atmosphere' and COST 68 'Sewage sludge processing'). These COST initiatives were incorporated later in the 1970s into the first Environmental research programme of the EC.

In the context of increasing environmental awareness, Belgian authorities decided to launch in 1970 a **'First national R & D programme on the physical and biological environment: water pollution'** which comprised 6 subprogrammes or projects:

- 'Coastal sea and estuaries' aimed at producing a mathematical model for the North Sea and the Scheldt estuary (*Project Sea*);
- 'Inland waters with the river Samber as a test river' aimed at producing a mathematical model for the Samber river (*Project Samber*);
- 'Technology for combating petroleum products on the sea surface and in harbours as well as the elimination of certain pollutants in industrial effluents' (*Project Technology*);
- 'Economic evaluation studies of pollution and its remedies' aimed at producing models for the optimum choice of water quality, ways of distributing the financial charges of pollution and of water purification plants (*Project Cost/Benefit*);

- 'Vulnerability of subterranean water' aimed at producing a mathematical model for groundwater (*Project Groundwater*);
- 'Training of people with regard to the environment'. This project was transferred to the Ministry of National Education, but was never launched.

The current evaluation has only reviewed *Project Sea.*

A general objective of all national R&D Programmes is to provide public authorities with a scientific basis for the execution of their responsibilities and the development of policy. The specific goals of *Project Sea* were to assemble a reliable science base on the North Sea ecosystem (including hydrodynamics, chemistry, biology, sedimentology) and to develop modelling tools for the simulation of natural and anthropogenic impacts on the marine environment. As such, it was a precursor of future actions, notably at a European level. The whole water pollution Programme was designed in such a way that early results could be provided to public authorities as soon as available. Interuniversity links were encouraged: for example, *Project Sea* and *Project Samber* involved participants active in both Projects on pollution related studies (inventory and transport of pollutants, development of a mathematical model of pollution).

Most contracts in *Project Sea* were planned initially for 3 years and subsequently extended to optimise the research output (Annex 3.1). A two-year extension enabled the mathematical models to be further evolved and also to assess the pathways and fate of toxic metals (Cd, Ni, Cu, etc) in the environment as well as through the food chain. The Minister of Science Policy agreed to the extension because research results to date were encouraging and appreciated internationally.

Thus *Project Sea* was first extended until the end of December 1975. In the second half of that year, it was realised that a funding mechanism had not been put in place to maintain the salaries of scientists and other project costs. As a response to this crisis, bridging measures needed to be put in place to keep a minimal research potential functioning and the models running until the final decisions of Government on how to utilise the project results in formulating future measures and policy (expected in mid-1976). Bridging funding was provided from a budget surplus from *Project Sea* to address these concerns and the need to prevent any gap with the subsequent phase of *Concerted Actions*. This enabled the functioning of the models to be maintained with a restricted group of researchers. Bridging support also allowed Belgium to continue participating in a number of international activities, e.g. FLEX '76 (Fladen Ground Experiment 1976), JONSIS, JONSMOD**,** COST and OSPARCOM (now called OSPAR; see Section 1.2).

The main achievement of *Project Sea* was to develop a suite of mathematical models for application to the North Sea and the Scheldt estuary. The suite comprised submodels for tides and storms, residual flow, active dispersion, cycles of biogenic elements and pollutants, and could in principle be applied in such diverse areas of activity as monitoring of water quality, fisheries, aggregate extraction, dredging, discharge of waste, siting of power plants, harbour and offshore infrastructures. Being able to integrate the most important compartments of the marine environment, the models were considered as pre-operational. Despite this the models provided alternative scenarios and supported decision-making. As an example, one model was used to simulate the effects of the exploitation of sand and gravel. This model was also used later in the planning of the extension of a large methane terminal in Zeebrugge. The results of all the investigations were reported and made available in a series of 11 volumes.

In institutional terms, the most important development arising from the Programme was the creation of the Management Unit of the Mathematical Model of the North Sea and the Scheldt estuary (better known by its acronym MUMM, see Section 2.3) in October 1976. This public entity has subsequently played a fundamental role in ensuring that the scientific results of *Project Sea* and succeeding phases were interfaced with government policy priorities.

Project Sea also had long-term consequences in the area of major research infrastructure. During the *Project,* marine scientists had at their disposal several vessels owned by the Navy (especially the RV *Mechelen*, from 1976 until 1983) or by other agencies including the Maritime Administration. On the completion of *Project Sea*, it became evident that Belgium needed a federally owned ship to fulfil national statutory obligations, such as monitoring the quality of water and fish products, and to give Belgian scientists an opportunity to contribute in a meaningful way to international marine research. After lengthy consultations, it was decided in 1982 to construct a research vessel and the new ship RV *Belgica* was launched in 1984.

As a final comment it is worth noting that 30 years ago policy makers had already seen the benefits of joining fresh (*Project Samber*) and marine (*Project Sea*) waters under a common umbrella. The Government deserves to be complimented for its vision, because of the recognition of the need for a system-wide approach to the water cycle.

3.3 Phases 2 and 3 - Concerted Research Actions (1976-1993)

After 1976, government support for most kinds of research, including marine sciences, was substantially reduced. The government had introduced in 1970 a new type of activity: '**Concerted Research Actions' (CRAs).** These actions were envisaged as an experiment to allow universities to develop research centres of excellence with a high international standard in areas of fundamental science. The decision on the research topics to be undertaken was left to the universities.

The first generation of CRAs on topics other than marine sciences covered the period 1970-1975. This was followed after some adaptations and tightening of objectives by a second round that included marine sciences in 1976-1981 (Phase 2 of the Belgian North Sea research programme). The initial goal was to further fundamental oceanographic research and to continue refining the North Sea models developed during *Project Sea.* A second goal was to promote a co-ordination between MUMM on the one hand and interuniversity and multidisciplinary teams on the other hand. The first *CRA* on marine sciences was called *Interuniversity Action Oceanology* (Table 3.1, Annex 3.2).

During all *CRA* periods, major Belgian universities submitted proposals for research and their priority topics on an annual basis to the Government. For marine sciences, these requests were made for 6-year periods: 1976-1981, 1983-1989, 1984-1990, 1985-1990, 1987-1993. The funds were distributed on the basis of 45 % for the French-speaking and 55 % for the Flemish-speaking Communities. Total available funds per annum in *CRA* 1976-1981 decreased and were divided between a few universities. Compared to the 12 institutions supported in *Project Sea* only four universities (5 in *CRA* 1981-1993) were funded.

All the submissions subsequent to 1981 are considered here as making a third phase of Belgian marine science funding (Table 3.1, Annex 3.3). They differ from Phase 2 because

they were submitted as individual stand-alone projects without networking elements. Compared to the first phase of *CRA* annual funding continued to decrease.

3.4 Phase 4 - Impulse Programme Marine Sciences (1992-1997)

By 1990, Belgium was drawn into a number of European initiatives. The Brundlandt report of 1987 had underscored the concept of 'sustainable development'. As a result and following a number of ecological incidents that affected the North Sea at that time (e.g. the seal epidemic of 1988 and the *Chrysochromulina* bloom of the same year) marine environmental issues assumed an increased policy importance. The North Sea Task Force (see Section 1.2.2) was established to monitor pollution mitigation and to promote a dialogue between scientists and managers. At EC level, the first MAST programme was launched in 1989 (as part of FP 2) and focused on European seas.

Belgian scientists were confronted with the challenge to participate at an adequate level in these European activities. In previous years, and in order to keep up with their contacts abroad, their tendency had been to specialise in a few areas of excellence. The drawbacks were predictable: narrowing the range of topics studied, losing out on innovation, relaxing of co-ordination and favouring duplication of work. In order to overcome this situation, the Government recognised that a unified programme focusing on the North Sea was once more needed.

In July 1990 the **Impulse Programme Marine Sciences (*IPMS*)** was adopted for the period 1992-1996 with well defined research themes (Annex 4). Implementation of the Programme required the co-operation of the State and the Regions. An agreement with the Flemish Region was signed in September 1991 (see Section 6.2.2), but was not matched by equivalent Walloon support since this Region has no responsibility for marine issues. For the first time in Belgium project proposals were reviewed by foreign experts. Out of the 26 projects submitted in response to a call 12 were funded. A feasibility study for the establishment of a marine institute was funded following a restricted call for tenders. An overview of the granted projects is given in Annex 3.4.

3.5 Phase 5 - Scientific Support Plan for a Sustainable Development Policy: Sustainable Management of the North Sea (1997-2003)

Following the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro, Brazil (1992), the concept of sustainable development assumed increasing importance in the political agenda of many nations. International Belgian commitments now forced decision-makers to integrate the notion in their proposals. A **Scientific Support Plan for a Sustainable Development Policy (1996-2002)** was set up as an umbrella for eight individual programmes, one of which *Sustainable Management of the North Sea* was focused on the marine environment with 18.2% of the *SPSD* budget (Table 3.2).

Table 3.2 Research budget distribution of *SPSD-I* (1996 – 2001)

Programme	Budget	
	(MEURO)	%
Global change	15.9	27.6
North Sea	10.5	18.2
Mobility	7.8	13.5
Earth observation	5.0	8.7
Levers	5.7	9.9
Antarctica	4.8	8.3
Food	4.4	7.6
Supporting actions	3.5	6.2
Total:	**57.5**	**100**

Note: The *SPSD* was approved by the Council of Ministers in 1996 for a period of 5 years together with a budget of 68.3 million Euro, of which 15.8 % was reserved for management and valorisation of research results. The Table shows what the Programmes received for project financing. Field costs were not included.

As a component of *SPSD*, the new North Sea programme gave Belgium an instrument to fulfil its international obligations, both worldwide (UN Conventions) and regionally (OSPAR, ICES), and stressed the need to:

- provide support for political decision-making;
- identify human impacts on the environment;
- achieve multidisciplinarity, by combining the results of socio-economic studies with those of research on natural processes;
- integrate Belgian research teams into international projects.

In order to exploit and manage sustainably the North Sea and its resources it is essential to describe accurately the present situation and to forecast its future evolution. Despite progress achieved in earlier BELSPO programmes, many uncertainties remain. The programme was implemented through two types of activities:

1. Strategic scientific research, whereby scientists from various institutes and disciplines, organised in networks, were required to investigate eutrophication, chemical pollution, the protection of species and their habitats, and the sustainable use of the sea and to establish a databank to house the results of research projects. The following questions were addressed:

- How can the health of the sea be established?
- What is the socio-economic cost of a deteriorating marine environment?
- What are the risks of chemical discharges into the sea?

2. Targeted scientific actions, which were primarily designed to enable authorities to address problems raised in the 1993 North Sea Quality Status Report and thus were more limited in scope and duration. The North Sea SPSD programme enabled new teams to prove their capability and develop credentials for future research initiatives at both a national and international level. The frequency of the calls allowed new and novel areas of research to be targeted and supported.

One of the novelties of *SPSD* was the introduction of multidisciplinarity and the formation of networks. A major consequence of this was the ability to co-operate at federal level. Furthermore, the formation of networks has helped to stabilise teams in the middle term and

to facilitate international integration. Proposals were reviewed by foreign experts. An overview of the funded projects is given in Annex 3.5.

A special Call 'Stimulation action concerning international co-operation North Sea' was launched in 2001 with a total budget of approximately 0.5 M Euro to encourage research teams active in the Programme to collaborate with researchers in other states bordering the North Sea. Supporting activities included funds to facilitate the mobility of researchers to and from Belgium and for the organisation of international scientific meetings. Only two proposals were submitted and granted under this heading. Outstanding funds in the budget were transferred to a similar action under SPSD-II (see below).

3.6 Phase 6 - Scientific Support Plan for a Sustainable Development Policy, Phase II: Global change, ecosystems and biodiversity' - North Sea (2001-2005)

A second phase of *SPSD* is currently under way. Its objectives are similar to those of *SPSD-I*, but the architecture is completely different. In order to develop a scientific approach which is more centred on environmental problems, more coherent, more integrated but also more pragmatic towards research and policy, a single co-ordination structure entitled 'Global Change, Ecosystems and Biodiversity' was chosen. The aim was to unite, and in some cases reorient the *SPSD-I* programmes and strengthen the biodiversity component. *SPSD-II* thus consists of:

- a socio-economic strand named Sustainable Production and Consumption Patterns;
- a natural sciences strand on Global Change, Ecosystems and Biodiversity;
- supporting actions to integrate the first 2 strands and translate the findings for use by government and society.

Mixed actions combine strands 1 and 2 to ensure interdisciplinarity and integration. In principle, greater attention than in *SPSD-I* is being given to the involvement of local, regional and federal administrations and of potential users of research results. In consequence, 'Project User Groups' have been established to facilitate communication between researchers and decision-makers and to ensure the application of research themes to political, social and economic needs.

The continuation of the activity 'Sustainable Management of the North Sea' now falls under strand two. Its main themes are: process studies (e.g. nutrient fluxes), pollutants, sedimentary systems in relation to the sustainable management of the Belgian EEZ, social and economic dimensions of North Sea sustainable management, and operational oceanography. An overview of the funded projects is given in Annex 3.6.

The same type of strategic and targeted research actions as in *SPSD-I* was applied. Again a special component in the Calls was introduced for international co-operation.

3.7 Symposia, workshops and publications

In 1985, 1989, 1993 and 1996, workshops (Table 3.3) organised by the Academy of Sciences and others were held under the title 'Progress in Belgian Oceanographic Research' and the presented papers published in book format. The BELSPO organised symposia in 1994 and 2002 and published the products of the 1994 meeting.

Table 3.3 Symposia and workshops held

Year	Title	Organiser	Main topics
1985	Progress in Belgian Oceanographic Research	Belgian Academy of Sciences: Committee of Oceanology [1] National Fund for Scientific Research: Belgian Center of Oceanography [2]	- Hydrodynamics and mathematical modelling - Geology and geochemistry - Biology - Ecotoxicology - Ecohydrodynamical study of the Ligura Provencal Front (Corsica)
1989	Progress in Belgian Oceanographic Research 1989	Services of the Prime Minister – Science Policy Office Ministry of Public Health and Environment - Management Unit of the Mathematical Models of the North Sea and Scheldt Estuary	- Physical oceanography - Ecosystem dynamics - Stable pollutants
1993	Progress in Belgian Oceanographic Research	Royal Academy of Belgium: National Committee of Oceanology [3]	
1994	Dialogue between Scientists and Users of the Sea	BELSPO [4]	- Production of the North Sea: lower and higher trophic levels - Export opportunities for Belgian know-how in marine sciences - Health of the North Sea - The aggrieved sea
1996	Progress in Belgian Oceanographic Research	Royal Academy of Belgium: National Committee of Oceanology [5]	
2002	Sustainable Management of the North Sea: presentation of research results	BELSPO	All projects of the BELSPO Programme *Sustainable Management of the North Sea* 1997-2003

[1] The Royal Academy of Sciences has a National Committee of Oceanology that is affiliated to the Scientific Committee on Oceanic Research (SCOR) of the International Council of Scientific Unions (ICSU). Its President is Wollast-ULB

[2] Belgian Centre of Oceanography of FNRS was headed by Distèche-ULg

[3] Published with the support of the Royal Academy of Belgium and the Ministry of Public Health and Environment. The technical organisation of the 3-day symposium was undertaken by IRMA and IZWO

[4] Proceedings of a symposium held on the occasion of the 10th anniversary of the oceanographic research vessel *BELGICA*.

[5] Published with the support of the Royal Academy of Belgium and the Royal Society of Sciences in Liège

The goal of the 1985 symposium was to give Belgian scientists an opportunity to present the results of their recent research in the field of oceanography. This was also a useful occasion to allow a better diffusion of Belgian efforts among the international scientific community by publishing the papers presented.

The 1989 symposium was used to synthesize the results of research projects recently conducted by Belgian scientific teams in the North Sea and the Scheldt Estuary, either financed by the National Programme of Concerted Actions in Oceanology, EU (mainly MAST) or from the teams' own resources. The output of the many cruises made by the *Belgica* were also evaluated, in particular with reference to the Ministerial Declaration on the Second International Conference on the Protection of the North Sea (1987).

The 1994 event was a three-day symposium held on the occasion of the 10th anniversary of the oceanographic research vessel *Belgica*. The meeting brought together scientists, policy makers and users of the sea. Because the state of health of the sea had become a matter of concern due to the way it is used by mankind, a debate with users was seen as a vital necessity. In the past, such a debate had been sporadic, but is likely to become an ongoing process with a view to rational management of the marine environment and its resources. In addition to the various sessions, the symposium proceedings state:

> "In the face of changing needs which stem from the work done and new approaches adopted, scientists and politicians are working together to agree future research priorities, which are as follows:
>
> - Exercising greater control over the quality of data on the marine environment.
> - Enhancing integration, interdisciplinarity and modelling and fine-tuning existing models by a more precise analysis of the natural processes involved.
> - Obtaining a clearer idea of major evolutionary trends by gathering long-time series of measurements, including historical data about the state of the marine environment in the past.
> - Quantifying the risks of damage and developing a more detailed analysis of their economic anf social costs.
> - Making more intensive use of satellite data.
> - Developing greater computing power and more networking.
> - Continuing to adapt the law of the sea to reflect raw discoveries made in the natural sciences.
>
> These priorities will help us to improve our basic knowledge, and to respond more effectively to the needs of the political decision-making process at all levels, national and international."

The symposium held in 2002 presented the results of the BELSPO funded project and lasted two days. The audience was made up of scientists and representatives from the governments involved in sustainable management of the North Sea. This occasion was also used to present the first findings of the evaluation panel.

In several cases, project results were published whereby use was made of a special BELSPO dissemination budget, but remarkably this was done only with *SPSD-I*.

4 ANALYSIS OF PROJECTS

4.1 Synthesis of project appraisals

The scientific assessment of the 72 projects completed during the five phases of the Belgian North Sea Programmes (with a sixth one recently started, SPSD-II) was undertaken by a panel of three thematic reviewers. The subjects covered in the programmes were: eutrophication, marine geochemistry, marine geophysics, sedimentology, hydrodynamics, structural and functional biology, ecosystem dynamics, ecotoxicology, and socio-economics. These subjects were divided into three larger thematic areas for the project analysis:

- Ecosystems and Marine Biology.
- Marine Chemistry.
- Geology, Data management, Modelling and Socio-Economics.

The primary material for the reviews were final reports submitted by the project leaders and annual reports for the most recent SPSD-II Programme where final reports were not yet available. A wide range of additional information was also provided to the reviewers, including copies of the original contract documents from recent phases, copies of the five most representative publications of the project leaders, the calls for proposals from the later phases, summaries of interviews made with all project leaders to date and others involved in North Sea research, bibliographic searches and citation analyses. In the early programme phases little technical information was given in the contracts so it was difficult to assess the planning of these projects. Together the reports of all the projects comprised a substantial set of documents. It must be emphasised however, that this documentation comprises a synthesis of more than 30 years of scientific research representing work by hundreds of scientists.

A one-page template was produced on which to summarise the main characteristics and the evaluation of each of the projects. The template is divided into sections that provide summary information on each project, including a list of known participants, the budget, start and end dates, objectives and products of the research such as publications, PhDs and models. The main review comprises an outline of the Content and Quality of the report and three sections emphasising Scientific quality, Output and Societal relevance. The reports for each of the projects in template format are attached as Annex 5.

When the project reports are looked at in totality they do not comprise a fully integrated and planned national research programme on the North Sea. Instead they reflect the specialist expertise available in Belgium and an historical evolution from the first programme *Project Sea* which did represent a focussed national programme. This apparent lack of focus was a consequence of changing science policy and funding priorities, especially the marked reduction in funding for marine research in the *Concerted Research Actions* and changing priorities through time for research themes. The quality of projects has not been homogeneous over time and the integration evident in early BELSPO programmes was lost subsequently.

4.1.1 Ecosystems and Marine Biology

Six topics are grouped under this thematic heading (Table 4.1):

- *Phaeocystis* and eutrophication.
- Cycling of organic matter.
- Ecology of zooplankton.
- Ecology of macro- and meiobenthos.

- Aquaculture and ecology of fish.
- Research on aquatic birds.

To some extent the themes are connected by their relation to the models developed in *Project Sea*. Some of the projects contain aspects of several different disciplines. The table below lists the projects carried out in the different phases of BELSPO North Sea research.

Table 4.1 The projects in Ecosystems and Marine Biology

Theme	BELSPO Programme Phase [1]				
	1	2	3	4	5
Phaeocystis and eutrophication	1, 5, 9, 11, 20	?4	5	7	2, 16
Cycling of organic matter	1, 5, 9, 11, 14, 20	1?, 4, 7	5	9	
Ecology of zooplankton	3, 6, 9, 11, 12, 13, 16, 19			9	
Ecology of macro- and meiobenthos	3, 6, 8, 9, 11, 12, 13, 16, 19	5		8, 10	4, 14,
Aquaculture and ecology of fish	3, 6, 9, 11, 12, 13, 16, 19	6	7		4, 12
Research on aquatic birds				10	4

[1] The project numbers refer to the sequence in Annex 3.
No project reports were available from Phase 6, because projects have only recently started

1. *Phaeocystis* and eutrophication

Because of the prolific growth of the prymnesiophyte algae *Phaeocystis*, eutrophication has been considered as a major issue in Belgian coastal waters. In the Netherlands *Phaeocystis*. is perceived as a problem because it can at times produce thick layers of foam on beaches which may negatively effect tourism. Surveys undertaken showed that foam formation was not excessive on Belgian beaches and that beachgoers did not see the foam, which usually appears over a short period in May, as a problem. In the past the occurrences of large blooms of *Phaeocystis* were believed to be caused by high inputs of nutrients from the *Scheldt* and other coastal rivers. Recent results from *SPSD-II* have shown however that the abundance of this alga is more controlled by inputs of freshwater, as it is negatively related to salinity, and that it shows no relationship to varying nutrient inputs from the *Scheldt*. Most of the *Phaeocystis* is also shown to be biodegradable via the microbial loop and is not sedimented to the bottom. The blooms of this alga may thus be a non-problem. These results have considerable policy and economic relevance and complicate the assessment of the extent to which Belgian waters may be eutrophic under the Screening and Comprehensive procedures of OSPAR. The work that has been undertaken under this latter heading does not appear to have capitalised on the very extensive experimental, field and modelling studies undertaken over the last 30 years in Belgium. The teams involved in this work, especially through their participation in European programmes, have made substantial contributions to research on eutrophication issues and are internationally acclaimed for this work. In particular the progressive development of the complex MIRO model from an incipient growth in *Project Sea* has been impressive. Future quantitative applications of the new 3-D version of the model are constrained by its sensitivity to poorly known parameters and boundary conditions. A key finding of one of the earlier projects was that nitrogen reductions would have little impact on the coastal sea in contrast to phosphate reductions where major effects are likely to be seen with consequences for living resources. Also only half the nitrogen coming down the *Scheldt* exits to the sea, much

disappears to the atmosphere through denitrification and the greater part of the particulate nitrogen sediments out in the estuary. Obtaining statistics on the fluxes of nutrients to the sea from different catchments in Belgium proved to be a particularly difficult exercise to provide data input for MIRO. This was because different approaches are used for the measurement, data processing and archiving of data in the three regions of Belgium. There is a clear need for standardisation and intercalibration of approaches by catchment on a countrywide scale, especially in the light of the EC Water Framework Directive.

2. Cycling of organic matter

Research on the cycling of organic matter was closely linked to the first theme on eutrophication and much of the research has received considerable international acclaim. This recognition has almost certainly come from the high productivity of the teams involved and their excellent publication record in international journals. The bacteriological and modelling aspects of this work continued from their foundation in *Project Sea* although the work has not been maintained with the same intensity in recent years after Billen left for a chair in Paris. This situation serves to emphasise the need to ensure that productive scientists of international stature, undertaking work of key importance for Belgium, need appropriate encouragement and stable funding to minimise the effects of a braindrain. Over the years this work has emphasised the important role that bacteria play in the utilization of the products of primary production in both planktonic and benthic phases. Key new techniques were developed and the modelling has considerable practical application in both freshwater, estuarine and marine environments in progress towards less polluted and sustainable ecosystems.

3. Ecology of zooplankton

A small number of studies is grouped under this heading. Zooplankton was involved in the earliest BELSPO studies directed at the production of an inventory of the biota of the North Sea. Work on zooplankton grazing, which is also relevant to the previous topic, was of a high international calibre, especially in the area of faecal pellet research. The work focussed on the breakdown and sedimentation of faecal pellets and showed that material ingested by copepods in Belgian waters is rapidly sedimented to the bottom.

4. Ecology of macro- and meiobenthos.

Benthos is a collective name for organisms living on and in the sediment at the bottom of the sea, meiobenthos passes a sieve with meshes of about 1 mm, whereas macrobenthos is retained by such a sieve. Belgium has a long and excellent history in benthic research and at the start of the BELSPO North Sea Programmes benthic studies were already in progress. Especially in shallow waters benthic organisms play an important part in the foodweb, so the benthos cannot be neglected in models describing the foodweb of the North Sea. Last but not least, the benthos is mainly sessile and thus a benthic organism integrates the conditions at a particular place at the seabed during its lifetime. This makes benthic organisms suitable for monitoring purposes; the state of the benthic community gives information about the conditions at sea during a period of up to several years. All these factors together make benthic studies a strong subtheme in Belgian marine research.

The benthic programme started with an inventory of benthic and other organisms in the North Sea and a quantification of their respective biomass. Both projects were inspired by the North Sea models developed in *Project Sea*, but also judged on their own merit they provided excellent data and an example for studies elsewhere. The next phase of the programme consisted of a number of detailed studies on meiobenthos and on macrobenthos from restricted areas. Belgian scientists at that time worked at the forefront of meiobenthos

research and that is especially reflected in a pioneering study on energy flow through the meiobenthos. The macrobenthos work is solid but not particularly innovative. It is hard to judge which of the many Belgian publications on benthic ecology and taxonomy published in that period derived from the BELSPO projects and which were based on other funding. Anyhow, Belgian benthic science was productive in that period so it is likely that many publications have entirely or partly been made possible by BELSPO funding. In the period 1982-1986 (*Concerted Research Actions*) a study on 'Benthos in marine ecosystems and environmental pollution' was funded, but no further information on this project was made available to the reviewers. In the past ten years projects in which benthic studies were related to human influences on the sea and the Scheldt estuary were initiated. Benthic studies were used to define a marine protected area, to study the distribution of pollutants, and to describe the biodiversity of the North Sea.

Benthic ecology is now a strong branch of Belgian marine science; groups in Ghent, Brussels, and Antwerp (and the Belgian scientists working just across the border at Yerseke in the Netherlands) are among the top in their field. They have an excellent publication record and there is no doubt that BELSPO funding played a major role to support this development.

5. Aquaculture and ecology of fish.

There are few studies on fish in the open sea in the North Sea Programmes. Fish were included in the first inventories of the North Sea, but the only subsequent project on fish was part of a larger study in which the biodiversity of fish and their parasites was considered. The minor role of fish and fisheries in the BELSPO programme is, no doubt, due to the presence of the Sea Fisheries Department in Ostend. The reports studied show only limited interaction between participants in the BELSPO programmes and researchers at this institute.

A second group of projects are related to aquaculture that was executed by the strong aquaculture group at UGent. This group occupies a leading position in the world of aquaculture, but the BELSPO funded projects contain little innovative science and seem to have resulted in few publications. Several of the projects are essentially literature studies.

6. Research on aquatic birds

Birds appear in the BELSPO programme only in the more recent projects. This is a development that reflects an international trend; scientific papers on birds in marine scientific journals have only recently become more numerous. The BELSPO funded bird work concerns mainly inventories and censuses. It is not particularly innovative.

4.1.2 Marine Chemistry

The research efforts developed over the years have been very consistent with the objective of addressing a complete evaluation of the contamination status of the Scheldt estuary and adjacent North Sea. They can be organized in four subsections (Table 4.2):

- Contamination status of the environment
- Mechanistic studies and modelling of the fate of contaminants
- Impacts of contaminants on the biota: basis for ecotoxicology studies.
- Analytical chemistry and method developments

Table 4.2 The projects in Marine Chemistry

Theme	BELSPO Programme Phase [1]				
	1	2	3	4	5
Contamination status of the environment	2, 5, 9, 10, 15, 17, 18, 22, 23, 24, 26	2, 3	6	4, 5	1, 3, 8
Mechanistic studies and modelling of the fate of contaminants		2, 3 1?3?		4, 6	1
Impacts of contaminants on the biota. Basis for ecotoxicology studies	2, 9, 15			1, 2, 3, 10	3, 5
Analytical chemistry and method developments	5, 9, 17, 22, 24, 26		6	1, 4, 5	1, 10

[1] The project numbers refer to the sequence in Annex 2.
At the time of evaluation, not all final reports were submitted yet and because the annual reports were so differently from the context of research activities undertaken, separate sheets are sometimes produced.
No project reports were available from Phase 6, because projects have only recently started

1. Contamination status of the environment

The series of BELSPO programmes promoting biogeochemical investigations have resulted in an in depth knowledge of the contamination status of the North Sea. The co-ordinated approach used to evaluate contamination of the North Sea and the Scheldt estuary illustrates the integrated philosophy used in *Project Sea.* These studies addressed both trace metal and organic pollutants in a range of media from sediments to all levels of the food chain. The approaches continued in the Concerted Research Actions. An outcome was a highly interactive exchange between the involved teams. The results have yielded a clear understanding of the transfer of contaminants in the food chain. Resulting development of concepts contributed to early attempts in chemical modelling. This expertise was later to become an exceptional achievement of Belgian scientists and a main contribution to marine science.

In the CRA projects the role of the atmosphere as a transport route for heavy metals to the sea was also revealed. The work was at the forefront of marine science at this time. This important programme promoted major advances in aerosol science at an international level. Specifically, the studies characterised the composition, formation and global contribution of atmospheric transport of trace contaminants to the North Sea. Air-sea interactions were also of high relevance during *IPMS* when a complete assessment of the exchange of Volatile Organic Compounds (VOCs) between all compartments of the North Sea were undertaken. In addition *IPMS* supported an integrated study of the behaviour and fate of trace metals in the Scheldt estuary. This estuary has become one of the best modelled estuaries on this planet.

A complete review and estimate of sources and inputs of all known contaminants to the North Sea is summarised comprehensively in Chapter 4 of the Quality Status Report on the North Sea (QSR 2000, OSPAR). The first *SPSD* projects saw the development of programmes targeted towards the presence of trace metals and polychlorinated biphenyls (PCBs) in sediments and associated organisms. They are followed by a series of studies on the biogeochemistry of nutrients and trace metals. Despite a close integration with the European intercalibration exercise QUASIMEME, there was no major advance in knowledge of biogeochemical processes. However, all studies highlight the importance of the inputs of the Scheldt as a contributor to the contamination of the North Sea.

In brief, the series of programme phases consistently attempted to determine the contamination status of the North Sea and the Scheldt. During the first three programme phases, the original approaches, the integration of the scientific topics in marine biogeosciences and the excellence of the associated teams promoted this discipline with Belgium as a world leader. Many of the early developments set the pace internationally in Europe, but also with excellent recognition in the USA. However, this former excellence and novelty has not been maintained in recent programme phases as few significant advances have been achieved. In general, all studies related to this topic were of high societal relevance.

2. Mechanistic studies and modelling of the fate of the contaminants

The series of mechanistic studies start well after *Project Sea* which produced an inventory of the contamination status of the North Sea. This work highlighted issues on the mechanisms driving the translocation and fate of contaminants. The results were the basis of remarkable modelling initiatives on marine ecosystems. It was followed by an exceptional *CRA* report on the development of hydrodynamic and dispersion models. This report was put together by scientists who subsequently became the leaders of the Belgian marine research community. All main questions and issues of marine science were approached in this volume, from hydrodynamic and water quality modelling, the behaviour of organic matter and nutrients and preliminary studies on the boundary conditions for heavy metals at the air-sea interface.

Reactivity studies continued during *IPMS* were the kinetics of partitioning of dissolved and particulate phases of trace elements using radioactive techniques. This series of studies produced an integrated understanding of the field variability of trace metal behaviour in estuarine and coastal systems. Despite the quality of the work performed, it was not novel in relation to international developments in biogeochemistry. Nonetheless, these results contributed to a strengthening of the biogeochemical models developed by the 'Belgian school'.

3. Impacts of contaminants on biota: a basis for ecotoxicology

Concerns over the impacts of contaminants on the food chain were present in *Project Sea* and *CRA*. In fact some of the early studies addressing the possible impact of contaminants on the physiological status of both vertebrates and invertebrates were complete and advanced for their time. These early tests were applied to many areas in the North Sea and clearly illustrate the concerns for the impact of contaminants on all links of the food chain.

The *IPMS* resulted in uneven results on the topic of contaminant impacts and biological responses. The studies did not establish clear relationships between contamination levels in sediments and effects on benthic organisms. Another series of studies identified the contaminant levels and veterinary status of animals stranded on North Sea beaches. Despite this detailed work and the remarkable analytical effort no clear relationships were established.

Detailed studies of the impact of heavy metals on the asteroid *Asterias rubens* have enabled this organism to be used as an efficient indicator of ecosytem contamination. Results are in excellent agreement with current ecotoxicological knowledge and propose an original molecular approach. An array of tests based on *Asterias rubens* has been applied to a range of coastal sediment samples. Despite the high quality and societal relevance of the results produced we suggest that ecotoxicology is underdeveloped in Belgium.

4. Analytical chemistry and method development

Analytical chemistry has always been important in Belgium. In this respect the different programme phases have significantly contributed to the development of this discipline with variable success over time. In general, the sample collection, method development and quality control have always been rigorous allowing older data to remain valid today for long-term comparison. Rigorous developments in inorganic analysis, either using atomic absorption spectrometry for solid samples (biota or sediments) or anodic stripping voltametry for dissolved trace elements produced high quality data.

Research quality was especially high in Project Sea with analytical advances and objectives well positioned at the forefront of marine chemistry science. In terms of analytical developments, the most innovating trends were also most advanced during these early days; they slowly lost their innovative character to become a follow-up approach of major issues promoted in adjacent countries. Research and analytical developments produced in SPSD were of good quality but are an updated copy of international work. This status is of concern since refined understanding of contamination levels in the North Sea is of high relevance for the future with an expected increase in anthropogenic pressure on these fragile ecosystems. This is also of concern if Belgian science wishes to contribute to global monitoring and regulation of oceanic environments. It is worth mentioning one sector of analytical sciences that emerged at the international level during the CRA programme. An outstanding development enabling direct analysis of elements in aerosols by solid state spectroscopy techniques (X-ray spectroscopy, electron and ion microprobe analysis and laser microprobe mass analysis) brought Belgian scientists to the international forefront of air sea exchange research. It resulted in numerous international collaborations and in the development of an exceptional analytical centre, unique in Europe.

While developments have been constant in the field of inorganic chemistry, it has not been the same in the organic sector. After a promising start in *Project Sea* throughout the different programme phases the field of organic analysis has lagged behind in comparison to the situation in neighbouring countries. The only exception is a remarkable piece of work on method development and validation for VOCs, which allowed a complete overview of the reactivity and translocation of these organic compounds in North Sea ecosystems. Despite past efforts and the incentive provided by *SPSD*, considerable research is still needed to assess the molecular status of contaminants and their transformation in the food chain.

4.1.3 Geology, Data management, Modelling and Socio-Economics

Four topics are covered under this heading (Table 4.3):

- Sedimentology and sediment dynamics.
- Marine environmental database.
- Hydrodynamic and water quality modelling.
- Studies in support of management.

A few ancillary projects are outside these headings. The topics do not form an integrated whole as they largely stand alone and even some of the subdivisions appear isolated as project groups, often over a number of funding cycles. There appears to have been minimal interaction between the different topic groups,

Table 4.3 The projects in projects in Geology, Data-management, Modelling and Socio-Economics

Theme	BELSPO Programme Phase [1]				
	1	2	3	4	5
Sedimentology and Sediment dynamics	1, 4, 5, 7, 11, 20, 21		4		13, 15
Marine environmental database	1, 25				6
Hydrodynamic and water quality modelling	1, 5, 9, 11, 16, 20	1			
Studies in support of management				11, 12	7, 19

[1] The project numbers refer to the sequence in Annex 2.
No project reports were available from Phase 6, because projects have only recently started

1. Sedimentology and Sediment dynamics.

The first report for *Project Sea* under this heading provides an excellent and comprehensive summary of the offshore sedimentology of the eastern sector of the Southern Bight. It was the product of the analysis of a great many sediment analyses. Unfortunately the detailed results for these analyses were not given and do not appear to have been stored in a database and may thus now be lost to science. A key finding at the time was that only a quarter of the sediment in suspension was incorporated into bottom sediment, the rest was exported towards the German Bight. Subsequent work using geophysical methods outlined in detail the Quaternary and Tertiary stratigraphy of the Belgian continental shelf and using side scan sonar the bed forms of offshore deposits. The work showed that the large sand bedforms (banks) found off the Belgian coast are relatively stable. This is a finding that has potentially large economic consequences in a time of climate change. An ancillary project has evaluated, in a systematic way, the current stability of an armaments dump site from the First World War off Zeebrugge as well as potential risks and options for the future. This project would appear to have been carried out to address public concerns rather than for its scientific relevance. In total this research has provided a sound understanding of the offshore geology of the Belgian continental shelf. There is clear evidence of good international collaboration, but the publication record of this work appears poor for the amount of work that has been undertaken, so that an appropriate international recognition has probably not been achieved.

2. Marine environmental database

Storage of data in standard formats in a computerised database is an essential requirement for modern research and as a source for the data needed to construct and validate models. Belgium was clearly in the lead in telemetry and in international collaboration on the design and construction of databases in *Project Sea*. Shared data between countries was essential for the development of models and the Belgian group at ULg at this time played a key role in the development of international standards for data exchange. Unfortunately this lead was not built on and the establishment of an integrated database system to incorporate all data produced in Belgian national programmes was not initiated until 1997. Furthermore, the IDOD data centre in MUMM was not designated as a National Oceanographic Data Centre until 2000. The project was initially slow to get off the ground, but now appears to be operating efficiently. Its success will be largely dependent on the acquisition of data from the *SPSD-II* projects and later retrospective incorporation of data from historic programmes before the data is lost.

3. Hydrodynamics and water quality modelling

Mathematical modelling was at the core of *Project Sea* and there is no doubt that Belgium was at the forefront of marine modelling at this time and that there was excellent collaboration with other modelling groups around the North Sea. The productive teams led by J. Nihoul produced a whole sequence of models some of which have been upgraded subsequently and are routinely used today by MUMM in operational mode (e.g. tidal and storm surge forecasts). This work has huge practical and economic value, especially for a country that has extensive areas of low lying land adjacent to the sea that are potentially vulnerable to flooding. The modelling reports from this time are particularly impressive; sizeable documents they review the state-of-the-art for the time, methods used, limitations, simplifications used and the different schemes applied. For example, work included in the impressive report on the Scheldt estuary included a brilliantly expounded outline of estuarine models for the period with each of the basic equations discussed in detail. Many of the limitations to the use and interpretation of the models still apply. Use of applied dispersion models almost certainly led to the banned discharge of titanium dioxide from ships under the 'Oslo Convention'. A major finding of the hydrodynamic modelling was the identification of a residual current gyre off the coast of Belgium. This feature has considerable importance for sedimentation and as a result the area has higher concentrations of contaminants.

4. Studies in support of management

Although all studies delivering data to the various North Sea models can be seen as supporting the management of the North Sea, we consider here a number of studies directed at particular management issues. One project provided for this aspect a very solid basis: a report of 1,252 (!) pages (later published as a book of 733 pages) lists 'everything' concerning legal regulations relevant to the management of the North Sea. It is much to be regretted, however, that this splendid work is only available in Dutch. Two other projects explore the possibility of quantifying the ecological damage of marine pollution in financial terms and to charge this damage to the polluter (the polluter pays principle). This is interesting research, but it seems that little has been published. Finally, an ongoing feasibility study attempts to use a collection of historical samples of marine organisms as a reference value for the present situation of the North Sea.

4.2 Project output and impact

4.2.1 Project reporting

The size of final reports varies enormously. In the case of *Project Sea* reporting was in the form of a series of volumes of close to 400 pages whereas reports in other programme phases are at times minimalistic and only a few pages long especially in the *Concerted Research Actions*. To quote one reviewer "It looks as if the report reflects competent science, but it is too short to draw any conclusions on this". In one case the report is written as if it is the text of a lecture at a conference and in another case as if it was an undergraduate student project – in both cases a clearly highly unsatisfactory situation. In some examples the reports refer to earlier reports that are not summarised in the final report and yet appear to be an integral part of the project. A few projects only provide a literature review as the report, but it is not clear if this was all that was required as the original objectives are no longer on record.

The quality of reporting was generally high in Phase 1, declined in the period of the *Concerted Research Actions*, increasing in many recent projects of *SPSD-II* again to a high standard. The *Project Sea* volumes were of a comprehensive nature, thoroughly reviewing the

various topics covered and reflecting the holistic modelling approach that was being promoted during this programme. However, these were not real contract reports. In the subsequent phases, many project reports are poorly structured and few make reference to the original contract objectives. The latter often makes it difficult to determine the extent to which the original aims of the projects were fulfilled.

Most of the contract reports are in Dutch or French. This is appropriate for annual reports, but the panel is of the view that this limits the wider international circulation of the work and may be one of the reasons for the poor output by some teams in international journals. As English is recognised as the international language of science there would be considerable advantages if the final reports were written in English. The reports should be written in such a way that the text could be readily incorporated in manuscripts for subsequent publication. All annual and final reports should have executive summaries in English, Dutch and French. The French and Dutch summaries are particularly important in informing and facilitating research exchange between the Flemish and French-speaking Communities.

Considering the effort that goes into the production of the reports they are currently only 'circulated' and read by a limited audience. Copies of most, but not all of the reports and contract documents are currently held on file at BELSPO. Alternative or additional archiving should also be looked into and it should be advertised that a copy of the final reports, after peer review, is deposited in the Royal Library of Belgium. Furthermore, reports could be included in an international marine library abstracting system such as Aquatic Sciences and Fisheries Abstracts (ASFA). The national marine and oceanographic libraries of many European states contribute abstracts to this service (The library at VLIZ has recently become a Flemish node for ASFA). Such procedures would ensure that the work is made available to the scientific community, even if it is never published in peer review journals.

The scientific output of projects should be given as a list of publications (including grey literature and theses). We also suggest that offprints of published papers and submitted manuscripts should be included as appendices to reports. We recommend that BELSPO project reports should be concise and that funded scientists should be obliged to send copies of their publications to BELSPO, also of publications appearing after conclusion of the project. Funds for new projects awarded should only be made available after reporting obligations for previous projects have been fulfilled.

Authors of project reports are particularly poor at acknowledging the support provided by BELSPO towards the research undertaken. Recommendations on a form of acknowledgement in both reports and scientific publications coming from the work need to be formulated by BELSPO and incorporated in the contracts.

Establishing the true publication output of the different projects funded as part of the six phases of the North Sea research programmes has been difficult as few reports provide lists of publications arising out of the work and in many cases the publications would have appeared after the reports were produced. A bibliometric evaluation of the different project teams is given in a separate section below. From the evidence given in the reports it appears that there has been much variability in the output of the research teams funded as part of the BELSPO research programmes over the last 30 years. A number of the teams have been highly productive and widely published in international journals of a high calibre. Some of the teams have published very little and what has been published has been in grey literature or confined to Belgian journals in French or Dutch and so receives little international recognition. A

sizeable proportion of the funded research appears to have never been published and the only documentation of the work comprises the project reports that in a number of cases are poorly put together. Research theses at MSc and PhD levels are occasionally referred to in the reports, sometimes without reference to the authors, but are virtually never systematically cited.

It is clear that many of the project reports are not received by BELSPO on the due date for completion of the work, and in many cases not until many months/years later. The final reports for some of the *SPSD-II* projects for example, should have been completed in time to be included in this evaluation, but in some cases final reports were still not available in June 2002, six months after the contract end date.

4.2.2 Bibliographic analysis

Available information from the project reviews suggests that in too many cases publication of Belgian North Sea research in international peer-reviewed journals is too low despite the quality of the work and by comparison to other countries. It must be pointed out however, that some of the Belgian teams have achieved outstanding publication records and strong international recognition.

4.3 International co-operation

Evidence for the development of international working links from the contract reports is very variable. Strong international collaboration was very visible in *Project Sea*. This was especially evident in the hydrodynamic modelling and database community when current meter data and the development of international standards for data exchange were centralised at ULg. In the 1970-1980s Belgian scientists also played an active role in ICES participating in international exercises such as JONSMOD 73 and FLEX 76. Regrettably this international collaboration seemed to have fallen away temporarily. It is only recently that the early skills in databasing and links with ICES have started to be strengthened again with participation of the IDOD data centre team in the ICES Working Group on Marine Data Management in October 2001. This participation was long overdue as until this meeting there would appear to have been minimal contact with ICES despite the fact that much of the data to be included in the database will eventually be passed to ICES. By participating Belgium will benefit from the experience of other countries and be able to pass on the experience of the IDOD project to others.

In contrast to the above, strong links have been developed by a number of the teams with European researchers as partners in MAST and other EU funded projects. The integrated strategy developed in *Project Sea* has been developed as an approach by many other European countries in recent decades. This approach led some leading Belgian scientists to propose and co-ordinate, with excellent European support, large integrated projects such as Ocean Margin Exchange (OMEX [14]) or biogas in estuaries (BIOGEST [15]) illustrating the recognition at the time of Belgian marine science. Links were also developed with scientists from the USA who have contributed to some of the reports, possibly by having dual

[14] OMEX was financed under the EC-MAST programme (1993-2000) and was co-ordinated by R. Wollast of ULB (http://www.pol.ac.uk/bodc/omex).

[15] BIOGEST was a research project (1996-1999) funded by the EU in the framework of the Environment & Climate programme and the ELOISE (European Land Ocean Interactions Studies) projects network. It was co-ordinated by M. Frankignoulle of ULg (http://www.ulg.ac.be/oceanbio/biogest).

nationality. The geophysical community of Belgium has developed good international links through participation in their European professional association.

In conclusion, the scientific community within Belgium is at the forefront of international expertise. It is, however, relatively small. There are difficulties in developing, and retaining, a critical mass of scientists in any given area of research. Much to their credit, Belgian scientists have been particularly adept at overcoming this through a combination of external funding from many sources, long-term collaboration with non-Belgian colleagues and through growing collaboration within Belgium. BELSPO, by imposing cross-laboratory links, has promoted beneficial contacts within the country.

4.4 Overall evaluation of the projects

When looked at as a whole the project reports reflect work of a high scientific quality. In many cases the projects have provided important Belgian input into priority research and policy issues at European, North Sea Ministerial, OSPAR and international levels. Some of the projects have had a considerable international impact and in a few cases set the scene for similar work in other North Sea states.

The reports do not always reflect the quality of the work as published in international peer reviewed journals. Some of the poorest reports were by scientists who have a high international reputation. It would appear that the production of the contractual reports was perceived as a necessary, but unimportant chore. The scientific output of research projects is one way of supporting the integration of young scientists in society. From most of the reports produced this output is usually not listed and is difficult to determine retrospectively.

A number of the project reports are poorly structured and few make reference to the original contract objectives. It is thus often difficult to determine the extent to which their original aims were fulfilled. Guidance on report presentation has recently been produced by BELSPO, but there is scope for further improvements in this area.

Unfortunately, the impact of the considerable research effort by Belgian scientists, over the last thirty years, has been much lower than it should have been in terms of the quality of the science produced. In general, the scientific achievements of BELSPO funded projects has been high but with uneven outputs both within phases and by research groups. Much of the research is solid, but not innovative and the publication output is poor in a number of cases. This is true even when considerable work was clearly undertaken during specific projects and substantial reports were produced. For many projects during the last phases of the marine programmes, the results were not innovative enough to deserve frontline publication in international journals. And, in many cases in SPSD the output of integrated research projects was not published. Analytical developments in chemistry duplicated international advances and could then only be reported in average journals. Overall the publication output in international peer-reviewed journals was low, with a number of notable exceptions.

A few exceptional groups have developed outstanding research and have publication records in international journals that are equal to the highest scientific productivity at an international level. Their work is recognised by their international peers as being among the top in their field. These teams have been highly productive and in some cases had key roles in European Union projects.

There is thus considerable inhomogeneity in the outputs between different research groups. Furthermore, the groups with the greatest international contacts were also those in the forefront both in terms of scientific questions as well as at the level of their facilities and instrumentation.

This very heterogeneous situation has indirectly contributed to a brain drain of the most efficient and high performing young marine scientists to neighbouring countries. The situation serves to emphasise the need to ensure that productive scientists of international stature, undertaking work of key importance for Belgium, need appropriate encouragement and stable funding to minimise the effects of a braindrain.

There is little evidence of interactions between partners in BELSPO funded projects and other marine research organisations in Belgium not in receipt of BELSPO funds, e.g. the Sea Fisheries Department in Ostend. There also appears to have been minimal interaction between the different topic groups used here to summarise the results of the project research. Thus networking systems within Belgium do not seem to be working well and new systems to improve communication and collaboration need to be developed in the future.

In summary, the most innovative projects and integrated multidisciplinary approaches were promoted in Project Sea. Later, the quality of the science remained, but the cutting edge approach and integration was lost. Scientific and social outputs declined over the years except for some outstanding teams who were invariably also involved in international collaborative networks.

5. DATA MANAGEMENT

In this section we start with an expanded analysis of data management projects funded by BELSPO. We then explore the general issue of data management in Belgium. This analysis is needed because of some unsatisfactory aspects with regard to databasing and the duplication of NODCs in Belgium.

5.1 Data storage in Project Sea

Three decades ago during *Project Sea* Belgium was in the forefront of the development and construction of a database to store data obtained from physical oceanographic measurements. The programming and design skills needed to build the data storage systems used at the time were well advanced as a consequence of the modelling which was central to *Project Sea*. There was also considerable international collaboration at the time in ICES programmes that created joint data management systems. Shared data between countries was and is essential for the development of models. Belgian scientists drew attention to the problems of exchange of data between a number of different North Sea countries. The Belgian team played a key role in resolving these problems by translating the different datasets into a format that was readable by all countries and in the creation of a new international standard for data exchange. At the time ULg acted as the central depository for all current meter data acquired during the international projects JONSDAP 73 [16] and INOUT [16] as the computers there were more sophisticated and capable of accepting data in a variety of different formats than in the fledgling data centres of other countries. In addition the scientific team had obtained a reputation for its skill in overcoming problems of intercalibration. In the JONSMOD [17] initiative which involved even more countries, each country was using different computer formats so the problems of the earlier intercomparisons and exchange were repeated and a plea was made for further international standardisation of exchange formats. From this very promising start holistic management of oceanographic data produced by Belgium appears to have gone into decline and the continuing international developments that took place under the umbrellas of ICES and IOC seem to have been largely ignored until recently when first in 2000 VLIZ and then MUMM affiliated to IOC-IODE (see below) and second in 2001 MUMM started to participate in the Working Group on Marine Data Management of ICES (see below).

[16] Joint North Sea Data Acquisition Project is a co-operative data collection programme started in 1970 by the countries bordering the North Sea. The first phase of JONSDAP involved the systematic collection of data from moored stations and coastal observation sites in the North Sea from 1971 to 1973. The second phase, JONSDAP 73, was a programme of tide and current measurement in the Southern Bight of the North Sea. The third phase, JONSDAP 76, consisted of two intensive measurement programmes:
- FLEX, the Fladen Ground Experiment to study the development of the thermocline and the dynamics of the plankton bloom; and
- INOUT, a programme concerning the general circulation of the North Sea and the storm surge problem.

[17] Joint North Sea Modelling Group (JONSMOD), a scientific initiative led by J. Nihoul in the mid 1970s to co-ordinate modelling in the North Sea. The group fell into decline as J. Nihoul became involved in other activities, but was resurrected in 1982 and renamed the Joint Numerical Sea-Modelling Group. This group, no longer under the leadership of Belgium, organises highly successful modelling workshops. Both MUMM and ULg are active participants in the group.

5.2 Belgian Data Centres

The longest established data centre in Belgium is part of the MUMM which has maintained a databasing facility since it was established in 1976. The unit inherited the current meter archive and some other physical oceanographic data from *Project Sea* and currently houses two main oceanographic databases (Annex 2): the Oceanographic Data Acquisition System (ODAS) which is used to store real time data obtained by *Belgica* on cruises and for data obtained from moorings; and the recently developed Integrated and Dynamical Oceanographic Data management (IDOD) that mainly contains measurements of contaminants in air, water, sediment and biota. The IDOD receives, stores, manages and makes available to researchers and others marine data obtained by BELSPO projects. The development phase of the database was completed in 2002 and is now part of the Belgian Marine Data Centre (BMDC). This late entry is in contrast to most other North Sea countries that already have well established National Oceanographic Data Centres (NODCs). As of November 2002 the IDOD database started to operate on-line. However, members of the review panel have not managed to obtain access on-line. It is not clear if the system will be used in the future to store oceanographic data obtained by Belgian scientists outside BELSPO contracts as is the case for NODCs in other countries. At the end of 2002 there was no information on the MUMM web site on how to access information from either the ODAS or IDOD databases although this situation has now been put right.

Other geological databasing initiatives are outlined in BELSPO reports that do not appear, at present, to be included in IDOD such as NORDATABASE. As a national resource it is not clear what the long-term plans for the maintenance of this database are and how it will be integrated within the IDOD system. This situation needs to be reconciled. Other large data sources also exist in Belgium that were not funded by BELSPO such as the pCO_2 measurements stored at the ULg. These measurements are a national resource and should be included in the NODC.

The VLIZ is a relative newcomer to databasing as the institute was only established in 1999, but currently hosts on-line seven databases (Annex 2), some on behalf of partner institutions and some for data originating from VLIZ. Most of these databases would better be described as inventories or marine information systems as they do not house oceanographic data measurements. Exceptions are the ICES North Sea Benthos Survey (1986) and MIDAS (see below). New databases are also under development within the framework of national (BELSPO, AWZ) and international (EU) projects. The Marine Information and Data Acquisition System (MIDAS) developed by VLIZ inhouse, sounds remarkably like the ODAS system used by MUMM to record data obtained from the *Belgica*. There are clear opportunities for co-operation and standardisation here. VLIZ advertises well the availability and access procedures to get to its databases on its web site and is used as an example of a web based data access system for its East African marine species inventory by the Sea Search initiative [18] established under the EU Framework Programme.

[18] The Sea Search initiative is a spin-off of the EU-MAST programme and comprises the organisation of a European cooperative network for oceanographic data & information management. This network operates in a coherent and operational mode to strengthen the quality, service and overall performance of ocean and marine data & information management in Europe, both on a national and international level. The Sea Search web site, services and infrastructure are developed and operated by a partnership of 16 institutes from 15 different European coastal states. Belgium is represented by MUMM. (http://www.sea-search.net).

5.3 National Oceanographic Data Centre (NODC)

In 1961 IOC established the International Data and Information Exchange (IODE) initiative to facilitate and develop a global network of NODCs. It was not until 2000 however, that Belgium affiliated to the IOC- IODE network and then, unusually, affiliation was made through two 'National' Oceanographic Data centres, MUMM and VLIZ. Other countries, even large ones like China, have only designated one NODC. There is no reason why there should not be two data centres, but one should be given seniority as a NODC otherwise confusion and duplication of effort may occur. The VLIZ through its Flanders Marine Data Centre (VMDC) considers itself as a NODC for Flanders, but on the IOC web site it is said, as for MUMM, to be representing Belgium.

In certain respects VLIZ could be seen as being in competition with MUMM especially in the areas of the research vessels and the data centre. As indicated earlier the research vessels complement each other, but there is real potential confusion in the data centre responsibilities of both organisations. Considerable cost and logistical benefits could be achieved if the two data centres used the same software systems. We recommend that there should be only one National Oceanographic Data Centre and this should be MUMM on the basis of its historic precedence, the size of the data archives and their strategic content. A better and more cost effective approach would be to merge the two databasing systems. If this should not prove possible, VLIZ should be redesignated as a 'Designated National Agency' (DNA) within IOC. This redesignation would allow VLIZ to maintain its participation in the IOC system, but prevent international confusion over relative responsibilities between MUMM and VLIZ on databasing issues and improve decision-making. To enable this recommendation to be implemented we strongly propose that a mechanism be established under the auspices of BELSPO to improve links and communication between the two data centres. At present the archives held by the two data centres would appear to complement each other, but the ship-based measurements archived by VLIZ should also be sited in the MUMM data centre as a NODC. Any possible overlap between the two data centres needs to be resolved and BELSPO should examine how the joint ODAS and MIDAS databases could be made available on-line. The MUMM also needs to become more proactive as a NODC; we are pleased to see the late arrival of an appropriate web-based window and access system. If appropriate interfaces can be made between the two data centres they could again be seen as complementary.

Most other North Sea countries already have well established NODCs and the lack of early links with these bodies is evident in the reports of the IDOD project. There seems to have been little discussion with other national database operators in the formative years of the establishment of IDOD to learn from their experiences and use already developed software.

5.4 The IDOD database

The IDOD project was initiated by BELSPO in 1997 as a sophisticated storage system for marine environmental data that would ensure a smooth transfer of raw data from routine monitoring, field and laboratory experiments, mathematical models etc. as products to end users such as scientists, sea professionals and policy makers. The system is also intended to act as a 'Programme Data Manager' for measurements and data collected within the frame of the BELSPO *SPSD* programme. The project was divided into five different, but highly interdependent tasks:

- The production of an inventory of relevant data sets and databases.
- Analysis: establishing criteria for the input of data and data quality control.
- Design of the database.

- Implementation: formulation of data analysis tools.
- Production of templates for derived products, maps, tables, reports.

The project, with an initial five-year contract, was slow to get off the ground. From the contract reports there seems to have been little assessment of other equivalent databasing systems. The work seems to have started from a clean slate so that the slow progress was not too surprising especially given the poor international links discussed above. A further factor also appears to have contributed to slow progress during the early years of the contract, the complex division of labour between three agencies in the development of the system. The development of the prototype was limited by the choice of the relational database software to be used (Microsoft Access); this was the only system available to all the institutes. Using this relatively simple databasing software it was only possible to test part of the complex systems that were being developed. A number of properties of the database were not incorporated in the prototype because data was said not to be available to test the system.

The late establishment of a national databasing system has meant that most Belgian scientists were not geared up to send their data from both field and laboratory experimentation to a computerised data centre. Poor and slow input of data by the scientific teams involved in *SPSD-I* was another factor that may have delayed the development of the database. By early 2000 only 60% of the available data from *SPSD-I* had been received by MUMM. By the beginning of 2002 the complete datasets that should have been completed as part of the contractual obligation of *SPSD-I* had still not been submitted. Some scientists have not submitted any data. This situation was in part a consequence of a conflict between MUMM and the University teams on Intellectual Property Rights. The IDOD team had started to develop at an early stage a copyright and access system that took into account international treaties, European Directives, national laws and contractual obligations for discussion with data contributors. Access limitations, proposed by the BELSPO, included an embargo for scientific use of 24 months after data collection for users other than the data collector, including BELSPO (except for use in the support of policy development). Some researchers were unhappy at what they perceived as too short a gap to allow them time to publish their results. In the view of the reviewers this was an ample interval of time and could only help to stimulate early publication of research findings. With respect to *SPSD-II* contracts, research teams are reluctant to submit their data into this database. As a consequence, recent contracts now incorporate specific sections formalising the requirement to submit project data.

The BELSPO has invested considerably in the development of IDOD and sees its successful utilisation as a means of making data more readily available to the user community. On the basis of the tardy submission of participants in *SPSD-I* new methods to measure and analyse the data submissions of contractors are being included in IDOD. A partnership agreement made between MUMM, the research promotors and BELSPO forms part of the contractual agreements and includes practical and technical requirements for the annual transfer of data (re: Section 2.3). No penalty clauses are defined to the reviewers knowledge, they should be clearly stated e.g. no future contract to be awarded unless the data is submitted on time unless clear explanations can be given for a delay.

On the above evidence it is possible that the new IDOD database was reinventing the wheel, i.e. developing a new inhouse databasing system rather than using already available international standard software and approaches, exactly what the IOC - IODE committee argues against. Off the shelf purpose made software is already available from IOC for the use of NODCs. There is no suggestion in IDOD reports that this software has been utilised.

5.5 Other international affiliations

The ICES has played an important role as a regional data centre. Its Working Group on Marine Data Management (WGMDM) provides a forum for the exchange of expertise and ideas for those involved in marine data management in ICES Member Countries, and is involved in the setting of standards for the quality assurance and exchange of oceanographic data. Despite the fact that, in due course, much of the data received by MUMM is passed on to the ICES data centre it was not until October 2001 that MUMM participated in its first meeting of the ICES WGMDM. A more active role by Belgium in this Working Group should be encouraged in the future, to benefit from the experience of other countries and pass on knowledge gained in the IDOD project to others. In addition, VLIZ hosts the North Sea Benthos Survey database, an activity of the Benthos Ecology Working Group (BEWG) of ICES.

The MUMM also participates in Sea Search (see above), a group of 15 data centres that is promoting the development of standardised procedures within the European Union for all aspects of marine data management and archiving. The VLIZ is not identified as a member of this group although one of its web-based inventories, as indicated above, is advertised on the Sea Search web site.

5.6 Retrospective datamining

Much of the data from earlier BELSPO contracts, other than the latest *SPSD-I*, is in paper or older computerised formats that are no longer accessible and therefore difficult if not impossible to retrieve. The BELSPO through MUMM needs to develop a policy on procedures for the retrospecitive incorporation of data produced in BELSPO projects into the IDOD database in the future. Sizeable funds have been invested by BELSPO in research over the last 30 years. Much data in more recent projects is held on computer discs, which are even more susceptible to loss than paper records. Urgent attention needs to be placed on ensuring that the data from these projects is archived and made available for future researchers

The data from the historical Gilson collection will be made available as a result of a *SPSD-I* feasibility study (Annex 3.5). But the greater part of the data obtained in *Project Sea* and subsequent BELSPO research projects has never been archived in a computerised database and much may now be lost to science, though some may be retrievable from paper records. Some of the databases developed in *Project Sea* were maintained by MUMM after the unit was established and incorporated in 1984 into the ODAS database with the launch of *Belgica*. An inventory of this information should be placed on the MUMM website and a feasibility study initiated to determine what data from old BELSPO projects might be retrospectively archived and how long this might take.

6. CRITICAL ANALYSIS OF THE PROGRAMMES

6.1 Programme development

The launch of *Project Sea* marked a turning point for Belgian marine science. For the first time, research groups across the country were given an incentive and the means to co-operate on a major interdisciplinary undertaking. Some 200 researchers from 40 university laboratories and scientific institutes were involved under the active leadership of J. Nihoul (ULg). All interviews relevant to this period revealed a feeling of the 'good old days', when scientists met, exchanged ideas, built up teams and produced results. A structure was set up to manage the programme according to discipline: mathematics and physics, chemistry, biology, toxicology, sedimentology and geology. Every year, project meetings took place and reports were published; even if much of this was grey literature, results were at least put on paper. In consequence the results of the programme are still available for consultation even if the original data on which they were based no longer exists. In scientific quality, these reports were of the highest international standard and should have been published in prominent literature. Some interdisciplinary cruises were organised on the RV *Mechelen*, an old mine sweeper, and the experience – apart from its immediate benefits in terms of science - proved invaluable for the future design of the RV *Belgica*. A programme symposium was held every year, structured into sessions by sub-groups and plenaries, and *ad hoc* meetings took place within the sub-groups.

By structuring the work around the development of ecological models, Nihoul encouraged all non-physicists (e.g. biologists and chemists) to take a more systematic approach to their descriptions of marine processes. The success of this integration of oceanic research was in part due to the personality of the leading scientist. His modelling approach did not compete with other scientific disciplines, but on the contrary favoured co-operation at a national scale. At the time, competition for BELSPO funds hardly existed. Division of expertise developed instead and laboratories tended to specialise: UGent in benthos, ULg in physical oceanography, ecotoxicology and zooplankton, ULB and VUB in plankton ecology and chemistry. For a new generation of researchers the prospect of developing a career in marine science opened up. Of that generation some researchers have now reached retirement age, others will remain active in science for a few more years. It is understandable that all of them should feel nostalgic about the beginnings of the Programme.

Belgium was almost certainly the first North Sea country to develop such a holistic research programme. The BELSPO was fully behind the programme and thus must be credited with giving at this time a real impetus to Belgian marine science and researchers.

After *Project Sea* came two periods (1977-1981, 1982-1993) of Concerted Research Actions (these and the other Programme phases are presented in Table 3.1). The picture altered dramatically. Government support and funding for research was substantially reduced. This was a time of great change in Belgium involving state reform and reorganisation of authorities towards the Regions and Communities. Government funding in CRAs was also limited to 7 research groups in only 4 universities, compared to 27 research groups in 12 institutes in *Project Sea*. These few universities made the decisions on how the funds received from Government should be allocated to research. As a result, there was no programme structure and minimal co-ordination between research groups was attempted. In effect there was no longer a national marine science research programme. It is therefore not surprising that interdisciplinarity, probably the most positive feature of *Project Sea*, all but disappeared. It

was intended that the CRAs build on the modelling and interdisciplinarity of *Project Sea*, but this never happened. The *CRA* funding did enable a few university groups to continue work on the North Sea and the Scheldt estuary and to collaborate in some international exercises. However, each research group tended to function as an isolated cell. One of the effects of the programme decline was an increased specialisation by laboratories so that some areas of marine science were not addressed anymore and new topics could not be covered.

The total budget when averaged per annum reduced by 22 %; this was the primary reason for the programme decline as well as a lack of communication between laboratories and poor programme management. The situation deteriorated after 1981 due to a further reduction in funding per annum and a focusing on routine measurements for policy purposes. In the meantime, marine stations abroad had started to draw lessons from the innovative aspects of *Project Sea* and to catch up with their Belgian colleagues. One unfortunate result was a braindrain of scientists trained in *Project Sea* to other countries. Furthermore, the scientific productivity from the few universities funded in *CRAs* was not commensurate with the grants received. How these were used and managed was not sufficiently documented. It is also worth noting that Flemish universities received 72 % of the total *CRA* 1981-1993 budget.

A new National funding initiative started in 1991: the *IPMS*. This programme was designed to restore a vision for the study and management of the North Sea, as well as to re-establish Belgian research teams in an international and European context. Other BELSPO Impulse Programmes at this time were 'Global Change', 'Telsat' and 'Antarctica'. Unprecedented opportunities for collaborative work were on offer, but at a price - that of increased competition. Scientists had to apply for support in response to a call for proposals. Much of the relative informality of *Project Sea* got lost in the process and although good science was produced, the drive for interdisciplinarity did not persist at the same level. A new generation of scientists began to emerge, while the overall pattern of teams remained largely unchanged.

With the advent of *SPSD*, the research community was still asked to provide a scientific basis for environmentally sound management, but at a much more official level as the new concept of 'Sustainability' had moved to the fore. While North Sea research survived openly as one of the component programmes of *SPSD-I*, it was embedded in *SPSD-II* within the general heading of 'Global Change, Ecosystems and Biodiversity'. Marine scientists were perplexed by a lack of visibility of North Sea marine studies in the programme structure. It could also be argued that in the conscience of the public 'sustainable development' is not as real as the North Sea, which is a continuing reality for every Belgian citizen

The duality of strategic and targeted projects in *SPSD* was seen by many as having merit because it introduced order to the prioritisation and timing of activities; others were not convinced that the procedure was as clear cut. Whatever co-ordination existed in *SPSD-I* took place within the project networks (not between networks) and the different networks remained uninformed of each other's activities. *SPSD-II* tries to overcome this shortcoming by the grouping of networks within the same domain in so-called clusters.

Not all networks are well balanced in terms of size and commitment of partners. As for the integration of socio-economics in the research process - a fundamental innovation of *SPSD-II* – the extent to which it works remains to be seen, since projects have only just started.

Regionalisation, an inescapable consequence of the Belgian political context, is impacting heavily on some scientific issues, e.g., mitigating coastal eutrophication is a shared

responsibility between national and regional authorities. It is essential that the Flemish and French-speaking Communities have appropriate scientific skills covering such issues as catchment inputs of nutrients to the sea. The new EC Water Framework Directive makes such a requirement mandatory.

In more recent years, the BELSPO has clearly failed to place enough emphasis on bringing research groups together to discuss their findings and to develop future plans. Facilitating co-ordination and utilisation of research findings should be a primary responsibility of the BELSPO. However, research scientists also have a role to play in networking and disseminating their work; their role up to now has been unduly passive. For example, it was not until January 2002 that a national symposium (organised in this case by BELSPO) was held to outline the results of the *SPSD-I* Programme, 6 years after it started. Since the Belgian scientific community is small, everyone knows each other and the temptation is to rely only on informal contacts. This community should have been able to organise symposia or workshops themselves or to stimulate the BELSPO to do so.

The overall quality of science was generally good throughout the duration of all the programmes. It may seem unfair, in 2002, to backtrack as far as the *CRAs* for comments, but the fact is that these Concerted Actions interrupted a flow of research that had developed in a fruitful manner in preceding years. The promoters of the *Impulse Programme* must be praised for attempting to get Belgian Government-funded research back on stream. Since then, and especially with the onset of the *SPSD* programmes, continuity in the planning and scheduling of work can be observed, even taking into account the structural changes introduced in *SPSD-II*. It must be remarked however, that project continuity was achieved only by resorting to the extension of contracts from one phase to the next.

Government funded programmes over the last 30 years have provided major input to international collaborative research and the *SPSD* has opened the programme to fund the participation of European scientists.

Finally, it should be stressed that research institutes and their staff are more than ever in need of a long-term vision for North Sea research in order to develop their strategies. Stability is essential to keep teams together, help researchers establish national and international links and, if possible, limit any brain drain of young or experienced scientists to other countries. One of the interviewed project leaders stated that 'We export competence'. The loss of scientists abroad is clear evidence of high skill and a clear loss to the scientific potential of Belgium.

6.2 Operational management

The main actor in the planning and day-to-day management of Belgian North Sea research is BELSPO. This office is tasked to promote and implement research activities in Belgium as well as internationally. In managing North Sea research, BELSPO liaises with several ministries at Federal, Regional and Community level and acts under the supervision of a Steering Committee.

6.2.1 The role of the Belgian Science Policy (BELSPO)

Acting upon instructions from the then Minister of Science Policy and Programming, the Belgian Science Policy (BELSPO) became involved from the start of *Project Sea* in the planning of North Sea research. The development of the scientific plans for *Project Sea* were

undertaken by J. Nihoul and colleagues. At this time the responsibility of BELSPO was largely administrative, issuing contracts and providing financial support. BELSPO was not represented directly in the project, but was a member of the co-ordination committee of the National R&D programme on the physical and biological environment 'water pollution' to which *Project Sea* belongs. During the *CRA* periods, proposals were submitted by the university institutions and the Council of Ministers approved these and the corresponding budgets. Thus the role of BELSPO diminished, especially as there was no co-ordinating committee.

Since the *IPMS* was organised as a national programme, the role of BELSPO was resumed as a central programme co-ordinator. From that moment BELSPO has followed a well-established pattern of activities. This involved: writing of programme contents, publication and processing of calls for proposals, reporting on the outcome of reviews (for the Steering Committees and subsequently for the Minister of Science), negotiation of research contracts and technical and administrative management of the contracts. It was originally intended that BELSPO should take an active part in the dissemination of project results; this did not happen, apart from organising only a few conferences (Table 3.3). Reporting on Project *Sea* results was extensive in terms of project reports, but in most cases these reports were not widely disseminated. It is even unclear whether these reports and those of subsequent phases were seen by the BELSPO.

In the past, had the Office or a structured Programme never existed, some North Sea research would have been carried out anyway, but in a dispersed mode and with much more limited means. The interviews made with scientists record the strong impulse given to *Project Sea* by the then Director General of BELSPO. Nowadays, the Belgian scientific community takes a positive view of the role that BELSPO plays and they acknowledge the commitment of present-day staff. However, they feel that BELSPO, as mentioned above, could facilitate communication better by bringing *SPSD* networks together. This could be achieved by periodic workshops, providing scientists with feedback on reports as well as disseminating results to the general public, possibly by means of regular newsletters or press releases and special web pages. Although a separate budget exists for research dissemination, this is not constructively utilised. In order to build up the scientific credibility of the BELSPO and to strengthen the communication with the scientific community, the secondment of active scientists is recommended under the condition that vested interests are avoided.

It was noted that programme staff at BELSPO were not optimally informed of the overall context of BELSPO Programmes and related activities. Such a level of internal communication within BELSPO must be a prerequisite for *SPSD-II* and any future programmes where the integration of themes, multidisciplinarity and co-operation of research teams are essential.

In terms of the management of contracts, the system is reported by users to function satisfactorily. Improvements in management procedures are being put in place within BELSPO to cover annual and final reporting and standardisation of contracts. One of the important weaknesses of the programme implementation is the type and quality of information provided in the project reports. A much more rigorous interaction should be established between the research teams and the BELSPO. The structure of this control and the partnership mechanisms could be similar to current practice in the EU and France (CNRS). In the French approach in the evaluation of research laboratories, the participants in a programme make a detailed report of their research achievements including a list of

publications, lectures, posters and invited lectures. They should also provide detailed information on the non-permanent staff employed during the project and their trajectory after the project has finished. A scientific committee, consisting of Belgian scientists and some international experts and with the support and presence of BELSPO, should be set up to evaluate mid-term and final project reports in detail and perform on-site visits in the presence of the scientists involved. In any case, the BELSPO should keep regular contacts with scientists and provide feedback on project reports. The establishment of such a structure would allow the teams involved to have a stronger link with the BELSPO and result in a better scientific validation of the project than currently is the case.

The instructions produced by BELSPO for the drafting of research reports in the *SPSD-I* programme should be revised to take into account the comments in this review. The revision should also distinguish between annual and final contract reports and document the requirements for both. Not enough emphasis is placed in the current instructions on the products of the research, especially publications. Other countries now routinely produce computerised templates for contract reports with associated instructions that can be downloaded from the WWW. We recommend that BELSPO should do the same for future programmes.

Finally, it is important to stress that, depending on project durations, mid-term and *ex post* evaluations should be undertaken as part of the routine project management. A programme evaluation is also needed at the end of each programme, thereby taking into account progress made since previous reviews.

6.2.2 Scientific and political interactions in Belgium

An important issue to raise is the degree to which the major actors in Belgian North Sea research interact. Firstly, there appears to be little interaction between the BELSPO and the Royal Academy of Sciences 'Committee of Oceanology'. One notable illustration of this situation has been the past separate organisation of scientific conferences on Belgian marine matters (see Section 3.7). Of the 6 conferences covering marine research in the last two decades, three were randomly organised by each organisation without any apparent co-ordination.

There are a number of additional bodies providing funds to Belgian marine science, e.g.: Federal and Regional Ministries and other agencies, Community research bodies (FNRS and FWO), the Province of West Flanders, university funding departments (utilising *CRA* and Special Research Funds), and international agencies (e.g. EU). All these actors contribute to the formulation of science policy, but there would appear to be little interfacing with BELSPO in these matters.

Regions have competence over the environment and public works (waterways, harbours, sea protection and navigation buoys). The Federal Government is in charge of research on territorial waters and on the continental shelf. Regions address applied research and Communities fundamental research. The *IPMS* and subsequent programmes addressed both levels of authority simultaneously. For these reasons, after the adoption of the *IPMS* and further to the Special Act on the Reform of Institutions of August 1980 and its modification of August 1988, a co-operation agreement became necessary to formalise the relationship between the Federal authority, the Regions and the Communities.

A special agreement between the State and the Flemish region was signed in 1991 to co-ordinate the *IPMS* and resulted in the organisation of a joint 'Call for Proposals'. The agreement was needed to harmonise the research by both parties and to support the measures which both the Belgian and Flemish governments had to take within the OSPAR framework

6.2.3 The Programme Steering Committees

In the days of *Project Sea*, the Council of Ministers nominated a 'Co-ordination Committee' to supervise the implementation of the National R&D programme on the physical and biological environment: water pollution. Chaired by the President of the Interministerial Commission of Science Policy (BELSPO), its members were representatives of ministries (National Education, Public Health, Agriculture, Economic Affairs) and of BELSPO. Under the *CRAs* scheme, co-ordination -or what survived of it- was performed by a Scientific Committee of promoters (team leaders) in universities, which met upon its own initiative or at the request of BELSPO. A steering committee chaired by BELSPO was re-established from the *IPMS* onwards.

The organisations represented on the Programme Steering Committee (PSC) of the various North Sea programmes are given in Table 6.1. *SPSD-I* was structured vertically per programme, each with a separate Steering Committee and one overall Plenary Committee. In *SPSD-II*, the number of Steering Committees was reduced to one overall and two thematic committees. All Steering Committees were mandated in principle to give advice on and monitor the Programmes. They were supposed to link science and policy, give an opinion on project selection, make suggestions on programme objectives, co-ordinate input from Communities, Regions and the State, harmonise distribution of funds between various types of institutes, and make available the results to the public. Project selection is to a certain extent constrained by existing rigidities of the Belgian system, namely during the project calibration that ensures a balance between Flemish and French-speaking institutes. One might expect such a Committee to commission mid-term or *ex post* evaluations of research projects, but this has not happened yet. In practice, to the Panel's surprise, there seems to exist no clear written rules to guide the work of the different committees, nor to avoid the presence of vested interests. Furthermore, membership does not include independent active scientists and this limitation cannot but restrict the Committee's effectiveness. Universities are uneasy over the fact that MUMM has been and is still represented on the PSC although a candidate for BELSPO support in a number of research programmes. The Panel shares this feeling. A similar concern applies to VLIZ that has recently become a member of the PSC.

6.2.4 The Project User Groups

Project User Groups (PUGs) were introduced for the first time in *SPSD-I*, although at the time not for the North Sea programme. For each project, a group of potential users was selected to monitor the research and promote the exploitation of the resulting products. The groups comprised representatives of national and foreign governments, universities, research institutes, industry and NGOs. Their aim is to make sure that the projects are correctly positioned in the current context of science, politics, economics, social sciences, institutions, and environmental concerns, and to actively assist in the transfer of results for appropriate exploitation. They certainly have the potential to bring many benefits to the Programmes under the condition that an appropriate mechanism is established to communicate their findings and recommendations.

For North Sea research, PUGs were only introduced under *SPSD-II*. It is questionable whether the present membership is adequate to ensure the utilisation of results by the sectors and activities listed above. Furthermore, cases of double membership - Steering Committee and

User Group - do exist, but this situation should be avoided because of the risk of vested interest.

Table 6.1 Members of the Steering Committees in the North Sea Programmes

Members' organisations	Phases [1]					
	1	2	3	4	5	6
Federal State	♦	♦	♦	♦	♦	♦
Ministry of Small Enterprises, Traders and Agriculture (represented by a public research institute, i.e. Sea Fisheries Department – regionalised since 2002 - or Institute for Chemical Research)	♦	♦	♦	♦	♦	♦
Ministry of Economic Affairs	♦				♦	♦
Ministry of Finance						♦
Ministry of Foreign Affairs						♦
Ministry of National Defence	♦					
Ministry of National Education	♦					
Ministry of Social Affairs, Health and the Environment						♦
BELSPO	♦	♦	♦	♦	♦	♦
Federal Planning Bureau						♦
MUMM	♦			♦	♦	♦
ERM / KMS (Royal Military School)	♦					
Flemish Community				♦	♦	♦
Administration of Environmental, Nature, Land and Water Management					♦	♦
Administration of Foreign Policy						♦
Department of Science, Innovation and Media				♦	♦	♦
Department of General Affairs and Finances						♦
VLIZ						♦
French Community and Walloon Region				♦	♦	♦
Directorate General of Natural Resources and the Environment					♦	♦
Directorate General of Technology, Research and Energie					♦	♦
Directorate General for non-compulsory Education and Scientific Research)						♦
Ministry of Small Enterprises, Traders and Agriculture (represented by a public research institute, i.e. Agricultural Research Centre Gembloux) – regionalised since 2002						♦
Brussels Region				♦		♦
IBGE / BIM (Brussels Institute for Environmental Management)				♦		♦
NGO's and SMEs				♦		
BBL (Federation Better Environment Flanders)				♦		
ECOLAS (Environmental Consultancy and Assistance n.v.)				♦		
Greenpeace				♦		
Number of representatives	***17***			***12***	***11***	***26***

[1] Phases: 1 = Co-ordination Committee of the national R&D programme on *water pollution*
2 = *CRA* '*Oceanology*'
3 = other *CRA*
4 = Impulse Programme '*Marine Sciences*'
5 = SPSD-I: '*Sustainable management of the North Sea*'
6 = SPSD-II '*Global change, ecosystems and biodiversity*'

6.3 Programme dynamics

The purpose of this section is to present the evolution of financial budgets, grants and research teams broken down by the six programme phases, including the transformation between the phases. The various illustrations clearly show the dynamics throughout the phases. The respective analyses try to qualify and quantify the various issues brought to the attention of the reader.

6.3.1 Variations in programme budget

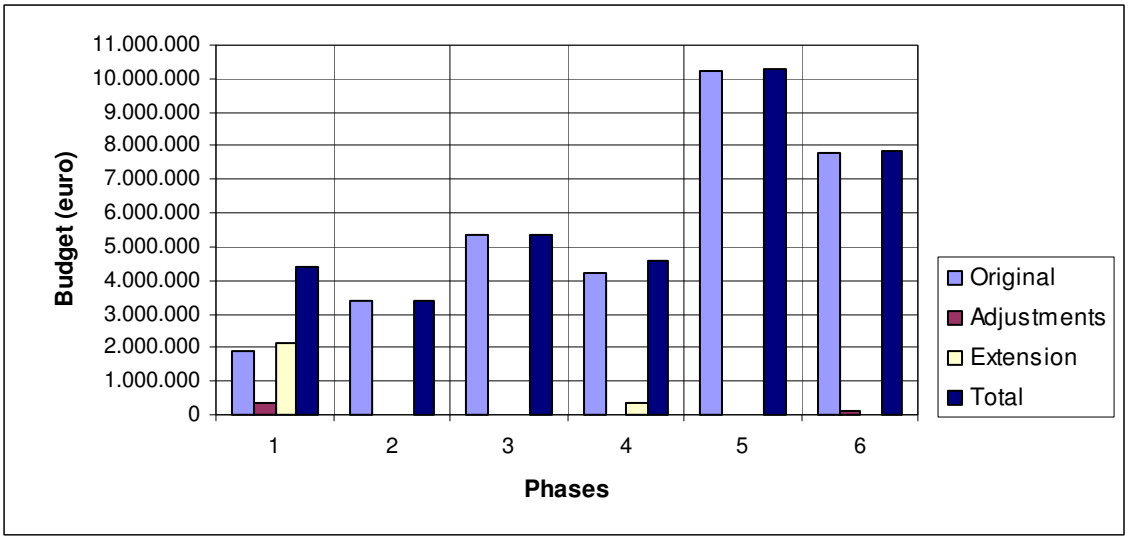


Figure 6.1 Programme budget per contractual period

Figure 6.1 shows a large variation in total budgets per programme. The end of Phase 1 shows a substantial budget increase of 57 % in comparison with the start of the projects: some adjustments (7.8 %) were made during the original project duration as a result of salary reassessments in the public sector and extra tasks for some contracts. At the end of the original contract duration, two extensions were granted that accounted for 49.2 % of the total grants: An extension of two years for almost all contracts was needed for the completion of the mathematical models and for further studies on toxic pollutants. A second extension of nine months for some teams was used to bridge a gap in order to keep a minimum research potential functioning to run the models whilst awaiting the decision of the Government on the final project report and to enable Belgian participation in international activities. Contractual changes reappeared in Phase 4 with a financed extension for all contracts (8.3 % of total grants) in order to guarantee a continuity of this Phase into the following one. Phase 5 extended ten projects, but only provided additional modest financing to one (0.3 % of total grants). Phase 6 adjusted three projects to enable them to form clusters with other projects by providing additional financial support equal to 1.1 % of the total grants.

In the submissions from universities, there was a gap between 1981 and the start of the subsequent *CRA* period in 1983. Furthermore, the opportunity to apply for marine science funds was not offered every year. In consequence, there may have been a sizeable interannual variation in the funding to universities.

In Figure 6.2, the variation in programme budgets is shown again together with the distribution per programme year. The *CRA* period marked a steady decrease of budget provisions. With an annual programme budget of 0.73 M Euro for Phase 1, Phases 2 and 3 provided 0.57 and 0.46 M Euro only. With the re-appearance of an organised programme, the amounts sharply increased from Phases 4 to 6 to respectively 0.98, 1.49, and 1.82 M Euro. A substantial increase in the programme budget was seen with the start of *SPSD* where Phase 5 has spent 10.28 M Euro. Phase 6 is projected to maintain a similar level of funding (at present, there is still one Call to go).

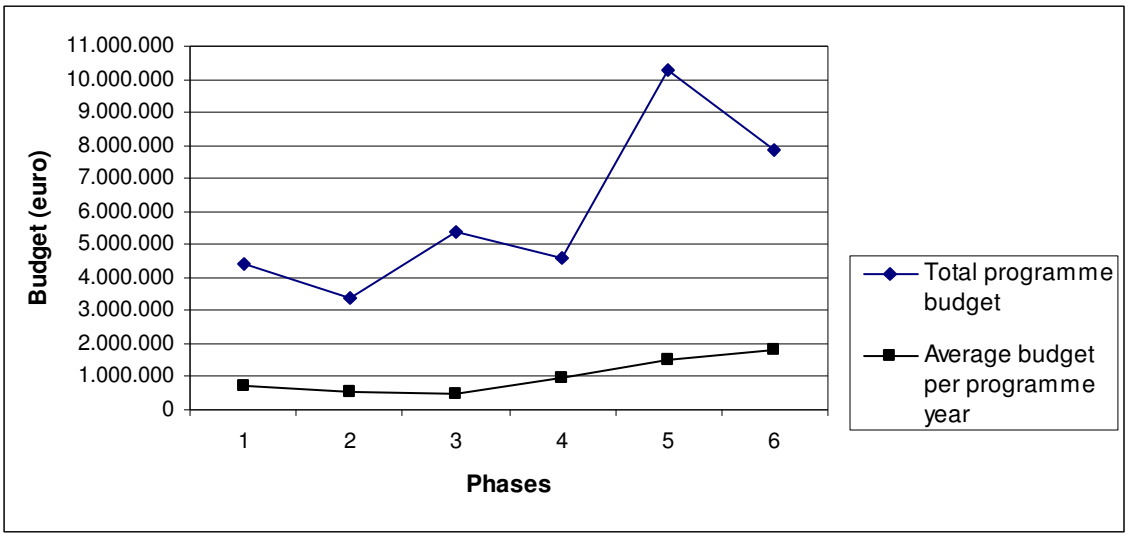


Figure 6.2 Programme budget per phase and per year

The large variation in programme budgets per phase and per year is a result of the evolution of research policy in Belgium. The national R&D Programme of Phase 1 was not continued and Concerted Research Actions for individual teams were the only financial source available to execute North Sea research. With the transfer of authorities to the Communities, the *CRA*'s were totally managed by them in Phase 3. On the re-introduction of a national programme, the *IPMS* was intended to boost scientific activities in this area and not just to maintain them. The umbrella programme *SPSD* gave marine science an appropriate emphasis with a variety of thematic priorities that can be modified during the course of each phase.

6.3.2 Contract organisation and institutional involvement

It was common that the ***durations*** of original programme phases were extended into the following ones (Table 6.3). In Phase I, two extensions in time were given on the initiative of the government including some extra financing. Such top-down mechanism was replaced by a bottom-up mechanism in later phases where requests came from scientists and extensions did not include extra financing anymore.

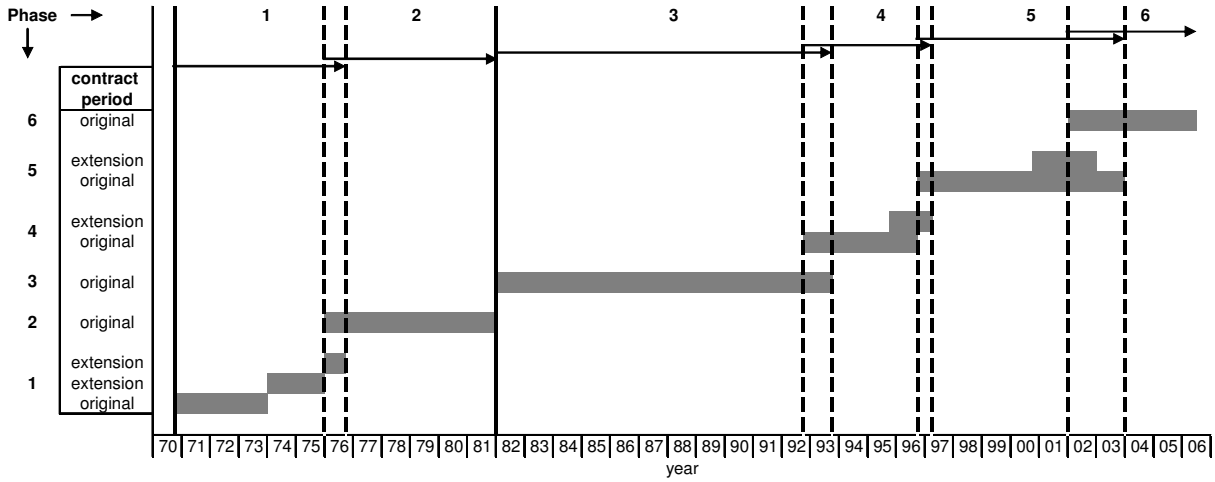


Figure 6.3 Contract periods

Apart from the *CRA* Phases, non-funded extensions of contracts were, upon request from the research teams, normally applied and allowed teams to enter a new Phase without a considerable gap in time. This can be seen in the overlap between the Phases (Fig. 6.3). The teams justified this mechanism of administrative extensions in order to keep research staff on the payroll of the institute / project and to include them in a new phase in case a contract was granted. Although the flexibility of the BELSPO with respect to contract management is welcomed in such cases, it places undue strain on the hosting institutions who have to cover project-related costs during this time.

From the 21 teams that entered *Project Sea* (Figure 6.4 and Table 6.2), 7 continued in Phase 2 (6 of them 10 months prior to the finalisation of their work in Phase 1; 1 contract 3 months later). In Phase 3, 5 teams continued that were active in Phase 2 (1 continued without an interval; 4 had a time interval of 1-1.5 years). In the transition from Phase 3 to 4, 4 teams continued, but with time intervals of 2.5-6.5 years. The transitions from Phase 2 to 3 and Phase 3 to 4 are clearly discontinuous. The first out of the five Calls of Phase 5 starts with 18 teams: 10 continued from the previous phase with a time overlap of 3 months, 2 teams did re-appear and 6 new teams enter (including MUMM). In the remaining Calls, 10 of the teams active in the first Call re-appear whereby they execute several projects at the same time during periods of many years. Even within 1 Call, teams can be active in various projects. The first out of two Calls of Phase 6 resulted in 16 teams (out of 21) continuing from the previous Phase: 1 team has a time gap of 5 month, 1 has no time interval, other teams have time overlaps of 1-22 months. Phase 5 teams that wished to continue in Phase 6 received an 1-12 months administrative extension in order to keep their personnel working on the grants.

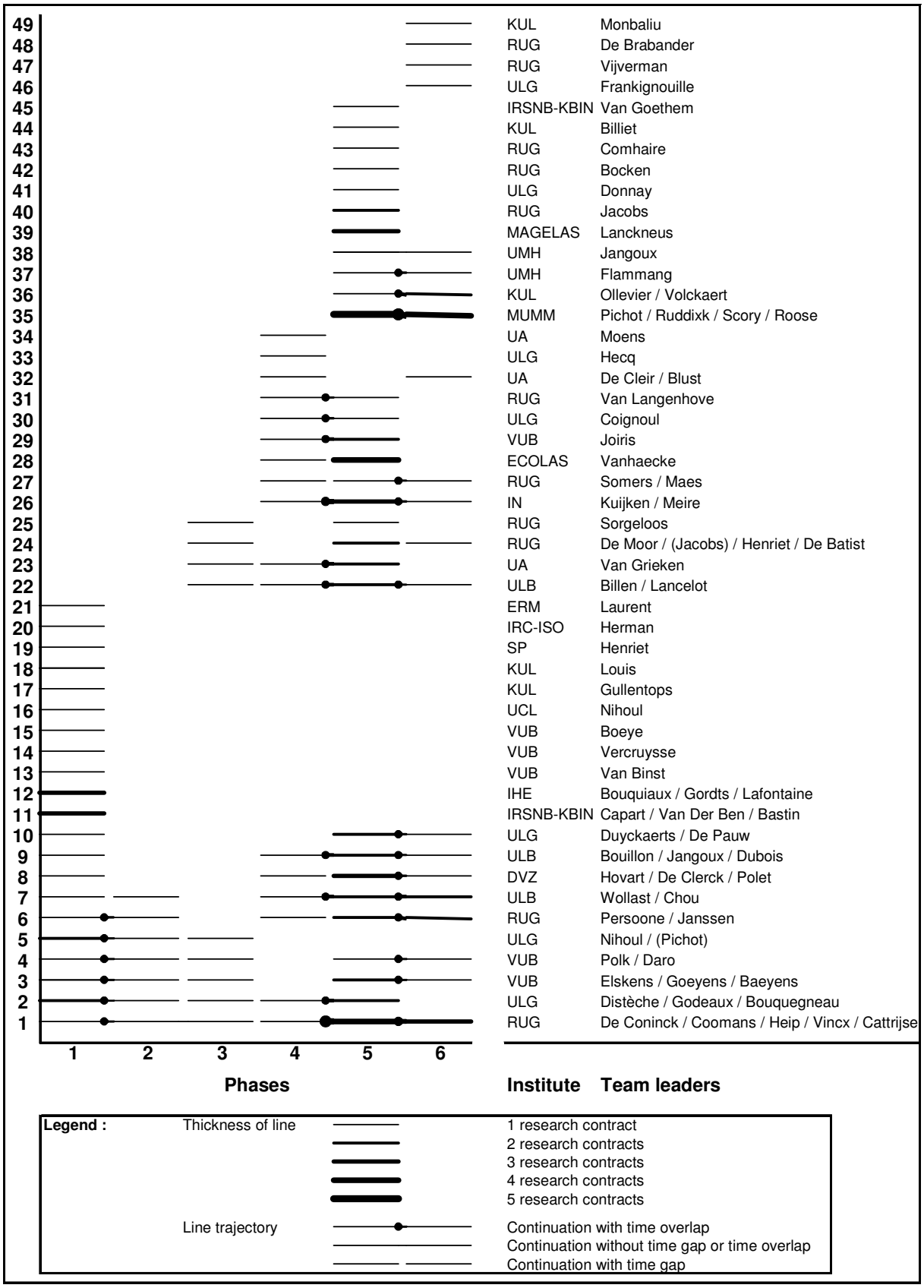


Figure 6.4 Involvement of research teams since 1970.

Although the contracts in Phase 6 were sent out in August-September 2002, all were given February 2002 as a start in order to harmonise the contracts of Part II of *SPSD-II*. The proposal evaluation took more time than anticipated and the grantees were slow to complete their Technical Annexes. Aware of the resulting backlog, BELSPO retro-actively made the contracts start in February, thereby also simultaneously extending all contracts by 3 months.

Table 6.2 Organisation of projects

Organisation of projects	Phases						Total
	1	2	3	4	5	6	
Number of projects:							
- single team projects			5	10	4		19
- networking projects:	1	1	2	3	16	8	31
of 2 teams				2	2	3	7
of 3 teams					1	7	3	11
of 4 teams						4	1	5
of 5 teams						2	4	6
of 7 teams			1					1
of 20 teams	1							1
- total	1	1	7	13	20	8	50
Participation of teams:							
- new	21		4	9	11	4	49
- abandoning		14	2	5	3	14	38
- re-appearing after absence in previous Phase(s)				4	5	1	10
- total	21	7	9	17	30	21	105
Continuity in presence of teams:							
- with time overlap		6			10	14	30
- without time overlap or time gap			1			1	2
- with time gap		1	4	4	4	1	14
- total		7	5	4	14	16	46
Teams appearing in more contracts:							
- in 2 contracts	1		1		11	3	16
- in 3 contracts	3				3	1	7
- in 4 contracts					2	1	3
- in 5 contracts					1		1
- total	4		1		17	5	27

Phase 1 can be considered as one large networking project (Table 6.2) with contributions from all 21 teams. The formation of networking projects became clearly apparent as of Phase 5. In 50 % of the networks, the disciplines were distributed among marine biologists and chemists. The other 50 % were made up of interdisciplinary consortia including biology, chemistry, data management, geology, hydraulics, law and strategic evaluation. This Phase was also characterised by a large number of Calls (5) and by more than half of the teams having more than 1 contract.

Table 6.3 Administrative origin of the research teams active in North Sea research

Institutional participation	Phases						Total	
	1	2	3	4	5	6	no.	%
Number of teams	21	7	9	17	30	21	49	100
Institutional and geographical origen:								
- university:	15	7	9	14	24	18	38	78
Dutch-speaking	9	4	6	8	15	11	25	51
French speaking	6	3	3	6	9	7	13	27
- public research institute:	6			2	4	3	9	18
Federal	6			1	3	1	8	16
Flemish				1	1	2	1	2
Walloon							0	0
- private research institute:				1	2		2	4
Flemish				1	2		2	4
Walloon							0	0

Note: Since January 2002, DVZ was transformed from a Federal to a Flemish public research institute. In the above table, it is still presented as a Federal institute in the 'Total' column.

Excluding the *CRA* periods that were solely destined for universities, the dominant presence of research teams in North Sea research is from universities with a 78 % participation (46 % Flemish-speaking Community, 32 % French-speaking Community). Public research institutes were strongly present in Phase 1 with 29 %, but with the re-introduction of a federal research programme in Phase 4, their participation was reduced to 13 %. Private research institutes were introduced as of Phase 4 with a participation of 6-7 %. Since 1970, the average participation of all teams from universities, public and private research institutes has been 78, 18 and 4 %. On the whole, the high number of Flemish-speaking teams (57 %), followed by French-speaking teams (27 %) and federal research teams (16 %) is proportionate to the scientific expertise at a Belgian level. It is clear that the largest group is from Flemish-speaking teams since the whole Belgian coastline falls within the region of Flanders. The reduction in federal research teams can be explained by a further specialisation of the institutes concerned. Since Phase 4, only DVZ, MUMM and RBINS have been active. With MUMM becoming a new department of RBINS in 1997, it remains the main federal partner for North Sea research. As part of the reform of federal public institutes in Belgium, DVZ was transferred to the Flemish Community in January 2002 and forms together with IN the two Flemish public research institutes. Remarkable is the absence of any Walloon public research institute.

Further details are given in Annex 6.1 where it can be seen that the majority of the research teams are from UGent (22 %), ULg (14 %), VUB (12 %); KULeuven (10 %); ULB (6 %) and UA (6 %). All other institutes that deploy research teams for North Sea research are below 5 %.

The ***intensity of participation***, i.e. teams taking part in more than one project per phase, shows a similar pattern of distribution to the number of participating teams discussed above. Details are given in the Table below.

Table 6.4 Institutional involvement in North Sea research contracts

Institutional involvement in contracts	Phases 1	2	3	4	5	6	Total no.	%
Institutional and geographical origen:								
- university:	17	7	8	14	38	23	107	73,8
Dutch-speaking	9	4	6	8	24	15	66	45,5
French speaking	8	3	3	6	14	8	41	28,3
- public research institute:	10			2	12	6	30	20,7
Federal	10			1	9	4	24	16,6
Flemish				1	3	2	6	4,1
Walloon							0	0,0
- private research institute:				1	7		8	5,5
Flemish				1	7		8	5,5
Walloon							0	0,0
Total number of contracts	27	7	8	17	57	29	145	100,0

Note: Since January 2002, DVZ was transformed from a Federal to a Flemish public research institute. In the above table, it is still presented as a Federal institute in the 'Total' column.

A pronounced difference can be seen between the number of active teams and the number of contracts executed for both public and private research institutes. Their share of participation is higher than the number of teams they deploy which can be attributed to their involvement in various projects per phase.

Annex 6.2 shows further details where it can be seen that the research teams most frequently participating are from UGent (24 %), ULg (13 %), ULB (12 %) and VUB (12 %). MUMM follows with 6 %. Teams from other institutes involved in North Sea research are below 5 %.

In terms of ***contract grants received per institute*** (Annex 6.3), the universities received 85 % of the total, varying between 76 and 87 % (disregarding the *CRA* periods): 52 % for the Flemish-speaking teams (varying between 34 and 53 %), 34 % for the French-speaking teams (varying between 29 and 47 %). Only in Phase 1 did the French-speaking universities receive a higher amount than their Flemish-speaking colleagues (47 % over 34 %). Public research institutes accounted for 13 % of all grants: 10 % for Federal and 3 % for Flemish teams. Private research institutes only made up 1 % of the research grants. The institutes that received most of the grants are from UGent (28 %), ULB (17 %), ULg (14 %) and VUB (14 %). MUMM and UA follow with 6 %. All other institutes obtained less than 5 % of all grants provided so far.

When grouping all the institutes together, as presented in Figure 6.5, it can be seen that average grant incomes for the institutes during the CRA periods showed a large increase in comparison with *Project Sea* with increments between Phase 1 to 2 and Phase 2 to 3 of 133 % and 29 % respectively. The subsequent periods show a considerable variation with a reduction from Phase 3 to 4 of 46 %, an increase from Phase 4 to 5 of 38 % and a reduction from Phase 5 to 6 of 23 %. Per programme year, the extremes are less pronounced, but the variations in between the Phases 1 to 6 are still remarkable with + 95 %, + 35 %, - 33 %, + 71 % and + 38 % respectively. The averages of the current phase are 8-9 % lower than the average over all phases together.

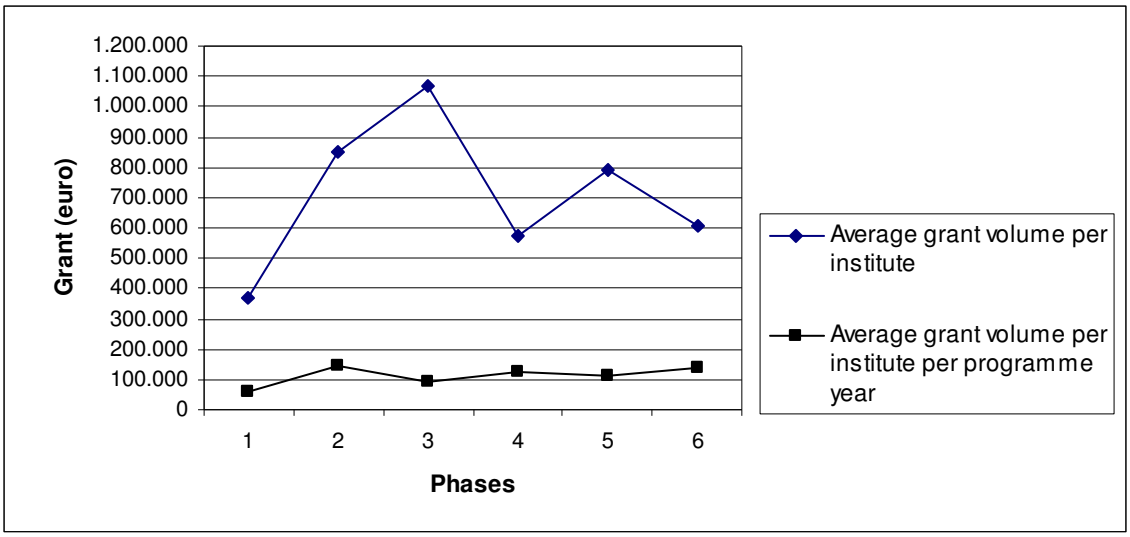


Figure 6.5 Average institutional grant income per phase

Average team grants for *CRA* were much higher than for *Project Sea* with increments between Phase 1 to 2 and Phase 2 to 3 of 199 % and 37 % respectively (Figure 6.6). The subsequent periods show a considerable variation with a reduction from Phase 3 to 4 and Phase 4 to 5 of 60 % and 33 %. Phase 6 appears to go against this trend with an increase of 28 %. Within this current Phase, there is also a difference between projects classified as targeted and strategic research where the latter have larger grants because the research period is longer.

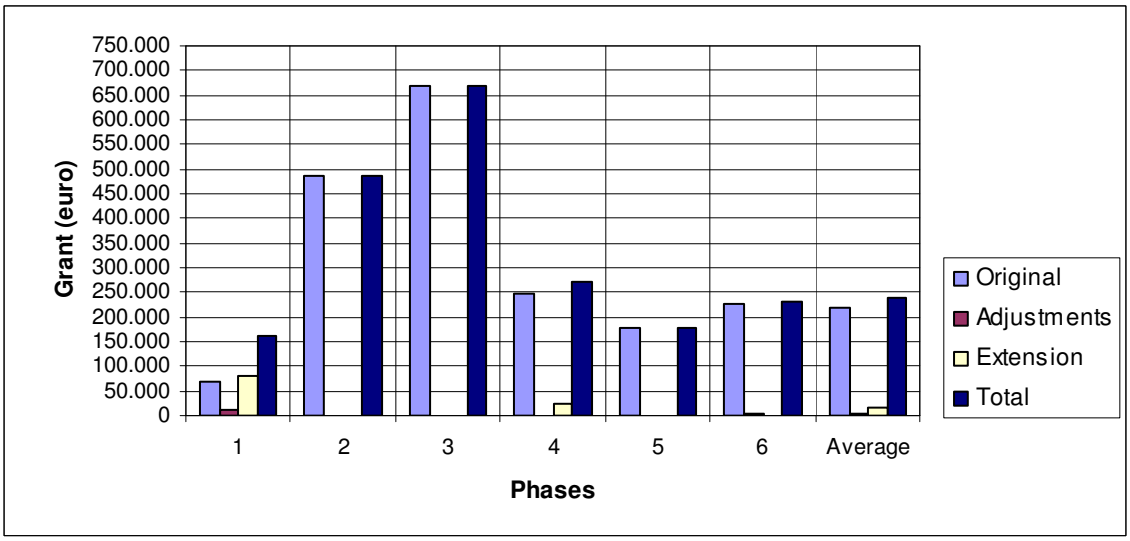


Figure 6.6 Average team grants per contractual period

Because the programme period durations differ per phase, the above differences become less pronounced when the grants are viewed per contractual year (Figure 6.7). A similar trend of variations can be observed in Figure 6.5 with variations per contractual year in between the Phases 1 to 6 of + 150 %, + 48 %, - 49 %, - 17 % and + 5 % respectively. The average of the

current phase also represents approximately the average over all phases together. In comparison with other countries, the research team grants are significant and allow teams to structure themselves. This financial structure should be preserved so that Belgian research infrastructure does not get diluted in the future in large European projects.

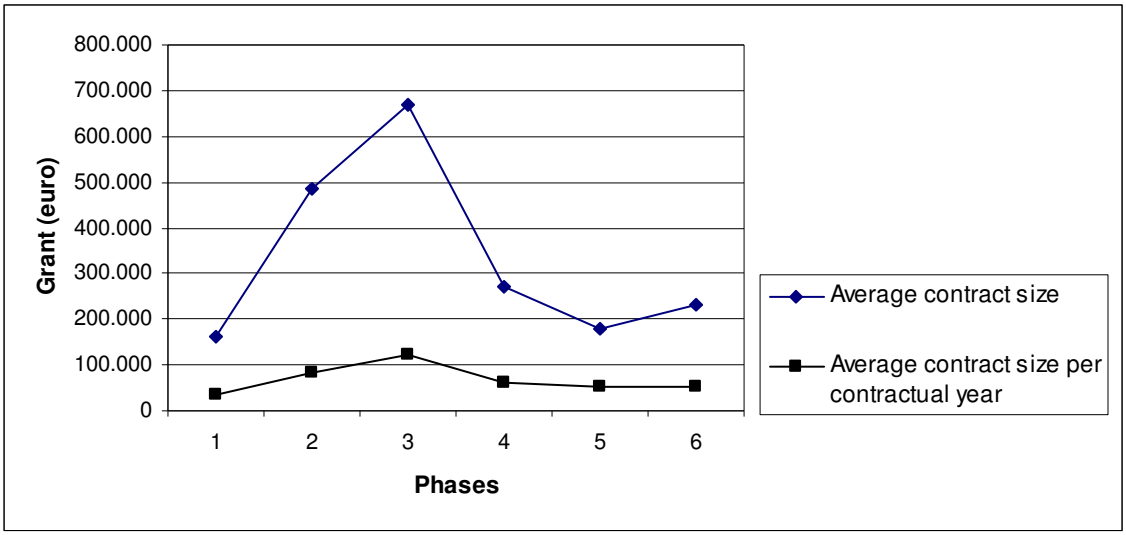


Figure 6.7 Average contract size per phase

An important issue in the North Sea and other programmes of the BELSPO is the promotion of multidisciplinarity and networking between teams. In Figure 6.8, extensive ***networking*** can be observed in *Project Sea* and *SPSD*. The trend for networking after a drop in the *CRA* and *IPMS* periods was resumed in *SPSD*. Although one more Call has to come in Phase 6, the total number of contracts is expected to be less than in Phase 5.

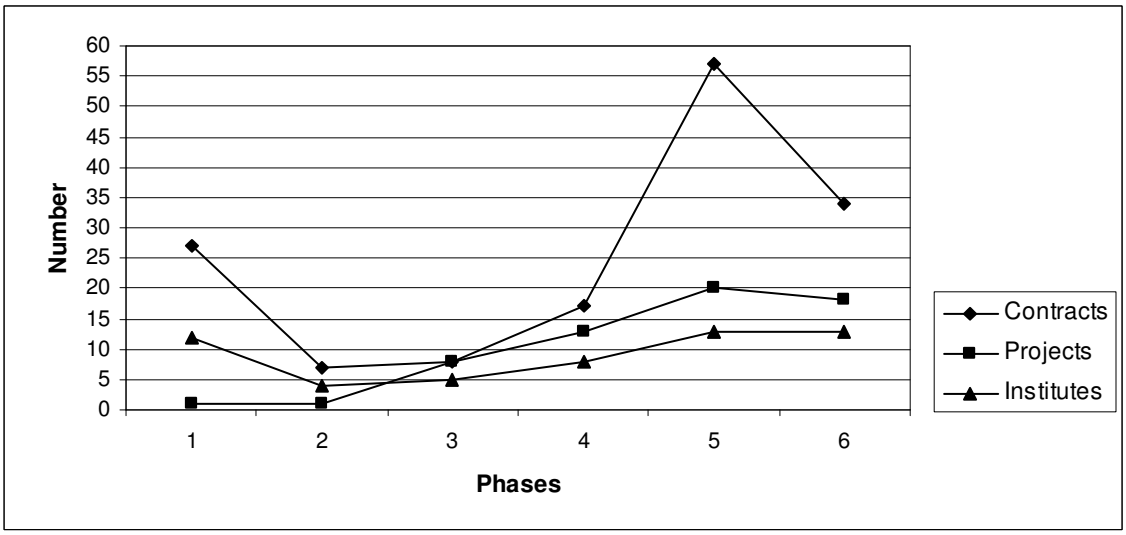


Figure 6.8 Number of projects in relation to contracts and institutes involved

6.4 Summarising

BELSPO-funded research on the North Sea began more than 30 years ago. Over such a long period, it was inevitable that the level and form of government support to marine research should fluctuate, reflecting changing patterns of national and international priorities. After a solid start from 1970 to 1976, followed by 15 years of relative but deepening withdrawal in the *CRAs*, the move forward was resumed with *IPMS* and confirmed, under another form, in *SPSD-I*; with the on-going *SPSD-II*, one notes however a certain loss of visibility of North Sea research in the programme structure. A detailed statistical analysis has been given on the spending and utilisation of funds. In terms of finances, the most encouraging feature is a pronounced increase in the global budget for North Sea research in *SPSD-I*. From *IPMS* onwards, the number of teams has increased steadily, with a strong move towards networking in *SPSD*. It must be said however that despite the existence of these networks, researchers still do not appear to interact sufficiently, nor are they offered enough opportunities to do so in the form of BELSPO-sponsored meetings. However, researchers should themselves communicate more pro-actively with the BELSPO, policy actors and the general public.

The BELSPO programme management performance has been adequate on the whole, although less in the project reporting policy and dissemination of results. Improvements are needed in the functioning of the Programme Steering Committee. The level of scientific and political interaction between BELSPO and other players on the Belgian scene (Royal Academy, public funding agencies, etc.) is not optimal. This deficiency has among other negative consequences of precluding any long-term vision for Belgian marine research. Such a vision is needed to help research institutions plan their strategies, stabilise their staff and, ultimately, prevent an excessive brain drain of bright young scientists to other countries.

7. SUMMING UP STRENGTHS AND WEAKNESSES

STRENGTHS

Science policy

- Significant political, financial and moral investment in marine science by means of research programmes and support to infrastructure.
- Strong initial impulse given by BELSPO (*Project Sea*) and a further one for *IPMS*.
- Scientific backing for Belgium's international commitments: OSPAR, ICES, North Sea Ministerial Conferences, EU directives.
- Ability to adapt to major international trends: *Project Sea* as a response to emerging concerns about the environment; the *Impulse Programme Marine Sciences* conceived partly as a national companion to the EC STEP and MAST programmes; the *SPSD* as a response to Rio 1992.
- Introduction of interdisciplinarity in Belgian marine science; extending this approach in *SPSD-II* by aiming to integrate natural and socio-economic sciences.
- Organisation of the Belgian biodiversity platform: interaction between researchers, policy-makers, field actors and NGO's and to promote national and international exchange of information.
- Significant level of grants for the research teams (in comparison with other European countries).

Visibility of Belgian North Sea research

- Clear identification of the North Sea as a stand-alone programme in Project Sea, Impulse Programme Marine Sciences (IPMS), Scientific Support Plan for a Policy on Sustainable Development Phase I (SPSD-I)of .
- Creation of MUMM and its central role in ensuring the commitment of Belgium to North Sea monitoring and management in national and international fora.
- Wide international recognition of some research results, e.g., the North Sea models and holistic approach developed in Project Sea.

Scientific quality, applicability of results

- Internationally recognised quality of much of the research. Especially strong performance on the following topics: development of models, integrated physical/ecological modelling, eutrophication and algal blooms, cycling of organic matter, ecology of macro- and meiobenthos, sediment dynamics and offshore geology of the continental shelf, hydrodynamics.
- Important practical and economic value of modelling, especially in the fields of storm surge and tidal prediction, water quality.
- Development of other models to identify, prioritise and implement research needs in thematic research (e.g. MIRO which addresses eutrophication).
- Focusing of targeted projects in SPSD-I on short-term practical issues.

Communication of project output

- Comprehensive and adequate production of reports for Project Sea contracts.
- Some outstanding publications in international peer-reviewed journals
- Special publications by BELSPO of some project results.

- Contribution to the OSPAR Quality Status Report 2000: a specific Belgian responsibility for the drafting of the chapter on Chemistry.
- Assisting in the drafting of legal texts for the 'The Law on the Maritime Environment' (published as a book in1999).

Creating the conditions for partnerships at Federal/Regional and international levels

- Forging interuniversity links, networking of universities and public research institutes all over the country.
- Creation of Project User Groups (PUG) in SPSD.
- Stimulating and financing foreign participation in Belgian networks.
- Enabling Belgian participation in collaborative projects with other North Sea countries, e.g. through EC Programmes (Environment, Marine Science and Technology).

Spin-off in research infrastructure

- Creation of a specific institute focusing on research and monitoring with a special emphasis on modelling.
- Representation in international conventions dealing with the North Sea, the North East Atlantic and the global oceans (MUMM).
- Catalyst for the creation of a Flemish institute for infrastructural support of marine research (VLIZ).
- Since 1997: development of a standard marine environmental database for data obtained from routine monitoring, field and laboratory research.
- Making the case for the essential need of an oceanographic research vessel (Belgica) and subsequently co-ordinating the construction and maintenance.

WEAKNESSES

Science policy

- Discontinuity in political commitment, priority setting and funding throughout the phases, resulting in a 'stop go' situation.
- Limited interaction of science and policy.
- Little clear evidence that project results have served to support Belgian management decisions on the North Sea.
- Newly developed models have not been used in the development of Belgium's eutrophication policy within OSPAR.
- Poorly defined integration of scientific disciplines and methods into a national monitoring strategy to evaluate the long-term health of the North Sea.
- Lack of a national strategy to prevent a brain drain of skilled scientists abroad.

Visibility

- Poor identification of North Sea research in the structure of *CRAs* and *SPSD-II (*In *SPSD-II*, visibility is only at the level of Calls for Proposals).
- Generally, with a number of important exceptions, a poor publication rate in internationally peer-reviewed journals.
- Limited visibility of scientific output and presentation of the relevance of research to society.
- Loss of innovation and therefore of pertinence in some sectors of marine analytical chemistry.

National collaboration

- Minimal interaction between Belgian public authorities in the research and management of the North Sea.
- Weak performance of the Programme Steering Committee in this respect and lack of interdepartmental consultations.
- Little interfacing in the formulation of science policy and exchange of information between BELSPO and other bodies that provide funds for Belgian marine science (Ministries, FNRS/FWO, ...).
- Absence of key sectors of economic activity in Project User Groups (PUG), as well as a lack of diversity of membership.
- Poor interaction between BELSPO and the Royal Belgian Academy of Sciences.
- Unclear division of responsibilities between MUMM and VLIZ on data banking and data management.
- Limited interest of scientists to develop collaboration or communication between research networks in *SPSD* (meetings or other initiatives).
- Lack of periodic BELSPO-sponsored workshops allowing for exchange of ideas and results.
- Clear problems in obtaining datasets on a national scale on key issues such as inputs of nutrients.

Project output and international impact

- Uuneven quality of project reporting in some phases.
- No known access to project reports for public consultation at the Royal Library of Belgium (protocol).

- Lack of a national archiving system in place for long-term storage and curation of biological and geological specimens and samples.
- Much funded research does not appear to have been published in peer-reviewed journals, but only in grey literature.
- International impact weaker than expected as publication record in peer-reviewed journals, apart from some brilliant exceptions, is low.
- Long delay by MUMM in setting up an integrated database system to collect data produced in Belgian national programmes.
- Lack of integration and valorisation of results.
- Few spin-off initiatives over 30 years of research.

Programme administration

- Need to resort to contract extensions to avoid gaps between phases has become the norm of programmes.
- Unclear and limited involvement of the Programme Steering Committee (PSC)
  Lack of involvement of active scientists to support the PSC.
- Calls for proposals too fragmented in *SPSD-I*.
- Weak interaction between BELSPO and the funded project teams.
- Vested interest of institutes that are at the same time participants in projects and/or members of the PUG and members of the PSC.
- Weak internal communication within BELSPO.
- No evaluation of contracts (apart from *IPMS*) and programmes until this 30-year review.

8. FUTURE PROSPECTS FOR BELGIAN MARINE RESEARCH

8.1 A continuing need for marine research in Belgium

Since the launch of *Project Sea* in 1970, Belgium has made a significant political, financial and moral investment in marine science, by means of research programmes and support for infrastructure. While this effort has understandably been focused primarily on the North Sea, it has extended beyond in response to political commitments and opportunities for international co-operation, the most notable illustrations being of course the sequence of Belgian Antarctic programmes inaugurated in 1985 [19] and the participation in EU programmes. The investment in marine sciences must be maintained and regularly adapted to an evolving situation. A lesson can be drawn from the *CRA* periods: a decline and discontinuity in research activities quickly follows a drop in the commitment of central government. Subsequent recovery as evidenced in the *IPMS* requires strong leadership and support from policy makers.

There are compelling reasons for keeping marine research alive in the country. The North Sea and its coastal zone, as for most other coastal areas of the world, will see an increase in anthropogenic pressures and will be subject to, largely unknown, impacts as a result of climate change in the next few decades. A continuous and integrated monitoring strategy to assess these changes is therefore essential. Because of the scale of the work involved, collaboration with other adjacent European countries will be essential.

As a maritime state bordering one of the most heavily used and exploited seas in the world, Belgium shares a number of obligations with other riparian countries, mostly within the frame of OSPAR, North Sea Ministerial Conferences, ICES and IOC. Updating the North Sea Quality Status Report (latest edition: 2000) is a continuous effort in which Belgium is committed to take part. The collection of environmental data from governmental and non-governmental sources needs to be harmonised to ensure compatibility between countries and quick access to validated data. In addition, important research has been initiated at a European scale, bilaterally or within the successive EUs Framework Programmes, to understand the ecology, health and dynamics of the North Sea. The effort is continuing – subject to periodic adaptations - and Belgium must continue to take its share of collaborative action. It is in the interest of Belgium, and of as many project groups as possible, to be active participants in the new European Research Area (ERA), a concept – and hopefully soon a reality through the 6th Framework Programme - that is ideally suited to marine research. A major element of the rationale behind the ERA is the concept of networking and centres of excellence.

Belgium also participated in the EC demonstration programme on Integrated Coastal Zone Management (ICZM) which ran between 1996 and 1999 with the support of the EC TERRA and LIFE funding instruments. One of the overall recommendations of this programme was the promotion of a collaborative approach to the planning and management of the coastal zone. This is to be achieved through partnerships at all levels of society and it is clear that science should continue to underpin these activities.

Clearly a substantial part of the Belgian effort must remain national. A research programme organised at the federal level is essential to link disparate research groups in the country, support centres of excellence, facilitate co-operation, maintain the international commitments of the Belgian government, and develop a strong focus for international co-operation. For

[19] See evaluation report of the BELSPO *Belgian Antarctic Programme 1985-2002*

example, the study of eutrophication and some of its effects such as harmful algal blooms is a problem that concerns all countries bordering the North Sea: it requires these countries to join in common research initiatives and this has indeed already taken place with Belgian participation in EU projects [20]. This is a good example of cross-fertilisation where Belgian science is recognised as of high quality.

8.2 The scope of future Belgian marine research

The North Sea communicates with the world ocean over the NE European continental margin. Natural processes in this sea are strongly influenced by North Atlantic climate and oceanography, and by exchanges of water masses and substances across the edge of the continental shelf. In recent years, Belgian science has been at the forefront in the study of cross-shelf exchanges. OMEX (Ocean Margin Exchange [21]), one of the largest European projects ever, was led from Belgium. Therefore a federal marine research programme, while continuing to target primarily the North Sea, must, as it does at present, include adjacent seas, i.e. essentially the Channel and the NE Atlantic. It should also make provision for activities elsewhere in the world.

At the moment, marine research opportunities outside the North Sea are scattered in different programmes under *SPSD* (e.g. in the Southern Ocean through Antarctic research and in the Atlantic through the Global Change programme). The marine component should be more clearly apparent in the organisation of *SPSD* in order to allow a better integration of research efforts and their application to policy.

The coastal zone of Belgium is subject to many pressures and requires an approach to its management which takes into acount natural processes and socio-economic factors. The development of 'Integrated Coastal Zone Management' (ICZM) in Belgium could be progressed as a pilot scheme covering a section of the Belgian coastline including the coastal dunes and the shallow off-shore area. This whole region could form a specific topic in a future research programme.

At this point, it should be recalled that Belgium lies primarily in the densely populated and heavily industrialised catchments of the Meuse and Scheldt, both of them bringing into the North Sea pollutants from Belgium and other upstream countries. In 1992, special agreements have been made with the countries within the catchment areas for joint management of the rivers following the Water Convention[22]. In 2000, the EU published the Water Framework Directive which obliges "Member States: to achieve the objective of at least good water status by defining and implementing the necessary measures within integrated programmes of

[20] EC-Environmental Research Programmes 1987-1994 with the following 3 projects: Dynamics of *Phaeocystis* blooms in nutrient-enriched coastal zones; Modelling *Phaeocystis* blooms, their causes and consequences. Biogeochemistry of *Phaeocystis* colonies and their derived aggregates.

[21] OMEX was financed under the EC-MAST programme (1993-2000) and was co-ordinated by R. Wollast of ULB (http://www.pol.ac.uk/bodc/omex).

[22] The Convention on the Protection and Use of Transboundary Watercourses and International Lakes was held in Helsinki in 1992 by the United Nations Economic Commission for Europe (UNECE). It is intended to strengthen national measures for the protection and ecologically sound management of transboundary surface waters and groundwaters, The Convention obliges Parties to prevent, control and reduce water pollution from point and non-point sources. Provisions are also included for monitoring, research and development, consultation, warning and alarm systems, mutual assistance, institutional arrangements, and the exchange and protection of information, as well as public access to information (http://www.unece.org/env/water). Treaties for the Protection of the Scheldt and the Meuse were signed in 1994 and subsequently International Commissions for the Protection of the Scheldt (http://www.icbs-cipe.com) and the Meuse (http://www.cipm-icbm.be) were established.

measures, taking into account existing Community requirements; to achieve the elimination of priority hazardous substances and contribute to achieving concentrations in the marine environment near background values for naturally occurring substances". The Belgian State must actively participate in the setting up of appropriate mechanisms, e.g. in the form of specific agreements, for interregional and international co-operation on the issue of catchment inputs to the sea.

Scientists and policy makers have by now come to accept that in order to understand, manage and develop the coastal margin and adjacent waters a catchment-based approach is needed in research. Atmospheric inputs should also be considered since a significant proportion of contaminants and nutrients are brought in by the wind. Future programmes should take into account all the boundary conditions around the North Sea, e.g. oceanic and Channel sources, catchments, estuaries, coastal margins and the atmosphere. Such a holistic approach to environmental studies requires a new framework for research.

In the panel investigations, finding elements of comparison between research programmes and the extent of funding undertaken by other North Sea countries proved to be difficult. This could inform BELSPO of the minimal national requirements for marine science personnel and funding. We recommend that a socio-economic analysis and comparison with other countries should be undertaken in the near future.

8.3 Long-term commitment

Belgian policy makers must take into account an ongoing revolution in marine science. In recent years, oceanography has moved away from the traditional expeditionary mode. On subjects such as climate-relevant research, ocean ecology, environmental impacts and for all purposes of operational forecasting, data have to be collected systematically over long periods from decades to centuries. Due to pressure from social and economic actors, one major challenge of current and future research is to enable forecasts of trends in the marine environment. Examples are: patterns of currents, wave climate, contamination levels, marine biota and coastal morphodynamics; all are topics of central concern for Belgium. In this context, the importance of long-term political commitment to marine science cannot be overstated. We recommend that science funding programmes should be for periods of about 10 years. Support at this level would enable Belgian scientists to participate at an international scale in major observational and forecasting programmes, thus enhancing the credibility of Belgium and allowing research institutes to develop their long-term strategies. Some degree of overlap in the form of rolling programmes would help avoid gaps and stabilise the potential of institutes. A typical 10-year time span should be divided into two 5-year phases, each of them with no more than two calls for proposals. The above implies a commitment to update research infrastructure. Plans should be put in hand for the maintenance and subsequent replacement of the '*Belgica'*.

Continuity, although a necessity, may have detrimental side effects. Guaranteed funding to research teams ('subscription tickets') can limit innovation through routine working patterns and reduced mobility of scientists. On the other hand, in a system where salaries are paid from the programmes, perceived instability of support can lead to a loss of researchers to more secure working environments away from science and/or as a brain drain. Continuity of funding must therefore allow for turnover of staff and recruitment of young scientists.

8.4 Planning strategy of future research programmes

General principles
Although from the interviews with Belgian scientists it appears that a stand-alone North Sea programme is clearly wished, such a central focus is not included in current BELSPO programmes which address global change, ecosystems and biodiversity. North Sea research is included as a subheading under these themes in specific Calls for proposals. The concept of 'Sustainable development' as currently applied in the *SPSD* offers an acceptable, if not ideal, framework for the pursuit of high-quality research in marine science.

Whatever the form taken by a future 'programme' it has to present to the scientists a 'package' of funding possibilities. The existing system of strategic and targeted actions should be continued in a modified form. Strategic actions will still necessitate calls for proposals; they are needed to address long-term research issues, maintain the existing research potential in universities and other institutes, and provide essential support to large infrastructures. Targeted or topical actions could be launched on the basis of specific tenders, e.g. to address requirements of monitoring and operational forecasting as set out under the QSR and GOOS.

For strategic actions the mode of operation could be the following. First of all, the BELSPO provides a general frame with the main research issues to be adressed. Scientists are then invited to prepare a detailed 'Science Plan' (see below) to be afterwards discussed, amended and agreed with the BELSPO. Specific Calls for proposals would then follow to cover the issues raised in the 'Science Plan'.

In practice, a document – analogous to the existing 'Document A', but more concise - will be produced at the beginning of each BELSPO programme, outlining the general set-up and providing a road-map as described below and setting out the reporting guidelines taking into account the Panel's remarks (re: Chapters 4 and 6). This document is to be placed on the Internet for consultation. A second and shorter document – equivalent to the existing 'Document B' - will introduce the calls for proposals, avoid duplication with 'Document A' and mention any modification to the original programme plans.

Scientist led strategic action(s)
Scientists often express reservations over the top-down procedures that are part of most national programmes. They ought to be more pro-active in developing/promoting new research initiatives, which could enable top-down and bottom-up approaches to meet. A key element in the development of a future research agenda should be the opportunity for Belgian researchers to identify for themselves the main research issues.

One possible way to achieve this is to develop a 'Science Plan' around which a new programme could be built. The 'Science Plan' has to make references to priorities at a Belgian scale and those of international programmes. It should also include recommendations on budget and a time frame. The mechanism to allow this to happen could be initiated and supported by BELSPO in the form of a two-day residential workshop with a leader or a scientific committee co-ordinating the preparation of the Plan. The leader will be selected from peers at or prior to this workshop either from within Belgium, or by recruitment of a Belgian scientist from abroad or by selection of a non-Belgian leader with exceptional leadership skills. Following publication of the Plan, BELSPO will publish a specific 'Call for strategic research proposals' from multidisciplinary teams on topics arising from the

workshop. If, as can be envisaged, the leader or scientific committee is entrusted with the general scientific co-ordination / general supervision of the selected projects, he/she/they should not take part in the Call. His/her/their funding as 'cluster co-ordinator' of the package of projects should be guaranteed as part of the total funding budget. Such an approach will help consolidate collaboration between Belgian marine scientists and ensure best utilisation of limited resources.

Establishing a clear 'sea chart'
A prerequisite for the successful implementation of any programme is that a 'road-map' or better still a 'sea chart' be developed to set in perspective the future research plans of BELSPO and to provide a long-term overview of funding opportunities. The road-map should aim to relate the above 'Science Plan' to policy needs at international, federal and regional levels. It should also explain to potential candidates where their research ideas fit throughout the duration of the programme, and provide an implementation flow chart, with appropriate milestones (timing of calls for proposals, of peer reviewing sessions and of evaluations). A road-map would guide enquirers from the national and international science communities and thus help to increase the visibility of Belgian marine science.

Strengthening international co-operation
The role of Belgium in the international scene has been described in Section 8.1. In keeping with the concept of the European Research Area (ERA), Belgium should investigate ways in which co-ordination with the national research programmes of other countries can be improved. This is in line with a recent initiative from the European Science Foundation (ESF) and its Marine Board [23]. Belgium's bilateral links in marine research with the adjacent littoral states of France, the Netherlands and the United Kingdom should be maintained and strengthened with a view to solving environmental problems of a transboundary nature. Learning from best practices in other countries, the exchange of know-how and collaborative research improves understanding of environmental phenomena and their management.

Opportunities to reduce costs have also to be looked into, such as occurs at present with Belgian scientists who use research vessels from other countries, and with foreign scientists that should continue to join *Belgica* cruises. Possible sharing of infrastructural facilities with other countries (laboratories, research vessels, databanks, etc.) needs to be investigated.

Introducing a Scientific Advisory Council at the Programme level
Because of the complex nature of North Sea and catchment processes and the many actors involved in the Belgian scientific scene, including the Royal Academy of Sciences, we suggest that a scientific advisory body be established. Representatives from scientific institutes from within and outside Belgium should participate in this Council and provide advice to the PSC on matters such as research priorities and research co-operation structures. Such a Council could be a joint initiative between BELSPO and the Royal Academy. Membership should avoid the occurrence of vested interest. The Council should normally meet once a year and more often during the inception phase of a new programme and the preparation of calls for proposals.

A better defined role for the Programme Steering Committee (PSC)
Given the political situation of Belgium, the Programme Steering Committee (PSC) plays an important role in bringing together federal and regional authorities. Despite the present restricted limitation of membership of Regions and Communities, the PSC is the ideal

[23] ESF Marine Board Position Paper 5; Integrating Marine Science in Europe (November 2002)-.

platform to interface with all parties concerned in the management of the North Sea and the catchment area, and especially with the Steering Committee for the North Sea and Oceans (see Section 1.2.1).

Steering committees were established for three of the past BELSPO funded programmes and are perceived as having been largely ineffective in the supervision of the programmes. To strengthen their role we recommend that they have clear written terms of reference, and have a regular timetable for meetings. A summary of their plenary meetings could be published on the WWW in order to inform the scientific community and others on the progress of the programme and any other initiatives that the PSC may take on.

Conflicts of interest must be minimised by careful selection of the members from organisations that are not funded in the programme, where possible, and might also include an independent scientist, preferably from abroad. Delegates need to be active in the committee and should be selected from senior members of staff in the organisations they represent and it will be preferable to restrict their mandate to three years. Membership from many different agencies could open up opportunities for co-funding, increasing the return on BELSPO investment. It could also be interesting to include NGOs in the PSC with an observer status in order to improve access to the wider public.

The value of a Project User Group (PUG)
We consider that Project User Groups (PUG) can bring many benefits to the programme since they are supposed to promote the application of research findings to the development of policy, services and industrial activities, for example, fisheries management, coastal protection, biotechnology and mitigation of hazards. The opening of future marine programmes to some aspects of catchment research will expand the potential membership of these PUGs. It is important to ensure that PUGs and project teams interact as effectively as possible. Clear terms of reference for the PUG are needed from BELSPO. At the start of new research contracts representation on these groups has to be agreed jointly between the project teams and the PSC. Negotiations to agree the membership of the PUG must be completed before the contract is let. The aim is to achieve a good balance of interests and an active participation of the members. Recommendations in the minutes of the PUG should be considered as formal requests to the project researchers. The extent to which the recommendations are followed up must be monitored and included in project annual reports.

8.5 Human dimension of the future programmes

Communication between Belgian marine scientists
One message that clearly emerges at the end of this review is that Belgian marine scientists, especially those who have good memories about *Project Sea*, do not currently have a good mechanism to communicate ideas within and between existing project networks. The newly introduced clusters in *SPSD-II* may change this perception. The scientists involved in all BELSPO projects, members of PUGs and other interested parties should be encouraged to meet at least annually on a Belgian wide basis. The Panel wishes to stress that such workshops/meetings should remain informal, otherwise the organisational burden and costs become prohibitive. University premises are perfect venues. The system should allow for suitable rotation among universities from the two linguistic Communities. An internal communication system within projects must become a norm. Records of project meetings and workshop proceedings should be published on the WWW. And we suggest that an electronic

newsletter might be a way of keeping BELSPO funded scientists informed of their progress in the programme.

Belgian scientists may wish to consider the possibility of creating a Belgian Marine Society equivalent to say the UK 'Challenger Society' or the 'Union des Océanographes de France' (UOF). The role of such a learned society in Belgium is to serve as a forum for discussion between marine researchers, to advance research and education in marine science and technology and to help the emergence of a common voice at national level. This Society could become affiliated with the European Federation of Marine Science and Technology Societies (EFMSTS [24]).

Public awareness, dissemination of research information

The panel wishes to emphasise the need to increase public awareness of the benefits of marine research. The perception of marine science should move from simple curiosity about charismatic species to understanding the challenges of ecosystem management. The interrelationships between the sea and catchments needs to be made understandable and citizens have to become aware of their own impact on ecosystems. Furthermore this approach would almost certainly attract new generations of scientists.

At present the public awareness and press office work of BELSPO on marine science appears to be at a low level. We recommend that the Office places a higher priority on the communication of (marine) science issues to the general audience in close contact with the public relation activities of MUMM, VLIZ and others. Whether the Belgian citizen likes it or not, the North Sea is part of his/her daily life.

A greater emphasis should be placed on the dissemination and exploitation of results by project teams than has been the case heretofore. Publication in international peer-reviewed journals is an essential requirement. Other media such as newspapers, television, and the WWW must also be used as a means of bringing research closer to the general public. Reactions from the public are welcomed and encouraged; these may even be useful to the further implementation of the research projects. The projects should make a regular update of their research progress on a special web site for which the BELSPO is asked to provide a portal.

Promoting the training and mobility of researchers

Research projects should involve extensively young researchers of different disciplines. Appropriate training will be essential for the maintenance of a long-term and sustainable marine science programme. The formation of multidisciplinary project teams is the most effective and appropriate way to deliver high quality research. To train researchers in such a setting will be beneficial for them in their career and for future projects where interdisciplinarity will be the mode.

Project funding from BELSPO can amount to a large part of the total support for a particular research unit. Nevertheless, structural mechanisms to enable young scientists recruited and trained during projects to subsequently integrate into the Belgian marine scientific community are weak and need to be strengthened. Preferably researchers should return and be integrated after some years of post-doctoral experience abroad. In Spain for example young scientists have to go abroad to strengthen their experience; incentive grants, sometimes with the support

24 Founded in 1998, this Federation consists of non-governmental full-grown scientific European Associations specialized in research and education around Marine Environment (www.efmsts.org)

of EU programmes, facilitate their return. In order to compete for positions, their recruitment is assessed at an international level on the basis of their publication record and the impact factor of the journal in which they have published. This situation results currently in a large number of young trained scientists that are willing to return and have a research history of the highest international standard. It is largely the result of EU Marie Curie fellowships and will undoubtedly raise the scientific level of science in Spain. The present situation in Belgium is the exact opposite; talented students can find the resources to obtain their PhD in excellent conditions, but after their PhD training they leave Belgium to be competitive in another country. This result in a net loss of talented scientists. Belgium should learn from the Spanish example.

Mobility of researchers is often stated in national and international programmes as necessary for the education of scientists. Existing mechanisms to facilitate short-term mobility need to be intensified. Possible extension of a mobility scheme to scientific administrators and industries should be considered. The Panel is surprised to note the poor response to the International Collaboration efforts launched by BELSPO and urges the scientists to make better use of such opportunities.

9. A PROPOSED VIRTUAL NETWORK

9.1 Background

Almost all countries in north west Europe have national oceanographic institutes, situated on the coast, that are recognised internationally as a window for their marine science. For example, in identifying the importance of the sea to their economy Ireland is currently building a major new institute in Galway with facilities for research vessels to dock nearby as its national marine centre. This institute will be closely affiliated with the nearby university. It is intended that this new centre will help stimulate national wealth creation based on the marine environment and shipping. A centre of excellence for marine science of this type does not exist in Belgium. If such a centre was established it could provide the essential connecting agent and element of continuity that appears to be missing at present. Acting as a hub for linkages with universities and other centres of excellence it could have an educational role, be attractive for SMEs in technology and biotechnology and act as a field station for university student courses. At present there is no field station with laboratory facilities and bench space for students on the Belgian coast. Recently the UK Marine Biological Association in Plymouth has refitted a new learning resources centre specifically for student field courses and postgraduate workshops. This new facility has been refurbished at a cost in the region of 600,000 Euro, a figure that includes some matching funds from the European Community.

Box 9.1 Possible advantages of a national centre for marine sciences

- Continuity and stability in the long-term
- A national focal point for Belgian marine science
- A centre of excellence for Belgian marine science
- Representing Belgian marine scientists as a whole
- Facilitating an appropriate critical mass
- Promotion of Belgian marine research in an international framework
- Support of Belgian participation in EC and international research programmes
- A structure to co-ordinate national marine research programmes
- A structure to co-ordinate monitoring
- A central organization to arrange contact meetings and symposia
- Location for a National Oceanographic Datacentre
- Collection of information on the status of Belgian marine research
- Oversight of the needs of researchers for field and research vessel facilities
- Development of joint research cruises
- Field centre facilities
- Access to running and clean seawater for experimental research
- Possible provision of sample archive and specimen storage facilities
- A hub for linkages with universities and other centres of excellence
- Co-ordination between research groups concerning common use of equipment
- Development of joint proposals by several research groups
- An attractive venue for public education on the marine environment
- Stimulation of small marine industries

9.2 Previous studies for a common marine scientific infrastructure

In 1993, a feasibility study (performed by ECOLAS), commissioned by the BELSPO, considered four alternatives for a Common Marine Scientific Infrastructure:

1. a co-ordinated network between 'centres of excellence';
2. an IZWO proposal for a Common Marine Scientific Institute;
3. collaboration with The Netherlands, in particular with the Centre of Estuarine and Marine Ecology at Yerseke;
4. addition to or common use of the Fisheries Research Institute in Ostend.

The report proposed to abandon the second alternative, mainly because of the high costs of a new building for ~55 staff, the unfavourable cost-benefit ratio, the small contribution that would be made to co-ordination of marine research, and a lack of interest among the scientific community. The third option was eliminated mainly because of a lack of political scientific and administrative support and an unfavourable cost-benefit ratio. The same reasons applied to the fourth option although the political and administrative problems were less in this case. So, by elimination the network of centres of excellence remained. In its final conclusion the report stressed, however, that the above analysis, based on the 1993 economic situation of Belgium, should reinvestigate the Ostend option in better times.

Another report by ECOLAS, commissioned in 1996 by the Flemish authorities, investigated the feasibility of establishing a Flemish Marine Institute and offered two options. The first was the creation of a Department of Marine Scientific Research at the Flemish Institute of Nature Conservation Research, Brussels, in combination with an update of the IZWO in Ostend. This proposal, however, met with political opposition and, hence, was abandoned. A second suggested option was to establish a Flemish Institute for Marine Science in Ostend positioned under the Flemish Administration for Science and Innovation. This institute was only to become involved in research if no other group was available and was intended to be primarily a supporting institution. The remit included a role as a datacentre and as a meeting platform for marine scientists and policy makers. It was proposed that the new Flemish institute should be fitted into the structure outlined in the 1993 ECOLAS report (Network of centres of excellence). The Flemish authorities decided to adopt this latter proposal for an autonomous Flemish Institute for Marine Science and using the above model established VLIZ in 1999.

The thoroughly researched 1993 report of ECOLAS also recommended the establishment of a co-ordination body under BELSPO for marine strategic research in relation to fundamental research. This recommendation was never implemented and there is still an urgent need for a single body to tackle this task (Some of the points in Box 9.1 were taken from this report).

Following international trends in the development of centres of excellence we believe that the time is ripe to establish a national centre of marine science to strengthen Belgium's position in research and its recognition and competitiveness internationally. Such a focus is needed in order to keep pace with the rapid developments that are taking place in marine science and to provide opportunities for associated development of spin-off industries. We believe that such a centre should be of a size that is appropriate to a country of the scale of Belgium and should act as a hub to existing national, Flemish and French-speaking marine research institutions as a 'Virtual Network'. The network will still need to have a physical presence and this is outlined below.

9.3 Possible scenarios for a Virtual Network

In seeking to establish what we term a 'Virtual Network' of Belgian marine research players, several alternative scenarios come to mind, taking into account the unique political situation of Belgium. A first option is to set up a co-ordinated network that would be an expansion of the *status quo* where BELSPO plays a limited co-ordinating role for Belgian marine science. A network of this type does not seem to work at present because regular meetings of scientists are not organised and BELSPO nor any other agency has clear co-ordinating responsibilities. This first option was rejected by the Panel as inappropriate, mainly because it will not result in a clearly recognizable national structure. One could also envisage to promote VLIZ and/or MUMM and/or DVZ as a central co-ordinating node or even as a Belgian Oceanographic Institute (BOI), but we believe this to be politically unacceptable.

Another, more ambitious option could be explored, i.e. a Virtual Network of all Belgian marine research players with a central administrative office and data centre. The central office would be responsible for co-ordinating the tasks listed in Box 9.1. It could be located anywhere, but if not by the sea would be perceived as an oddity as was the old National Institute of Oceanography in the UK which was situated far inland in a forest near Wormley (Surrey). It was no surprise that the English institute was transferred to a coastal location on the creation of the new Southampton Oceanographic Centre in 1996.

Historically, Ostend has been the main coastal centre for marine science in Belgium since the 19th century and today hosts parts of four different marine institutions (MUMM, AWZ, DVZ, VLIZ). Ostend was also identified in the 1993 ECOLAS report as the preferred site for a new marine institute. Appropriate land and buildings that could possibly be revitalised and renovated as part of the old fish market in the harbour are currently available. The area is highly suitable for the location of a national centre for marine sciences with good access to seawater and seagoing facilities. We suggest that this coastal city is the obvious location for a BOI, despite political difficulties for French-speaking scientists because of its location in Flanders.

A variant of the above option could also be proposed, in the form of 'bilocation' Brussels-Ostend', taking into account that several federal and regional players are located in these two cities. In the present political situation, this latter option might seem the most advisable, and if deemed necessary, would keep the door open for a full move to Ostend after a transition of a few years.

9.4 Outline of a preferred scenario for a Virtual Network with its core unit

9.4.1 The concept

The concept proposed consists of: a ‘Virtual Network’ with various links throughout Belgium and a core unit which could eventually evolve into a full Belgian Oceanographic Institute (BOI). Figure 9.1 outlines schematically a possible scenario for the establishment of a BOI and virtual links to other Belgian marine organisations. The Virtual Network would comprise clockwise on the diagram: the following partners:

- Universities
- Federal and Regional Research Institutes
- Federal and Regional Research Vessels
- Small and Medium-Sized Enterprises (SMEs)
- Museums

- Aquaria
- Navy
- Federal and Regional administrations and BELSPO.

As an integral part of the Virtual Network, the core institute (BOI) would provide a range of facilities for Belgian marine science and education (University Departments and other research institutes). Of particular value to university research would be laboratories with running sea water for experimental work. To ensure the success of the BOI a feeling of ownership would need to be engendered in the outlying components of the Virtual Network.

We suggest that the BOI, once completed, should be made up of seven parts, again clockwise in Figure 9.1:

1. A National Centre for the co-ordination of marine monitoring
2. A National Field Studies Centre for Marine Science
3. Accomodation for visiting students and scientists
4. A National Marine Library
5. A Visitor Centre, associated small museum and lecture theatre
6. A National Oceanographic Data Centre
7. Laboratories

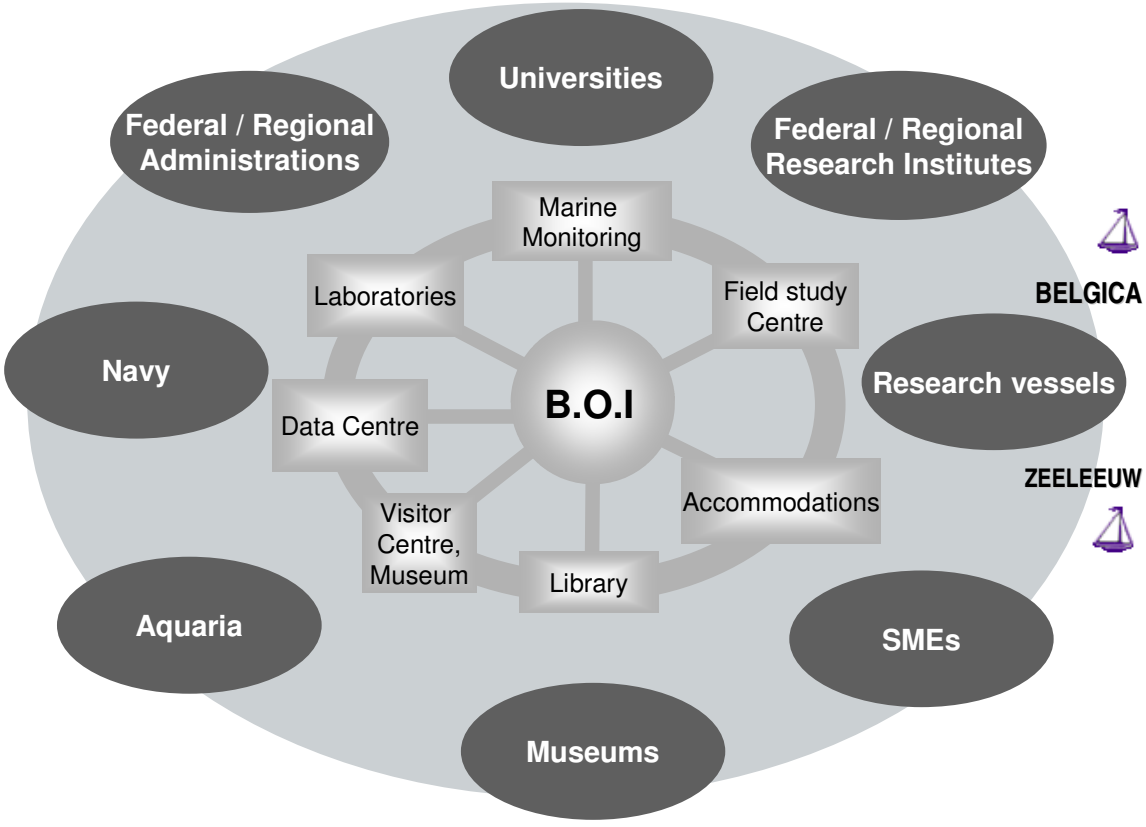


Figure 9.1 Proposed structure of a Virtual Network

We wish to emphasise here that the BOI should be a small structure appropriate to the size of a country like Belgium. It should follow the same format on a national scale as VLIZ does for Flanders. This means it should be primarily a supporting institution and the centre of a national network of excellence.

The BOI should normally not undertake research on its own initiative so that it would not be perceived as being in competition with the other partners of the Virtual Network. However, a few researchers should be included in its staff to service/manage experimental equipment and facilities for work carried out by the members of the Virtual Network. Such scientists could be appointed on secondment for different periods from the affiliated organisations. The facilities should also include storage for seagoing and other gear.

A visitor centre and possibly a small aquarium could be associated with the BOI as a public face for marine science. In any development, space should be allocated close by, if possible, for associated and innovative Small and Medium-Sized Enterprises (SMEs) that may be attracted by the proximity of such core facilities. The location of Ostend as an international ferry port is likely to be especially attractive to new industries.

The laboratory facilities of the centre should be seen as a national infrastructural component of the proposal. Other large shared infrastructures could be established in the building, if needed, and jointly shared between universities. A lecture theatre would be a valuable component of the facilities and would ensure that the venue could be used as a conference centre.

Opportunities for both the *Zeeleeuw* and *Belgica* to moor alongside the BOI should if possible be made available, although the *Belgica* would still need to operate from the naval port of Zeebrugge for depth and other operational reasons. Adjacent mooring facilities would enable easy transfer of equipment and containers from the BOI prior to research cruises.

It has not been possible for the panel to undertake a cost-benefit analysis for the above proposal. Buildings already exist at a possible site in Ostend that could be modernised so that the construction costs of establishment could be minimised. Starting from a co-ordinating office, the full 'Institute' could be put together over a period of time to a pre-planned programme that could be moulded to meet the best windows of opportunity for transfer of existing units and staff. The costs of establishment could thus be spread over a number of years. We recommend that BELSPO establish a small working group to undertake a cost-benefit analysis. If a decision is taken to proceed in principle this working group should undertake its work within six months to ensure that momentum is not lost.

9.4.2 Membership

A two-way proactive interaction between the partners in the Virtual Network and the BOI will be needed to ensure its success. Some short comments on the proposed membership follow below.

1. ***Universities***

   Both French and Flemish-speaking universities are likely to gain most from the development of the Virtual Network through the provision of new shared educational and field facilities as well as previously unavailable research opportunities. Equable sharing of the new facilities needs to be ensured through an appropriate management. The virtual aspect of the Network could also be used through new means of communication to share teaching resources and develop joint courses between universities. Too little emphasis is currently placed on socio-economic and legal analysis of marine issues; if appropriately funded relevant university departments could take a lead in this area through the Virtual Network.

2. ***Regional and Federal Research Institutes***
   Parts of some existing federal institutes should in due course of time be incorporated into the new BOI and co-operation agreements will need to be developed with regional institutes to minimise duplication and improve efficiency. The new structures will strengthen the contributions of both federal and regional institutes to marine science.
3. ***Research vessels***
   Seagoing ability is crucial to the success of Belgian marine science. Co-operation agreements already negotiated for the joint exploitation of the federal and regional research vessels would be enhanced within a Virtual Network scenario.
4. ***Small and Medium Sized Enterprises***
   While it is envisaged that SMEs may be particularly attracted once the BOI is established, existing marine industries should be encouraged to contribute to the development of the Virtual Network.
5. ***Museums and Libraries***
   Under this heading at a national and regional scale there is at present little opportunity for a focus on marine issues and there is no National Marine Library. Existing museums and libraries should use the Virtual Network to strengthen their contribution to Belgian science.
6. ***Aquaria***
   There are a number of marine aquaria in Belgium. They may wish to utilise the Virtual Network to develop their educational role and possibly through the acquisition of fresh material for their exhibits.
7. ***The Navy***
   The Belgian Navy operates the research vessel *Belgica* and is also involved with hydrographic and other surveys. Networking links through the Virtual Network would serve to strengthen its contribution to marine science.
8. ***BELSPO and other Federal and Regional administrations***
   One of the primary roles of the Virtual Network will be to facilitate co-ordination of Belgian marine science and this applies especially to the policy needs of both federal and regional ministries. Once in place the Virtual Network should build on existing communication structures.

9.4.3 Key facilities of a BOI

1. ***National Centre for the co-ordination of marine monitoring***
   The greater part of the statutory marine monitoring undertaken to fulfil the requirements of national legislation, EU Directives, OSPAR, Bonn and other conventions is a national responsibility. Other monitoring especially in the near shore and in estuaries is within the competence of Flanders. Belgium in partnership with Flanders needs to review its existing monitoring, rationalise, improve and initiate new systems within the framework of GOOS. A new national centre could take on this co-ordinating role and should include responsibility for research vessel logistics and aerial monitoring.

2. ***National Field Studies Centre for Marine Science***
   If Belgian universities wish to undertake marine field studies with their students, at present there are no suitable laboratory facilities. Modern marine science is becoming highly technical and students need to undertake training in real situations on the sophisticated equipment that is presently in use. Establishing a learning resources centre with associated basic accomodation for groups of students would fulfil a real need in the Belgian scientific community. The gravitas of siting such a centre within a BOI would create considerable added value especially the linkages with the library and museum for educational use. Such

a centre needs to have a few researchers associated with it who also have a part time teaching role. Linkages with partner universities may make it possible to have rotational six monthly or annual fellowships by secondment from their home institution. The centre should also play a key role in publicising North Sea and marine science in general and if possible should employ a public relations officer, possibly seconded or rotated from BELSPO. Educational programmes at all levels: primary, secondary, university, adult and for retired persons should be encouraged.

3. ***Accommodation for visiting students and scientists***
   Provision of moderately priced accommodation and catering for visiting researchers and students should be included in the BOI. Successful models for comparison are the facilities at the Marine Laboratory in Roscoff, France and the Kristineberg Laboratory in Sweden. Residential housing associated with the BOI would enhance its scope and could have a multiple role, serving field study courses and conferences

4. ***National Marine Library***
   A national Belgian library that focuses on marine issues does not exist at this time although a regional marine library has been created in recent years. Most of the journals taken are obtained on exchange so that it is not fully comprehensive in its coverage. This latter library is part of national library networks and affiliated to international library associations as well as recently starting to input Belgian publications into the main international online archiving medium (ASFA). Until this abstracting service was initiated much of the research ongoing in Belgium was not advertised to the international scientific community. There is a need for a National Marine Library to service all Belgian marine science that works in partnership with existing institutions. This need only be a small unit attached to an existing library. A networking library system is exactly what is needed here, focussing on modern electronic means of communication and providing information on where journals and other publications are available in Belgium as well as producing electronic copies of articles.

5. ***Visitor Centre, associated Marine Science Museum and Lecture Theatre***
   A marine Visitor Centre as an interactive educational facility on the marine environment could provide a public face for the BOI and would complement the field centre. The Visitor Centre could include a small marine science museum displaying material to the public in an interactive way; affiliated members of the Virtual Network and especially universities might help in the provision of materials for exhibits and in their design. The centre could be used as a window for universities to display the work of their key units working on the marine environment. Historical material covering marine issues, which is at present in store in the museums of Brussels and other centres, might be temporarily transferred to Ostend making it available to the public and scientific community in ways that would not be possible in the capital. The centre could be a catalyst for the organisation of mobile exhibitions to inform Belgian people about marine issues. We stress particularly here the value of making capital out of the Gilson Collection. Including a small lecture theatre within the confines of the BOI would provide additional teaching opportunities.
6. ***National Oceanographic Data Centre***
   At present Belgium as a small country is the only one that has two designated NODCs affiliated to the IOC and yet neither appears to be acting in a full capacity as a NODC. Existing systems that are available are to a large extent based on inventories or hold data, with exceptions, that are from recently funded BELSPO projects. Much oceanographic data, such as the thousands of pCO_2 monitoring measurements funded by FNRS, are not

archived on a national scale. Only parts of the existing NODCs are on-line and for one of them only since November 2002, although the reviewers did not manage to access this database. As such they are not playing the key role that other national data centres in the ICES community undertake. Data is essential for new directions in future research and modelling and the volume of information that needs to be stored is increasing at an enormous rate. Appropriate resources need to be put in place to enable the existing data centres to function together as a Belgian Oceanographic Data Centre, equivalent to its Dutch or British counterparts. Developing a collaboration agreement with one or more existing data centres from other North Sea states may be one way of improving interactive aspects of the present system. This approach could be engaged through the ICES Network of Oceanographic Data Centres and in particular to improve on-line facilities.

7. ***Laboratories***
   To provide necessary backup to monitoring co-ordination, a chemical laboratory could be attached to the BOI for the analysis of key determinants. A possible role could be to prepare and store reference material of sediments, particles and biota collected and analysed through rigorous procedures. Belgium needs such a specimen banking system supported by a strong analytical capacity for purposes of standardisation and certification. Useful examples exist in Germany (Environmental Specimen Bank [25]), USA (National Biomonitoring Specimen Bank [26]) and as a co-operative venture of the Nordic countries (Nordic Environmental Specimen Banking [27]). A further possibility might be that such a facility could be developed in partnership with adjacent countries or with other existing facilities in Belgium. The laboratory facility could be used as a platform for training and for interaction with other Belgian environmental research programmes. A teaching role for the laboratory must automatically be connected to the above Field Centre. Analyses that require the use of highly sophisticated techniques or specialist equipment could still be undertaken by universities or other laboratories under contract, providing that appropriate quality control procedures are in place.

9.4.4 Governance

Membership of the Virtual Network should be open automatically to all Belgian organisations active in marine science at the present time and subsequently to newcomers. A secretariat should co-ordinate all aspects of the networking of the Virtual Network. Creative interaction between the Virtual Network and the BOI will be essential and require considerable leadership. A governing Council, with an appointed President, should be established to oversee the development and provide advice to the Director of the BOI. Membership of the Council should include representatives of universities active in marine science, the main national and regional public research institutes, other important marine organisations, BELSPO, and if possible should also include some senior personnel from scientific institutions in countries adjacent to Belgium.

9.5 Adapting the marine infrastructure of Belgium

Creation of a BOI will require existing marine science agencies in Belgium to adapt to the new situation. A proposed scenario outlining how existing laboratories might contribute and interrelationships with adjacent and more distant organisations is summarised below. Parts of

[25] http://www.chem.unep.ch/gmn/05_ESB.htm
[26] http://www.chbr.noaa.gov/Newsletter/volume2/issue1/nbsb.html
[27] http://esb.naturforvaltning.no/index.htm

a number of existing federal and regional institutions could form the building blocks for the initial stages of the new 'Institute', but new staff may have to be recruited and new units created to fill in any gaps in present structures. During this review we have recognised for example a need for the creation of a centre for the development of reference materials and for quality control of marine chemistry. This could be part of the BOI or attached to an existing centre with marine chemistry expertise. The establishment of the 'Institute' should be progressive and could be implemented to minimise effects on personnel and units. It should be recognised however, that the timing is crucial to set the plan in motion as the key development land for the siting of the 'Institute' is not likely to remain available for long into the future. The suggested input of Universities, RBINS/MUMM and regional organisations in the proposed BOI is outlined below. Some of the functions of the BOI might be fulfilled in partnership with VLIZ or DVZ, with a widening of focus from Flemish to Belgian interests.

9.5.1 Contribution of Universities

As can be seen from the annexes there are many universities (UA UCL KULeuven Ulg ULB VUB UGent) undertaking marine research in Belgium. However, most units working within universities are small. Through the co-ordination role of the BOI improved linkages between different university units are likely to develop. The BOI is intended to provide universities in particular with joint and shared national facilities that they would not be able to afford as individual institutions. This new resource, which universities could play an important role in progressing, would enable new and shared degree and postgraduate qualifications to be developed. As a consequence of the Bologna Declaration [28] universities are currently developing new curricula for Batchelor and Master degree courses so that a system of European wide common credits can be put in place by October 2004. Provision of field facilities would strengthen the position of Belgian universities in offering new courses.

Universities are most likely to benefit from the creation of the Field Studies Centre and the associated lecture theatre and laboratories. They may also wish to provide planning and organisational input to the visitor centre, museum and library. To emphasise their 'ownership', or perhaps partnership is a better word, of the BOI universities may wish to explore secondment of staff to fill key roles in the above units.

9.5.2 Contribution of RBINS/MUMM

The Royal Belgian Institute for Natural Sciences (RBINS) should be a key partner in the new BOI because it hosts MUMM. Units of MUMM would contribute essential building blocks for the proposed new Virtual Network. Both of these organisations would need to play a key role in the planning and negotiations for the proposal and would need to feel an ownership and a continuation of their past work in the new development. We propose the following existing units within RBINS/MUMM as potential contributory building blocks to a BOI:

1. Necessary chemical laboratories for the National marine monitoring programme which are already sited in Ostend as an outpost of MUMM.
2. Marine and aerial monitoring and research ship logistics already sited in Ostend as part of MUMM.
3. The Belgian NODC at present sited within MUMM in Brussels.

[28] The Bologna Declaration was signed by the Ministers of Education of 29 European countries on 18-19 June, 1999 and extended in 2001 to 33 countries. The Declaration is a binding commitment between the countries to reform their own higher education systems in an agreed direction - the creation of a European Higher Education Area (EHEA). It is a commitment in principle and practice to create a comparable and increasingly converged system of graduate and post-graduate education across Europe, in order to maximize transferability and mobility within Europe.

4. An extension of the RBINS museum, library and specimen archiving facilities.

Chemical laboratory

Existing analyses for Belgium's marine monitoring programme, including statutory monitoring, are undertaken by more than one laboratory depending on the determinants that are being analysed. This approach, which is co-ordinated from the MUMM laboratory in Ostend, is likely to continue due to the specialist equipment that is necessary in many cases. The existing MUMM laboratory undertakes analyses for metals. The laboratory is accredited to CODA (Conservation Options and Decision Analysis) and linked to the QUASIMEME (Quality Assurance of Information for Marine Environmental Monitoring in Europe) and QUASH (Quality Assurance of Sampling and Sample Handling) quality control systems. We suggest that this laboratory be transferred to the new BOI. Establishing a new unit would give an opportunity for an appraisal of existing requirements and updating of equipment. Part of the new laboratory should provide opportunities for teaching. A primary focus of this unit would be the co-ordination and quality control of chemical analyses for Belgium's national monitoring programme.

National monitoring

Monitoring undertaken at present by MUMM and in part DVZ, largely to service the Co-ordinated Environmental Monitoring Programme (CEMP) of OSPAR is co-ordinated and managed by MUMM. The existing MUMM unit in Ostend is primarily responsible for this work. The cruises of the *Belgica*, including routine monitoring cruises and aircraft monitoring for the BONN Convention, are also managed by this unit. We suggest that it should form part of the core facilities of the new proposed centre.

A Belgian NODC

The responsibility for national archiving of marine data is currently one of the remits of MUMM; the relevant unit has been affiliated to IOC as the Belgian NODC. Full information on the existing unit and its databasing activities is included elsewhere in this report and in the project appraisal on IDOD. At present the IDOD database is only acting as a national databasing system for BELSPO funded projects and is,since mid-2003 available on-line to other Belgian or international scientists. Improvements need to be made to the system so that the availability of data is more transparent, including the provision of web-based information. Data from Belgian sources other than BELSPO funded research should be included. A developing interaction between the present VLIZ and MUMM data centres will be essential for the success of this proposal. Siting the two units beside each other should lead to considerable savings and improved efficiency. We recommend that this unit should form the core of a new NODC as part of the Virtual Network.

Museum and Library

As the host of Belgium's foremost museum and a major library the RBINS has a high international reputation. Establishing regional branches of major museums and art galleries has proved highly successful financially and with the public in some countries. The archiving, library and educational aspects of the BOI could be considered as an outreach component of RBINS. Here the emphasis needs to be placed on structuring information, curating information and facilitating access to information from library holdings and external resources. Partnership agreements should be negotiated with existing Flemish institutions in Ostend to minimise staffing and capital costs for any development.

During the period of this review the Panel has received many comments from members of both the French and Flemish-speaking research communities on the central role that MUMM currently plays in marine research. The MUMM plays a key role on advisory panels for government research funding, identifies and influences research to be undertaken and then receives funds from government to undertake the research. There is general unease over the way that MUMM has a role as both a 'gamekeeper and poacher', at times in perceived competition with universities. It is also widely felt that some of the current structures of MUMM, with the notable exception of the co-ordination of the *Belgica* are not working well for Belgian science. Communication channels between MUMM and Belgian scientists do not appear to be operating efficiently. The difficulties experienced during the development of the databasing project IDOD and incorporation of the data is one case in point.

In the light of the above, we are of the view that the different components of MUMM should be broken up as part of the organisation of the proposed Virtual Network. Two alternative scenarios could be envisaged:

- one where MUMM continues to retain the overall management of the units transferred to the BOI as part of a federation of units, some new and some transferred, with a Director responsible for the interfacing and interaction between the component parts, and
- a second one where parts of MUMM are transferred and integrated into the BOI, in a manner totally independent of MUMM

In the latter scenario the MUMM would be able to continue its highly successful research remit in competition with other Belgian research agencies and universities. The present 'gamekeeper and poacher' situation that has been criticised by a number of interviewees as part of this review would no longer exist.

9.5.3 Contribution of Regional Institutes from Flanders

Existing Flemish Institutes in Ostend would need to re-examine their priorities and their situation in Belgian marine science if our proposals should be implemented. There would need to be an adaptation of priorities and aims to the benefit of Flemish and Belgian marine science in general. There might for example be considerable financial and practical advantages if some of the units within the BOI were formed by the merger of parts of existing Belgian, Flemish and French-speaking organisations. One possibility would be to join the two current datacentres with a combination of the expertise of MUMM and VLIZ, possibly with staff funded from both National and Flemish resources.

1. VLIZ

The existing VLIZ institute in Ostend would be considerably reinforced if a BOI was established in close proximity. If this did not prove possible an unambiguous memorandum of understanding should be developed that clearly outlined respective responsibilities. Detailed negotiations would of course be necessary on how the two organisations should interrelate.

2. DVZ

Close to VLIZ is the Sea Fisheries Department (DVZ), which is primarily responsible for the provision of scientific advice on the sustainable exploitation of living marine resources. Its proximity to the proposed site of the BOI and the subjects researched would add considerably to the workability and value of the 'Virtual Network'.

3. AWZ

In Ostend is sited the laboratory and offices of the Coastal and Waterways Division of AWZ that is responsible for the management of coastal defences, beaches and dunes as well as the infrastructure of ports and coastal canals and the operation of a hydrometeorological station.

This institution would provide another arm to the local branches of the Virtual Network and could contribute in constructive ways to the work of the components of the BOI by providing data and infrastructure.

9.5.4 Contribution of French-speaking institutes

An institution/secretariat that plays an equivalent role to VLIZ in co-ordinating, promoting and acting as a public face for the science of French-speaking researchers does not exist at present. To balance the strong Flemish representation we propose the establishment of a small entity linked to the BOI to provide a powerful and visible sign of the contribution of the French-speaking Community to Belgian Environmental Science. A similar remit to VLIZ as a supporting body and meeting platform for French-speaking marine scientists and policy makers is envisaged.

Comprehensive negotiations with the Walloon Region and French-speaking Community would need to be put in place to see such an entity come to fruition. We realise that there exist considerable political difficulties, but believe that the advantages for the French-speaking Community in having a marine outpost for its expertise would have enormous benefits. As well as a public face the remit of such an entity ought to provide a co-ordination and information centre for French-speaking marine and possibly climate scientists. Proposed formative responsibilities of the entity are:

1. to co-ordinate contributions from the French-speaking Community to marine and environmental related research and policy;
2. to facilitate federal and institutional collaboration;
3. to develop public awareness of marine issues in the French-speaking Community;
4. to emphasise the contribution of French-speaking scientists to marine research.

The authorities of the Walloon Region and of the French-speaking Community should be committed to discuss with their scientists and industries the need for a strong place within marine research and the proposed Virtual Network. There would be considerable advantages if the French-speaking entity was based within the BOI as it could then best ensure adequate interaction with the national centre. However, even if this was not possible we still believe that there is a clear need for such an entity and it could in an alternative scenario be attached to a French-speaking university.

To improve the visibility of French-speaking marine scientists there is a need to promote their specific research expertise. Adoption of a research theme such as modelling might be one way of doing this with the French-speaking entity promoting these ideas. A further possibility might be to expand the fledgling networking initiative at the Ulg known as AQUAPOLE (a technology pole) that is focussing on all aspects of the marine environment and especially the Scheldt, to the whole French-speaking Community. A freshwater equivalent known as MARE is also being launched. The final choice of topic to be addressed should be left to the French-speaking research community to decide.

9.6 First steps towards implementation of a Virtual Network [29]

Procedures to put both the Virtual Network structures in place need to be considered separately, but implemented in an integrated way. There are already examples of efficiently

[29] The concept of a Virtual Network as described here was outlined and discussed during the BELSPO Symposium 'Sustainable Management of the North Sea: presentation of research results' in January 2002.

run Virtual Networks in Belgium, one being the Flanders 'Interuniversity Institute for Biotechnology' (VIB). In this institute 9 university departments have agreed to work together with co-ordination from one central body. This and other examples should be examined and used as models for the establishment of the Virtual component of the 'Institute'.

The recommended size of the BOI as the core of the Virtual Network is difficult to determine and could reflect the size of the Belgian population, the relative size of the Belgian EEZ compared to other North Sea countries, might reflect the relative contribution of the sea to the GDP of Belgium or could be representative of the number of partners in the Virtual Network. Initially we suggest that the 'Institute' should evolve from existing structures and staff already employed in Belgium, possibly as a co-ordinating office of limited size. Costs could be minimised by a progressive staged development over a period of years.

The BOI should be self-funding, largely from national resources. Funding of the building costs and maintenance should be a federal responsibility, but aspects of the work and some infrastructural facilities of the Virtual Network could be funded by joint agreements between the BELSPO, Regions, Communities and if appropriate universities. The possibility of matching funding from the European Commission should be investigated. Field courses and other facilities such as the Visitor Centre would be able to cover their costs by charging.

We strongly recommend that an economic analysis be undertaken comparing the marine research infrastructures and programmes of other North Sea states. This could be used in the future to help advise BELSPO and the Belgian Government on the appropriateness of the current investment in marine science. Part of the analysis should reflect the economic need for parallel Regional, Community and National funding mechanisms and the core scientific pool of researchers needed in each of the regions.

Because of the existing political structure in Belgium we recognise that there are a number of problems that would need to be surmounted to establish a BOIon the Belgian coast . However, the Panel is of the view, based on historical precedent and Belgium's role in North Sea science that a permanent BOI on the coast is long overdue. An ideal location is available in Ostend for the site of the core in the region of the old fish market; a prime development location that is not likely to remain available for long. The nearby location of existing Flemish marine institutes and the proposed development of a small French-speaking sister 'institute' to VLIZ would give Belgium a marine science complex appropriate to its maritime traditions and interests. This site could certainly prove attractive to other national or even international organisations. An alternative option could be to bilocate the BOI in Ostend and Brussels, taking advantage of existing facilities of RBINS and MUMM. A new Virtual Network could act as a window for Belgian Marine science and a catalyst for research and technological development in the 21st century.

10. MAIN RECOMMENDATIONS IN BRIEF

The need and context for marine research in Belgium

- Keep Belgian marine research alive, notably at a federal level. Geography and geopolitics impose on Belgium the role of a maritime state controlling a key segment of a highly sensitive and exploited sea. Scientific research contributes to the visibility of Belgium in the management of the North Sea basin. The scientific potential for this exists in the country and must not be allowed to decline.
- Set the Belgian effort in an international context: UNEP and its action plans on Regional Seas, IOC and its focus on data management and training, OSPAR and other conventions, ICES and its focus on the North Atlantic. Belgium is a partner country in the activities of all these organisations. Maintaining an adequate Belgian research infrastructure to support these international obligations is essential. This can be achieved by keeping Belgian teams active in research, giving them incentives and an appropriate framework to co-operate, and maintaining their visibility, expertise and credibility, both within the country and internationally**.**

Widening the scope of marine research

- Develop a long-term vision (10 years or so) for marine research in Belgium, implying long-term commitment and support at the policy level: this will ensure programme stability, allow research institutes to develop their own strategies, slow down brain drain of post-docs, etc.
- Take a holistic approach to programme development by including the North Sea coastal margin and its whole catchment area (freshwater and atmospheric inputs). Make the initiative national and visible in a clearly labelled section of a Sustainable Development programme and structure the overall programme in a way that provides opportunities for action at a regional level.
- Aim for organisational flexibility of research in universities and other institutes. This should include the creation of inter-institutional interdisciplinary networks which can evolve into scientific centres of excellence in environmental sciences related to marine-coastal-catchment areas.
- While focusing on the North Sea basin and the North East Atlantic, provide opportunities to extend expertise into other seas (the Atlantic Ocean, the Mediterranean, the Southern Ocean [30], etc.).
- Develop Integrated Coastal Zone Management in Belgium, starting with a pilot scheme in a defined area of the Belgian coast.
- Undertake a comparative socio-economic analysis of research programmes and their level of staffing/funding in North Sea countries.

Planning future research programmes

- Introduce the practice of 5-year 'rolling programmes' in order to avoid gaps between phases and stabilise the research potential of institutes.
- Present packages of funding possibilities with topics that require a limited number of calls for proposals (strategic-type projects) and topics that only require specific tenders (targeted-type actions).

[30] The Souhern Ocean has been dealt with until now in the BELSPO Antarctic programme from 1985. See evaluation report *The Belgian Antarctic Programme 1985-2002*

- In the definition of strategic actions, enable bottom-up and top-down approaches to merge by encouraging scientists to formulate their research priorities through the preparation of a 'Science Plan' at the time of programme inception by BELSPO.
- Establish a road map of programme implementation, with appropriate statements of objectives, general conditions and milestones. Not only will it help scientists plan their research and their proposals, it will also inform enquirers from abroad and contribute to the visibility of Belgian science.
- Place greater focus on the applicability of research findings to policy, services and industrial activities.
- Promote more actively the training and mobility of researchers and provide adequate incentives to post-docs for careers in Belgium.
- Consider seconding senior scientists to BELSPO

Improving national co-ordination and interactions

- Improve interactions between political levels in the country (Federal/Regional/Community) and between various stakeholders (Academy, Ministries…).
- Co-ordinate Federal and Regional/Community research initiatives in order to assemble programme ideas and prevent risks of duplication.
- Give a better defined role to the Programme Steering Committee (PSC) with clear written terms of reference and a regular timetable for meetings.
- Set up a Scientific Advisory Council with international participation in order to guarantee a neutral input into the decision-making process of the PSC.
- Seek ways to improve interactions between BELSPO and researchers: dedicated workshops to prepare science plans and to clarify implementation procedures; regular visits to laboratories; regular feed-back on project reports.
- Improve co-ordination between project networks, notably by organising annual or biannual informal workshops to exchange results and ideas.
- Create an BELSPO electronic Newsletter to keep funded scientists informed of progress in the programme.
- Consider the possibility of creating a 'Belgian Marine Society' to contribute to the advancement of research and education in marine science and technology, disseminate information and promote the advancement of marine science and technology in Belgium.
- Assure an appropriate composition and Terms of Reference for Project User Groups (PUG) with a view to achieving a balance of interests and an active participation of members.
- Ensure that PUGs and project teams interact effectively.
- Avoid excessive diversity of responsibilities into any one organisation to ensure transparency in the Belgian marine scene.

Strengthening international co-operation

- Continue to play an active role in conventions and fora addressing the North Sea.
- Continue to build on international and European partnerships developed at various scales, especially during EC/EU research programmes (Environment, MAST…), and be an active promoter of the new European Research Area, a concept that lends itself ideally to be tested in marine research.
- Seek to improve co-ordination with research programmes of other North Sea countries (opportunities to share expertise, experience, costs and the use of major infrastructures).

Improving the operational management of projects

- Where relevant, improve the effectiveness of operational management: review and harmonise the reporting regime, avoid unnecessary fragmentation of calls for proposals, simplify the accompanying documentation of calls.
- Set up internal communication systems within each project network, publish records of project meetings on the web.
- Place greater emphasis than before on the dissemination and exploitation of results by the project teams.
- Carry out mid-term and / or *ex post* evaluations of research projects
- Do not wait 30 years before undertaking the next major review of BELSPO research – undertake regular reviews at say 5 year intervals or at the end of each programme.
- In the next review assess progress against the actions identified here.

Formulating a national data policy for Belgium

- There should be only one National Oceanographic Data Centre (NODC).
- Establish under the auspices of BELSPO a mechanism to improve links and if possible merge the two data centres in Belgium (MUMM and VLIZ).
- Develop a 'national data policy' with criteria for the use of data (e.g., agreements between data producers and data archiving centres) and provisions for data availability.

Introducing the concept of a national Virtual Network

- Develop a Virtual Network of all Belgian marine research players (Universities, Federal and Regional Research administrations and Institutes, Research Vessels, SMEs, a chemical analytical centre and specimen bank, Museums, etc.).
- Once fully developed, the network will be organised around a Belgian Oceanographic Institute, preferably located in Ostend (or alternatively bilocated in Ostend and Brussels), that will host the National Oceanographic Data Centre, a National Centre for the co-ordination of marine monitoring, and other facilities for scientists, students and the general public.
- Develop the Virtual Network by incorporating units from existing MUMM facilities for chemistry and monitoring (that are already in Ostend) into the BOI and by formalising links to AWZ, DVZ and VLIZ and establishing a small French-speaking component with a co-ordinating remit similar to VLIZ. Various adaptations will be needed to the existing organisation and mandates, especially of MUMM and VLIZ.
- The establishment of the Virtual Network should be progressive and should evolve from existing institutional structures and staff. An economic analysis should be undertaken to compare marine infrastructures in other North Sea states.
- The success of the Virtual Network depends on the commitment of the science community and a political / financial endorsement from the Federal State and the Regions.

Informing the Belgian citizen about marine research

- Educate Belgian citizens about the North Sea, their sea.
- Promote public awareness of the benefits of marine research, moving from simple curiosity (e.g. about charismatic species) to some understanding of ecosystem management and of anthropogenic impacts.
- Inform the public about research projects and their outcomes in media such as television, newspapers and the internet.

Annexes

Annex 1 Abbreviations

Acronym		Web site
AEWA	African – Eurasian Waterbird Agreement (UNEP)	http://www.unep-wcmc.org/AEWA
AMINAL	Flemish Administration for Environmental, Nature, Land and Water Management	http://www2.vlaanderen.be/ned/sites/milieu
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas	http://www.ascobans.org
ASFA	Aquatic Sciences and Fisheries Abstracts	http://www.fao.org/fi/asfa/asfa.asp
AWI	Science and Innovation Administration of the Flemish Community	http://www2.vlaanderen.be/ned/sites/overheid/mvg
AWZ	Waterways and Marine Affairs Administration (Flanders)	http://www.lin.vlaanderen.be/awz
BBPF	Belgian Biodiversity Platform	http://www.biodiversity.be/bbpf
BELSPO	Belgian Science Policy	http://www.belspo.be
BOI	Belgian Oceanographic Institute	
CCIEP	Coordination Commission for International Environmental Policy	
CEMO	Centre for Estuarine and Marine Research	http://www.nioo.knaw.nl/CEME
CEMP	Co-ordinated Environmental Monitoring Programme (OSPAR)	
CMS	Convention on the Conservation of Migratory Species of Wild Animals (UNEP)	http://www.unep-wcmc.org/cms
CODA	Conservation Options and Decision Analysis	
COST	European Co-operation in the field of Scientific and Technical Research	http://cost.cordis.lu/src
CPMR	Conference of Peripheral Maritime Regions	http://www.crpm.org
CRA	Concerted Research Actions	
CSR	Cruise Summary Report (ROSCOP)	
CWD	Coastal Waterways Division (AWZ)	
DGENORS	Directorate General for non-obligatory Education and Scientific Research of the French Community (Direction Générale de l'Enseignement non obligatoire et de la Recherche scientifique)	http://www.cfwb.be/infosup
DGTRE	Directorate for Technologies, Research and Energy of the Walloon Region (Direction Générale des Technologies, de la Recherche et de l'Energie)	http://mrw.wallonie.be/dgtre
DNA	Designated National Agency	
DVZ	Sea Fisheries Department (Rijksstation voor Zeevisserij)	http://www.dvz.be
EC	European Community	
ECOLAS	Environmental Consultancy & Assistance	http://www.ecolas.com
EDMED	European Directory of Marine Environmental Datasets	http://www.sea-search.net/edmed
EDMERP	European Directory of Marine Environmental Research Projects	http://www.sea-search.net/v_edmerp
EEZ	Exclusive Economic Zone	
EFMSTS	European Federation of Marine Science and Technology Societies	www.efmsts.org
EHEA	European Higher Education Area	
EPBRS	European Platform for Biodiversity Research Strategy	http://www.bioplatform.info/EPBRS

ERA	European Research Area	http://www.cordis.lu/era
ERDF	European Regional Development Fund	http://europa.eu.int/scadplus/leg/en/lvb/l60015.htm
ESF	European Science Foundation	http://www.esf.org
EU	European Union	
EuroGOOS	Association of Agencies to further the goals of GOOS, and in particular the development of Operational Oceanography in the European Sea areas and adjacent oceans	http://www.eurogoos.org
FCSD	Federal Council for Sustainable Development	http://www.belspo.be/frdocfdd/en
FH	Flanders Hydraulics	http://watlab.lin.vlaanderen.be
FLEX '76	Fladen Ground Experiment 1976 (a JONSDAP measurement programme)	
FNRS	National Scientific Research Fund (Fonds National de la Recherche Scientifique)	http://www.fnrs.be
FP	Framework Programme (EC)	
FWO	Fund for Scientific Research (Fonds voor Wetenschappelijk Onderzoek)	http://sun.fwo.be
FUNDP	Interuniversity Faculties of Notre-Dame de la Paix in Namur Facultés Universitaires Notre-Dame de la Paix à Namur)	http://www.fundp.ac.be/
GDP	Gross Domestic Product	
GOOS	Global Ocean Observing System	http://ioc.unesco.org/goos
IBGP	International Geosphere-Biosphere Programme	http://www.igbp.kva.se
ICE	Interministerial Conference on the Environment	http://www.environment.fgov.be/Root/tasks/coordination/coordiN.htm#05
ICES	International Council for the Exploration of the Sea	http://www.ices.dk
ICSU	International Council of Scientific Unions	http://www.icsu.org
ICZM	Integrated Coastal Zone Management, an EC Demonstration Programme	http://europa.eu.int/comm/environment/iczm
IDOD	Integrated and Dynamical Oceanographic Data management	
IMIS	Integrated Marine Information System (VLIZ)	http://www.vliz.be/vmdcdata/imis
IMO	International Maritime Organisation (UN)	http://www.imo.org
IN	Institute of Nature Conservation	http://www.instnat.be
INOUT	a JONSDAP measurement programme from 1976	
INTERREG	Interregional Cooperation Programme	http://europa.eu.int/comm/regional_policy/interreg3
IOC	International Oceanographic Commission (UNESCO)	http://ioc.unesco.org
IODE	Oceanographic Data and Information Exchange (IOC)	http://ioc.unesco.org/iode)
IPMS	Impulse Programme Marine Sciences (BELSPO)	
IPR	Intellectual Property Rights	
IRMA	Institute for Marine Research and the Interaction Air-Sea (Institut de Recherches marines et d'Interactions Air-Mer)	http://www.ulg.ac.be
IWT	Institute for the Promotion of Innovation through Science and Technology (Instituut voor de aanmoediging van Innovatie door Wetenschap en Technologie)	http://www.iwt.be

IZWO	Institute for Marine Scientific Research (Instituut voor Zeewetenschappelijk Onderzoek)	
JGOFS	Joint Global Ocean Flux Study (IBGP)	http://www.uib.no/jgofs
JONSIS	Joint North Sea Information System	
JONSDAP 73	Joint North Sea Data Acquisition Project	
JONSMOD		
KMMA / MRAC	Royal Museum for Central Africa (Koninklijk Museum voor Midden-Afrika / Musée Royal d'Afrique Central)	
KULeuven	Catholic University of Leuven (Katholieke Universiteit Leuven)	http://www.kuleuven.ac.be
LIFE	funding instrument from the European Regional Development Fund	http://europa.eu.int/comm/environment/life
LIN	Flemish Administration for Environment and Infrastructure	http://www.lin.vlaanderen.be
LOICZ	Land Ocean Interactions in the Coastal Zone	http://www.nioz.nl.loicz
LUC	University Centre of Limburg (Limburgs Universitair Centrum)	http://www.luc.ac.be
MAGELAS	Marine Geological Assistance	http://www.magelas.be
MARPOL	International Convention for the Prevention of Pollution from Ships (IMO)	
MAST	Marine Science and Technology (EC)	http://europa.eu.int/comm/research/marine
MIDAS	Marine Information and Data Acquisition System (VLIZ)	
MUMM	Management Unit of the North Sea Mathematical Models	http://www.mumm.ac.be
NATO	North Atlantic Treaty Organisation	http://www.nato.int
NGO	Non Governmental Organisation	
NODC	National Oceanographic Data Centre	
NSTF	North Sea Task Force	
NWO	Netherlands Organisation for Scientific Research	http://www.nwo.nl
OBIS	Ocean Biogeographic Information System/Census of marine life	http://marine.rutgers.edu/OBIS
ODAS	Oceanographic Data Acquisition System (MUMM)	http://www.mumm.ac.be/EN/Monitoring/DataCenter/datatypes.php
OMEX	Ocean Margin Exchange	http://www.pol.ac.uk/bodc/omex
OPRC	International Convention on Oil Pollution Preparedness, Response and Co-operation (IMO)	http://www.imo.org/Conventions/mainframe.asp?topic_id=258&doc_id=682
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic	http://www.ospar.org
PSC	Programme Steering Committee	
PUG	Project Users Group	
QSR	Quality Status Report (OSPAR)	
QUASH	Quality Assurance of Sampling and Sample Handling	
QUASIMEME	Quality Assurance of Information for Marine Environmental Monitoring in Europe (EC)	
R&D	Research and Development	
RBINS	Royal Belgian Institute for Natural Sciences (Institut Royal des Sciences Naturelles de la Belgique / Koninklijk Belgisch Instituut voor Natuurwetenschappen)	http://www.kbinirsnb.be
RAMSAR	Convention on Wetlands, signed in Ramsar, Iran	http://www.ramsar.org

RIB	Rigid Inflatable Boat	
RIKZ	National Institute for Coastal and Marine Research (Netherlands)	http://www.rikz.nl
RIVO	Netherlands Institute for Fisheries Research	http://www.rivo.dlo.nl
RNODC	Responsible National Oceanographic Data Centre	
ROSCOP	Report of Observations/Samples collected by Oceanographic Programmes	http://www.ices.dk/ocean/roscop
RV	Research Vessel	
SCNSO	Steering Committee for the North Sea and Oceans	
SCOPE	Scientific Committee on Problems of the Environment	http://www.icsu-scope.org
SCOR	Scientific Committee on Oceanic Research (ICSU)	http://www.jhu.edu/~scor
SLAR	Side Looking Airborne Radar	
SME	Small and Medium-Sized Enterprise	
SPSD	Scientific Support Plan for a Policy on Sustainable Development (BELSPO)	
SRI-DOI	Research and Innovation Office of the Brussels-Capital Region	http://www.bruxelles.irisnet.be/EN/1EN_admi/1EN_3ADM/eco/ondin.htm
STEP	Science and Technology for the Environmental Protection (EC)	
STEREO	BELSPO Research programme for earth observation	http://telsat.belspo.be/about/ostc.html#stereo
TERRA	funding instrument from the European Regional Development Fund	http://europa.eu.int/comm/regional_policy/innovation/innovating/terra
UA	University of Antwerp	http://www.ua.ac.be
UA-RUCA	UA-National University Centre of Antwerp (Rijksuniversitair Centrum Antwerpen)	http://www.ruca.ua.ac.be
UA-UIA	UA-University Institution of Antwerp (Universitaire Instelling Antwerpen)	http://www.ua.ac.be/uia
UCL	Catholic University of Louvain-la-Neuve (Université Catholique de Louvain-la-Neuve)	http://www.ucl.ac.be
UGent	University of Gent (Universiteit Gent)	http://www.ugent.be
ULB	Free University of Brussels (Université Libre de Bruxelles)	http://www.ulb.ac.be
ULg	University of Liège (Université de Liège)	http://www.ulg.ac.be
UMH	University of Mons-Hainaut (Université de Mons-Hainaut)	http://www.umh.ac.be
UN	United Nations	
UNCED	United Nations Conference on Environment and Development	http://www.unep.org/unep/partners/un/unced
UNCLOS	United Nations Convention on the Law of the Sea	http://www.unclos.com
UNECE	United Nations Economic Commission for Europe	http://www.unece.org
UNEP	United Nations Environment Programme	http://www.unep.org
UNESCO	United Nations Educational, Scientific and Cultural Organization	http://www.unesco.org
VIB	Flemish Institute for Biotechnology	http://www.vib.be/frame.cfm
VLIZ	Flanders Marine Institute (Vlaams Instituut voor de Zee)	http://www.vliz.be
VMDC	Flanders Marine Data Centre (VLIZ)	
VUB	Free University of Brussels (Vrije Universiteit van Brussel)	http://www.vub.ac.be

WDC	World Data Centre	
WDF	Water Framework Directive (EU)	http://europa.eu.int/comm/environment/water/water-framework
WGMDM	Working Group on Marine Data Management (ICES)	http://www.ices.dk/committe/occ/mdm
WMO	World Meteorological Organisation	http://www.wmo.ch
WWW	World Wide Web	

Annex 2 Databases

MUMM (Management unit of the mathematical model of the North Sea and the Scheldt estuary) hosts an oceanographic data centre

MUMM is setting up tools to receive, manage, store and circulate marine data. MUMM's scientific vocation also means that it can integrate into this 'management' the scientific exploitation of data, for its own or 'external' needs (assistance for other scientists, assistance with political decision-making, international relations). For these purposes, over the past few years MUMM has built up a centre of human and technical expertise. The preparatory phase of the new database on the marine environment will come to an end - to the extent that this concept has any meaning in the context of computer developments – towards the middle of 2002. These developments complement the 'ODAS' database (Oceanographic Data Acquisition System) which is basically intended to store the data constantly acquired by the *Belgica* or obtained through anchored instruments of MUMM. The data stored at MUMM primarily concern the zone of the Belgian continental shelf and the Scheldt estuary and cover the past thirty years.

- Data acquired in real-time (ODAS):
  The real-time data acquisition system 'ODAS' (Oceanographic Data Acquisition System) gathers and processes up to 200 parameters. The corresponding database is updated virtually in real time. In addition to the physical and chemical parameters measured constantly since 1984 during each *Belgica* campaign (~200 days/year), it contains a substantial collection of current and wave measurements taken during long-term anchorage in the nineteen seventies and eighties, as well as CTD profiles since 1984.
- Data on the quality of the marine environment (IDOD, financed by the BELSPO in the framework of *SPSD*):
  The database on the quality of the marine environment (IDOD, Integrated Dynamical Oceanographic Data Management) mainly contains the concentrations of numerous substances in the air, the water, the sediment and the biota (that is, in living organisms). These values are the result of measurements taken in situ and analyses carried out in laboratories. In addition to the concentrations, quantitative information on the biota is also stored. These values would be pointless if they were not accompanied by precise information about the circumstances in which they were measured. This is what is known as 'meta-information', a term that covers information such as the position in which samples were taken, the date, the time, the weather conditions, the sampling and analysis methods used, etc. This database has just been brought into use and currently contains several tens of thousands of items. An inventory and detailed description of other data are currently being prepared, with a view to planning their incorporation into the information system. All these data, documented and verified, constitute a coherent and unique source of information for scientists and other users.
- Data catalogues
  Alongside real measurements, MUMM has worked together with scientists and institutions to build up various data inventories. For example, there is an inventory of Belgian marine research projects and an inventory of sets of Belgian data on the marine environment. In the context of the Sea-Search web site, these inventories are used to add to European catalogues, which can be consulted on the Internet. EDMERP = European Directory of Marine Environmental Research Projects (http://www.sea-search.net/v_edmerp/search.asp); EDMED = European Directory of Marine Environmental Datasets (http://www.sea-search.net/edmed/welcome.html).

VLIZ (Flanders Marine Institute) hosts various databases through its Flanders Marine Data Centre (VMDC):

- Integrated Marine Information System (IMIS): A database combining information on expertise and institutions, projects, conferences, and literature, developed and maintained at the VMDC.
- North Sea Benthos Survey (NSBS): Biogeographic/taxonomic database of North Sea Benthos (including results of the Benthic Ecology Working Group of ICES).
- Aphia: Marine species register for the North Sea: Used to support other biological database activities on the North Sea currently undertaken at VLIZ.
- Marine Species Database for Eastern Africa (MASDEA): Biogeographic/taxonomic database of marine species in the Western Indian Ocean/East Africa.
- Ecotox: Database with properties and risk and safety phrases of poisonous chemicals transported over the North Sea, and ecotoxicology tests on these chemicals.
- Monitoring Network Flemish Banks (Meetnet Vlaamse Banken): Set up for the acquisition of real-time oceanographic and meteorological data along the Belgian coast and on the Belgian continental shelf. Oceanographic parameters: waves, tidal height, current and water temperature. Meteorological parameters: wind, air pressure, air temperature and rainfall.
- Marine Information and Data Acquisition System (MIDAS): Developed by VLIZ to plan the ship time of the RV *Zeeleeuw*, to register information on scientific activities and to monitor navigational, meteorological and oceanographic parameters during the cruises.

Annex 3.1 Phase I - Research contracts from the 'First National Research & Development Programme on the physical and biological environment 'water pollution': Coastal sea and estuaries' (*Project Sea*) (1970 – 1976)

No.	Title project	Cat [1]	Promotor	Institute		Grant			Duration		
				name	cat [2]	original [3]	extension	total	orig.	ext.	total
						[Euro]			[months]		
1	'Establishment and development of the general co-ordination model; Hydrodynamics; Sea-air interactions; Informatics; Data compilation; Centralisation, selection and treatment of meteorological data concerning the North Sea'	D H M	Nihoul	ULg	u	310,868	280,120	590,987	38	24	71
2	'Documentation centre; Chemical parameters (routine measurements, selective measurements); Physiological studies; Co-ordination of the collection of physiological information'	C D P	Distèche	ULg	u	200,080	153,198	353,278	38	24	71
3	'Zooplankton'	B P	Godeaux	ULg	u	40,007	63,659	103,666	38	24	71
4	'Dynamics of sedimentation and sea-air interaction'	M S	Nihoul	UCL	u	55,107	42,886	97,992	38	24	62
5	'Sediment chemistry: North Sea and estuaries; Research on dissolved silicium'	C E S	Wollast	ULB	u	91,097	155,033	246,129	38	24	71
6	'Physiological studies; Chorophyls and primary productivity; Zooplankton and phytoplankton; Co-ordination of biological studies'	B P	Bouillon	ULB	u	224,615	188,077	412,691	38	24	62
7	'Sediments and suspension; Co-ordination on sedimentation studies'	S	Gullentops	KULeuven	u	47,274	54,735	102,009	38	24	62
8	'Phytoplankton'	B	Louis	KULeuven	u	71,173	31,061	102,234	38	24	62
9	'Chemical parameters (routine measurements, selective measurements, food chain); Co-ordination of the whole chemical programme of the model (incl. co-ordination with the group Physiology)'	C	Elskens	VUB	u	140,661	173,996	314,657	38	24	71
10	'Pesticides'	B C	Vercruysse	VUB	u	46,903		46,903	38		38
11	'Primary production and nanoplankton; Zooplankton (incl. co-ordination); Planktonic marine bacteria'	B	Polk	VUB	u	142,414	254,983	397,397	38	24	71
12	'Microbiology'	B	Boeye	VUB	u	55,345	51,587	106,932	38	24	62
13	'Macrobenthos and meiobenthos (incl. co-ordination of the group Biology)'	B	De Coninck	UGent	u	85,997	136,242	222,239	38	24	71
14	'Microbenthos'	B P	Persoone	UGent	u	36,670	63,411	100,081	38	24	71

15		'Inventory of the sea pollution; Studies and research on fish and crustaceans; Inventory of water course pollution; Other chemical and bacteriological determinations'	B C	Herman	IRC / ISO	r-pu	4,462	24,294	28,756	8	24	41
16		'Changes in the full life cycle of fish; Obstruction of the fishing activity; Study of taste changes and composition'	B	Hovart	RVZV	r-pu	74,972	128,012	202,984	38	24	71
17		'Analysis of pesticides'	C	Henriet	SP	r-pu	42,276	95,910	138,185	38	24	62
18		'Chemical parameters'	C	Capart	RBINS	r-pu	67,360		67,360	38		38
19		'Coastal flora and fauna'	B C	Capart	RBINS	r-pu	16,485	35,598	52,082	38	24	62
20		'Sedimentation and sediment chemistry'	C S	Capart	RBINS	r-pu	26,134	33,272	59,406	38	24	71
21		'Establishment of a mineralogical map of the mathematical model network'	C S	Laurent	ERM / KMS	r-pu	12,395		12,395	24	12	36
22	a	'Inventory of pollutants: sea, water courses, other determinations (metals, pesticides, bacteriology)'	C	Bouquiaux	IHE	r-pu	73,738	80,883	154,621	38	24	71
	b	'Analysis of pesticides'	C	Gordts	IHE	r-pu	37,784		37,784	38	24	62
	c	'Bacteriological programme'	B	Lafontaine	IHE	r-pu	42,972	48,885	91,857	38	24	62
23		'Chemical parameters (routine measurements, selective measurements)'	C	Duyckaerts	ULg	u	28,934	69,162	98,096	12	24	36
24		'Data collection; Data compilation and exploitation'	D L M	Pichot	ULg	u	175,409		175,409	24	9	33
25		'Identification and elimination of interferences through mass spectrometry (within the studies on pesticides, food chain, physiology)'	C	Van Binst	VUB	u	81,086		81,086	24		24
Total							**2,232,215**	**2,165,002**	**4,397,218**			
Average per team							**82,675**	**80,185**	**162,860**	**34**	**24**	**59**

[1] Category of research (interpreted from the contracts):

B	Biology	H	Hydrodynamics
C	Chemistry	L	Logistics
D	Data collection	M	Modelling
E	Estuaries	P	Physiology
H	Hydrodynamics	S	Sedimentation

[2] Institute category: u university; r-pu public research institute

[3] Including salary adjustments made during the course of the original project period

Notes: Contract # 23 concerns the operation of the research vessel.

Source: BELSPO contracts

Annex 3.2 Phase 2 - Research contracts from the 'Concerted Research Actions: Interuniversity Action Oceanology' (1976 – 1981)

No.	Title project	Cat [1]	Promotor	Institute		Grant			Duration		
				name	cat [2]	original	extension	total	orig.	ext.	total
						[Euro]			[months]		
1	Oceanology - Modelling of marine system dynamics; Hydrodynamics; Physical oceanography and meteorology; Data treatment	M	Nihoul	ULg	u	607,339		607,339	72		72
2	Oceanology - Marine ecotoxicology; Chemical oceanography; Instrumental oceanography	C D E	Distèche	ULg	u	540,408		540,408	72		72
3	Oceanology - Chemical oceanology; Instrumental oceanology	C D	Elskens	VUB	u	607,339		607,339	72		72
4	Oceanology - Biotic elements in the marine ecosystem and in the marine system dynamics: Phytoplankton activity; Zooplankton activity; Bacterioplankton activity; Participation in the calibration of the model parts dealing with above studies	B M	Polk	VUB	u	423,898		423,898	72		72
5	Oceanology - Benthos and its relations in marine system dynamics: Benthic dynamics and production; Coastal zone; Scheldt area; Participation in the calibration of the model parts dealing with above studies	B	De Coninck	UGent	u	369,361		369,361	72		72
6	Oceanology - In vitro study of the transfer coefficients between trophical levels of the food chain in view of their exploitation in mariculture: In vitro study of energy transfer; Uptake of hydrodynamic, chemical and biological parameters in fishery models	B M	Persoone	UGent	u	371,840		371,840	72		72
7	Oceanology - Exogenic contributions into the marine ecosystem; Interactions between the water column, sediments, and the waters in between	C M	Wollast	ULB	u	490,829		490,829	60		60
Total						**3,411,015**		**3,411,015**			
Average per team						**487,288**		**487,288**	**70**		**70**

[1] Category of research (interpreted from the contracts): B Biology; C Chemistry; D Data collection; E Ecotoxicology; H Hydrodynamics; M Modelling

[2] Institute category: u university

Source: BELSPO contracts

Annex 3.3 Phase 3 - Research contracts from other 'Concerted Research Actions' (1982 – 1993)

No.		Title project	Cat [1]	Promotor	Institute		Grant			Duration		
					name	cat [2]	original	extension	total	orig.	ext.	total
							[Euro]			[months]		
1		Benthos in marine ecosystems and environmental pollution – Marine ecosystems; Pollution of Belgian coast waters and the estuary of the western part of the Scheldt	B C E	Coomans Heip	UGent	u	535,202		535,202	51		51
2		Ecohydrodynamic study of oceanic fronts – Modelling of oceanic fronts; Physical, chemical and biological measurements; Production comparisons; Ecohydrodynamical front modelling; Evaluation of front influences; Comparative hydrodynamic studies concerning various marine types	H M	Distèche Godeaux Nihoul	ULg	u	532,971		532,971	72		72
3	a	Ecology and geochemistry of marine systems – Ecological functions; Biotransfers of stable pollutants; Geochemistry of heavy metal traces [3]	B	Elskens	VUB	u	463,189		463,189	66		66
	b		C E	Polk	VUB	u	490,953		490,953	66		66
4		Marine geology – Sediment dynamics and morphodynamics; Seismic stratigraphy; Tithostratigraphy [3]	G S	De Moor Henriet Jacobs Marechal	UGent	u	1,459,225		1,459,225	57		57
5		Oceanology: Microbiological study of basic processes which govern the circulation of organic matter in the marine and estuary environments [3]	B	Billen	ULB	u	631,459		631,459	72		72
6		Chemistry of the North Sea – Biogeochemical cycles of heavy metals in the North Sea; Atmospheric pollution by heavy metals above the North Sea and the evaluation of air-sea interaction processes; Material flux from the Scheldt estuary to the North Sea; Material input and transport through discharges, exploitation of sand and dredging [3]	C	Van Grieken	UA-UIA	u	677,989		677,989	66		66
7		Study of the lobster *Artemia* with regard to the improvement of its use in the foodchain as a source of food in aquaculture	B	Sorgeloos	UGent	u	558,578		558,578	72		72
Total							**5,349,567**		**5,349,567**			
Average per team							**668,696**		**668,696**	**65**		**65**

[1] Category of research (interpreted from the contracts): B Biology; C Chemistry; E Ecotoxicology; G Geophysics; H Hydrodynamics; M Modelling; S Sedimentation

[2] Institute category: u university

[3] participation to the 'Interuniversity Concerted Research Action North Sea'

Source: BELSPO contracts

Annex 3.4 Phase 4 - Research contracts from the 'Impulse Programme: Marine Sciences' (1992 – 1997)

No.		Title project	Cat [1]	Promotor	Institute		Grant			Duration		
					name	cat [2]	original	extension	total	orig.	ext.	total
							[Euro]			[months]		
1	a	Molecular dynamics of metal uptake, turnover and accumulation	A1	Decleir	UA-RUCA	u	176,004	9,445	185,449	48	6	54
	b	in marine organisms from the North Sea		Moens	UA-UIA	u	99,157	6,346	105,503	48	6	54
2		Marine ecotoxicology: distribution, fluxes and biological effects of pollutant metals in the asteroid *Asterias rubens*, a key species of North Sea littoral environments	A1	Jangoux	ULB	u	257,809	11,973	269,783	48	8	56
3	a	Pathological and ecotoxicological study of seabirds and marine	A1	Joiris	VUB	u	272,683	17,353	290,035	48	6	54
	b	mammals in the North Sea and adjacent areas		Bouquegneau	ULg	u	138,820	9,122	147,943	48	6	54
	c			Coignoul	ULg	u	109,073	55,305	164,378	48	6	54
4	a	Intercompartment distribution of mono-aromatic hydrocarbons	A1	VanLangenhove	UGent	u	210,709	11,626	222,336	48	6	54
	b	and C_1-C_2 organochlorines in the North Sea environment		Hovart	CLO	r-pu	235,499	10,164	245,662	48	6	54
5		Study of geochemical cycles of particulate heavy metals and organic micropollutants in the North Sea environment	A1	Van Grieken	UA-UIA	u	247,894	20,302	268,196	48	6	54
6		Transfer and behaviour of trace metals in the Scheldt estuary	A1	Wollast	ULB	u	347,051	22,856	369,907	48	6	54
7		Dynamics of coastal eutrophicated systems	A2	Billen	ULB	u	470,998	27,987	498,985	48	7	55
8		Structure and function of the benthos in estuarine and coastal marine ecosystems in relation to the present and future anthropogenic impact	A2	Coomans Vincx	UGent	u	470,998	34,804	505,802	48	6	54
9		Modeling and simulation of the zooplankton grazing pressure in the North Sea ecosystem: a practical and theoretical approach	A2	Hecq	ULg	u	272,683	14,973	287,656	48	6	54
10		Effects of pollution on macrozoobenthic communities in the Scheldt estuary	A2	Kuijken	IN	r-pu	247,894	16,683	264,577	48	6	54
11		Definition and application of ecological criteria and economic indicators to assess impacts and costs of various types of pollution in the North Sea	B	Persoone	UGent	u	371,840	98,711	470,551	36	18	54
12		Towards a future Belgian policy for the protection of the North Sea: Social and economic impacts	B	Somers	UGent	u	210,709	13,138	223,848	36	18	54
13		Feasibility study for a common marine scientific infrastructure	C	Vanhaecke	ECOLAS	r-pr	65,912		65,912	11		11
Total							**4,205,734**	**380,789**	**4,586,523**			
Average per team							**247,396**	**22,399**	**269,795**	**44**	**7**	**52**

[1] Category of research: A Dynamics of the Marine ecosystem: 1 Heavy metals and organic micropollutants 2 Eutrophication
B Interactions between the marine ecosystem and the economic and social system
C Specific action (programme management)

[2] Institute category: u university r-pr private research institute r-pu public research institute

Source: BELSPO contracts

Annex 3.5 Phase 5 - Research contracts from the 'Scientific Support Plan for a Sustainable Development Policy, Phase I: Sustainable management of the North Sea' (1997 – 2003)

No.		Title project [1]	Cat [2]	Promotor	Institute		Grant			Duration		
					name	cat [3]	original	extension [Euro]	total	orig.	ext.	total [months]
1		'Biogeochemistry of nutrients, metals and organic micropollutants in the North Sea':	B									
	a	Air-water exchange of nutrients and organic micropollutants		Van Grieken	UA-UIA	u	545,366		545,366	60	3	63
	b	Biogeochemistry of nutrients and trace elements in the estuary of the Scheldt and the Souhern Bight of the North Sea		Goeyens	VUB	u	541,697		541,697	60	3	63
	c	Air-water exchange of organic micropollutants in the North Sea		Van Langenhove	UGent	u	309,867		309,867	60	3	63
	d	Biogeochemical behaviour of trace elements in the North Sea		Wollast	ULB	u	309,867		309,867	60	3	63
2		'AMORE (advanced modeling and research on eutrophication): Eutrophication and the structure of coastal planktonic food-webs: mechanisms and modeling':	A									
	a	Phytoplankton, bacteria and protozooplankton dynamics: mechanisms and modeling		Lancelot	ULB	u	594,944		594,944	60	2	62
	b	Mesozooplankton feeding and food resources		Daro	VUB	u	309,867		309,867	60	2	62
	c	Physical controls on plankton dynamics and associated spatio-temporal variability: direct and inverse modeling		Pichot	MUMM	r-pu	215,667		215,667	60	2	62
3		'ICAS, Impact of sediment-associated heavy metals and polychlorinated biphenyls on North Sea biota':	B									
	a	Impact of sediment-associated heavy metals and polychlorinated biphenyls on postmetamorphic echinoderms of the North Sea		Dubois	ULB	u	446,208		446,208	60	4	64
	b	Impact of sediment-associated heavy metals and polychlorinated biphenyls on the premetamorphic development and perimetamorphic period of echinoderms of the North Sea		Jangoux	UMH	u	252,851		252,851	60	1	61
	c	Impact of sediment-associated polychlorinated biphenyls on echinoderms of the North Sea: analysis of ICES-recommended and non-ortho-substituted coplanar congeners		Flammang	UMH	u	193,357		193,357	60	4	64
4		'Structural and functional biodiversity of North Sea ecosystems':	C									
	a	Biodiversity of North Sea benthos and nekton		Vincx	UGent	u	628,906		628,906	60	6	66
	b	Biodiversity of the Belgian marine avifauna		Kuijken	IN	r-pu	309,669		309,669	60	6	66
	c	Genetic biodiversity of ecological important species in the North Sea ecosystem		Ollevier	KULeuven	u	309,867		309,867	60	6	66
5		'North Sea seabirds and marine mammals: pathology and ecotoxicology':	B									

	a	Inorganic pollutants		Bouquegneau	ULg	u	297,472		297,472	60	3	63
	b	Pathology		Coignoul	ULg	u	297,472		297,472	60	6	66
	c	Organic pollutants		Joiris	VUB	u	306,892		306,892	60	6	66
	d	Mortality at sea of oil-contaminated birds		Meire Kuijken	IN	r-pu	245,563		245,563	60	6	66
	e	Mortality in sea by oil-contaminated birds			MUMM	r-pu	61,973		61,973	60	6	66
6		'IDOD, Integrated and Dynamical Oceanographic Data management':	E									
	a	Information system design and set-up		Pichot	MUMM	r-pu	594,944		594,944	60	6	66
	b	Database design and geo-referenced data handling tools		Donnay	ULg	u	285,078		285,078	60	6	66
	c	Quality control and data analysis tools		Billiet	KULeuven	u	309,867		309,867	60	6	66
7		'MARE-DASM, Marine Resources Damage Assessment and Sustainable Management of the North Sea: Assessment of marine degradation in the North Sea and proposals for a sustainable management':	D									
	a	Development of socio-economic assessment criteria enabling the		Maes	UGent	u	286,317		286,317	48		48
	b	objective determination of the cost price of this degradation; Development and evaluation of governmental measures to guaranteeing an integrated management and sustainable use of the North Sea; Development of technical and juridical procedures enabling the evaluation of the degradation of the marine environment, including financial claims to the polluter		Vanhaecke	ECOLAS	r-pr	254,091		254,091	48		48
	c	Identification and quantification of the various factors contributing to the degradation of the marine environment		Janssen	UGent	u	118,989		118,989	48		48
	d	Development of technical and juridical procedures enabling the evaluation of the degradation of the marine environment, including financial claims for the polluter		Bocken	UGent	u	91,349		91,349	48		48
	e	Development of mathematical models which determine the chance of incidental discharges and related damages; both at environmental and socio-economic level		Pichot	MUMM	r-pu	198,315		198,315	48		48
8	a	Evaluation of the chemical contamination of the North Sea and	6	Baeyens	VUB	u	109,090	9,900 [4]	118,990	24	6	30
	b	estimation of the pollution from land	+	Van Grieken	UA-UIA	u	109,090	9,900 [4]	118,990	24	6	30
	c		8	Wollast	ULB	u	109,090	9,900 [4]	118,990	24	6	30
9		'ED-North: Evaluation of possible impacts of endocrine disruptors on the North Sea ecosystem':	4									
	a	Evaluation of the ED effects on the endocrine metabolism of marine organisms; Formulation of research needs; Development of policy measures		Janssen	UGent	u	55,974		55,974	25	6	31
	b	Development of policy measures		Vanhaecke	ECOLAS	r-pr	37,184		37,184	25	6	31

	c	Formulation of research needs; Critical review of ED: establishment of a database		Comhaire	UGent	u	55,578	55,578	25	6	31
10		Development of methods for the analysis of hydrocarbons and organic micropollutants in the marine environment	5	De Pauw	ULg	u	121,716	121,716	24		24
11		Monitoring of volatile organic compounds in marine organisms: analysis, quality assurance and feasibility	1	De Clerck	CLO	r-pu	148,736	148,736	24	12	36
12	a	Evaluation of the quality of ' turbot fry ' on the restocking success in the North Sea	2	Sorgeloos	UGent	u	134,904	134,904	24		24
	b				CLO	r-pu	13,634	13,634	24		24
13	a	Evaluation of the 'Paardenmarkt' site	12	Henriet	UGent	u	63,213	63,213	24		24
	b			Lanckneus	MAGELAS	r-pr	28,508	28,508	24		24
	c			Cattrijsse	UGent	u	28,508	28,508	24		24
	d			Kuijken	IN	r-pu	28,508	28,508	24		24
14		'Intensive monitoring of the evolution of a protected benthic habitat (HABITAT)':	11								
	a	Multidisciplinary case study of a selected are; Establishment of a habitat structure map; Development of methodologies with reference to a time and cost-saving permanent access to a nature resort: monitoring strategy and methodology		Vincx	UGent	u	73,922	73,922	24		24
	b	Establishment of regional map material of the macrobenthic and physico-chemical variables; Description of the macrobenthic and physico-chemical seasonal variability		Jacobs	UGent	u	64,403	64,403	24		24
	c	Establishment of regional map material of the macrobenthic and physico-chemical variables; Description of the macrobenthic nad physico-chemical seasonal variability			MAGELAS	r-pr	9,916	9,916	24		24
15		'Research of natural sand transports on the Belgian Continental Shelf: BUDGET (beneficial usage of data and geo-environmental techniques)':	10								
	a	Critical review of data and used methods; Recommendations for a new methodology, cartographic presentation and data distribution		Lanckneus	MAGELAS	r-pr	49,579	49,579	24	2	26
	b	Inventory of available data on the BCS; Recommendations for a new methodology, cartographic presentation and data distribution		De Batist	UGent	u	61,949	61,949	24	2	26
	c			Jacobs	UGent	u	12,494	12,494	24		24
	d			Pichot	MUMM	r-pu	24,789	24,789	24		24
16	a	Identification of marine zones affected by eutrophication (IZEUT)	7	Lancelot	ULB	u	99,157	99,157	24		24
	b				ECOLAS	r-pr	49,579	49,579	24		24
17	a	Long term trends in the macrobenthos of the Belgian Continental Shelf	15	Vincx	UGent	u	142,477	142,477	24		24
	b			De Clerck	CLO	r-pu	5,206	5,206	24		24
18	a	Fast and low cost analysis of dioxin-like compounds in marine matrices	16	De Pauw	ULg	u	99,157	99,157	24		24
	b			Dubois	ULB	u	9,916	9,916	24		24
	c			Bouquegneau	ULg	u	9,916	9,916	24		24

d			Joiris	VUB	u	29,747		29,747	24		24
19	The Gustave Gilson collection as historical reference for the Belgian marine fauna: a feasibility study	9	Van Goethem	RBINS	r-pu	123,947		123,947	24		24
20	Feasibility study concerning the Belgian participation in GOOS and in particular to its regional component EuroGOOS		Vanhaecke	ECOLAS	r-pr	25,496		25,496	6		6
Total						**10,251,835**	**29,700**	**10,281,535**			
Average per team						**179,857**	**521**	**180,378**	**39**	**2**	**42**

[1] In the case of networks, the title of subprojects are given (if mentioned in the contracts)

[2] Category of research

Strategic Actions:

A Eutrophication
B Chemical contamination
C Protection of species and their habitats
D Sustainable use of the sea
E Setting up of a databank with data series

Targeted Actions:

1 The feasibility of regular analysis (monitoring) of volatile organic compounds in the products of ocean fishery
2 The feasibility of '*restocking*' threatened fish stocks in the North Sea with the assistance of aquaculture
3 The feasibility of a system of ecotoxicological monitoring for the (long run) management of Belgian coastal waters
4 Evaluation of the potential impact on North Sea ecosystems of substances capable of disturbing hormone balance
5 Evaluation of new standardised and validated methods for determining and monitoring the evolution of hydrocarbons and micropollutants in the marine environment
6 Evaluation of the chemical contamination of the North Sea
7 Marking out the marine areas affected by eutrophication
8 Estimating marine contamination of telluric origin
9 Defining a 'point zero' in the evolution of the ecosystem of the North Sea
10 Study of the natural sand displacements on the Belgian Continental Shelf
11 Intensive monitoring of the development of a protected benthic habitat (HABITAT)
12 Evaluation of the situation at the 'Paardenmarkt' marine site
13 Feasibility study on monitoring the presence of toxic algae in Belgian coastal waters
14 Impact of offshore structures on marine ecosystems
15 Evaluation of displacements within the macrobenthic communities of the Belgian continental shelf due to anthropogenic influences
16 Development of fast analytical methods for determining dioxins, furans and dioxin-like PCB's in marine matrices

[3] Institute category: u university r-pr private research institute r-pu public research institute

[4] an extra financial extension of approx. 9,900 was given Euro per partner

Source: BELSPO contracts

Annex 3.6 Phase 6 - Research contracts from the 'Scientific Support Plan for a Sustainable Development Policy, Phase II: Global change, ecosystems and biodiversity' - North Sea (2001-2005)

No.		Title project	Cat [1]	Promotor [2]	Institute		Grant			Duration		
					name	cat [3]	original	extension	total	orig.	ext.	total
							[Euro]			[months]		
1	a	Management research and budgeting of aggregates in shelf seas	A3	De Batist	UGent	u	540,000			51		
	b	related to end-users		Pichot	MUMM	r-pu	398,000			51		
	c			Monbaliu	KULeuven	u	32,000			51		
2	a	Biogeochemical carbon, nitrogen and phosphorus fluxes in the	A2	Baeyens	VUB	u	269,000			51		
	b	North Sea		Chou	ULB	u	315,000			51		
	c			Frankignoulle	ULg	u	284,000			51		
	d			*Laane*	*RIKZ-NL*	*r-pu*	*80,000*			*51*		
3	a	Advanced modelling and research on eutrophication (AMORE-II):	A3	Lancelot [4]	ULB	u	535,000			51		
	b	linking eutrophication and biological resources		Ruddick	MUMM	r-pu	325,000			51		
	c			Daro	VUB	u	245,000			51		
	d			Volckaert	KULeuven	u	0			51		
	e			*Heip*	*NIOO-NL*	*r-pu*	*11,000*			*51*		
4	a	Balancing impacts of human activities in the Belgian part of the	A4	Maes [4]	UGent	u	450,000			51		
	b	North Sea (BALANS)		Vincx	UGent	u	90,000			51		
	c			Janssen	UGent	u	134,000			51		
	d			Scory	MUMM	r-pu	140,000			51		
	e			Polet	CLO	r-pu	94,000			51		
5	a	Silica retention in the Scheldt continuum and its impact on coastal	A5	Chou	ULB	u	400,000			51		
	b	eutrophication		Vyverman	UGent	u	265,000			51		
	c			*Regnier*	*UU-NL*	*u*	*62,000*			*51*		
6	a	ENDIS-RISK: endocrine disruption in the Scheldt estuary:	A2	Janssen	UGent	u	455,000			51		
	b	distribution, exposure and effects		Vincx	UGent	u	390,000			51		
	c			Roose	MUMM	r-pu	214,000			51		
	d			De Brabander	UGent	u	230,000			51		
	e			*Vethaak*	*RIKZ-NL*	*r-pu*	*25,000*			*51*		
7	a	'Effects of pollutants on benthic populations and communities of	A1	Dubois [4]	ULB	u	246,000			51		
	b	North Sea organisms	+	Blust	UA-RUCA	u	157,000			51		
	c		A2	Flammang	UMH	u	102,000			51		
	d			De Pauw	UIG	u	72,000			51		
	e			Jangoux	UMH	u	177,000			51		
8	a	'Higher trophic levels in the Southern North Sea 'Trophos'	B	Vincx	UGent	u	394,000			51		
	b			Kuijken	IN	r-pu	215,000			51		
	c			Volckaert	KULeuven	u	319,000			51		

	Heip	*NIOO-NL*	*r-pu*	*120,000*	*51*
Total				**7,785,000**	
Average per team				**228,971**	**51**

[1] Category of research: Strategic Research:

- A Marine ecosystems - Sustainable management of the North Sea
  - A1 Study of processes
  - A2 Pollutants
  - A3 Evaluation of sedimentary systems and development of new evaluative technologies with a view to sustainable management of the Belgian exclusive economic zone (EEZ)
  - A4 The social and economic dimensions of sustainable management of the North Sea
  - A5 Operational oceanography
- B Marine biodiversity

[2] Foreign partners are indicated in 'italics' (the BELSPO will finance 50 % of their participation in the project)

[3] Institute category: u university r-pu public research institute

[4] Lancelot (project # 3) receives an additional 30,000 Euro to co-ordinate the cluster of projects # 2, 3 and 5
Maes (project # 4) receives an additional 30,000 Euro to co-ordinate the cluster of projects # 1, 4 and 8
Dubois (project # 7) receives an additional 30,000 Euro to co-ordinate the cluster of projects # 6 and 7

Source: BELSPO contracts

Annex 4 The research topics of the various Programme Phases.

Phase	Title of programme phase and topics covered
1	National R&D programme on the physical and biological environment 'water pollution' ('*Project Sea*') • Data collection • Hydrodynamics • Chemistry • Biology • Physiology • Estuaries
2	Concerted Research Actions 'Interuniversity Action on Oceanology'
3	Concerted Research Actions 'Interuniversity Action on Oceanology' (phase 2) Interuniversity Action North Sea Interuniversity Concerted Research Action North Sea
4	Impulse Programme 'Marine Sciences' *1 Call - July 1991* • Dynamics of the Marine ecosystem: - Heavy metals and organic micropollutants - Eutrophication - Mathematical modelling • Interactions between the marine ecosystem and the economic and social system • Research on the behaviour of floating sediments and wave types using advanced techniques [1] • Sediment trend analysis [1] *Specific Call:* • Feasibility study on the establishment of a common scientific marine infrastructure
5	Scientific support Plan for a Sustainable Development, Phase I: Sustainable management of the North Sea *Strategic research Call 1 - July 1996* • Eutrophication: - Where and how do heightened nutrient concentrations or flows of anthropogenic origin bring about a change in the frequency, duration or scale of algal blooms, and what are the consequences of this? - How and to what extent does a heightened algal presence, a change in the species profile or the possible presence of toxic algae disrupt marine ecosystems at the level of zooplankton, benthos and the higher trophic levels? • Chemical contamination: - What are the sources, flows and destinations of inorganic and organic contaminants affecting the sea? - Does the supply and presence of these contaminants in the sea have an impact on marine life? • Protection of species and their habitats: - What is the distribution, in terms of time and space, of ecologically important species, of the species that play a key role as biodiversity indicators or of the species that are or might be threatened or vulnerable? What is the relationship between their various habitat types in the coastal zone and at sea? - What is the impact of human activities on the composition (biodiversity) and density of these species and the sustainability of their different habitat types? • Sustainable use of the sea: - How can the health of the sea be established with a view to determining the degree of human influence? • Setting up a databank with data series *Strategic research Call 2 - July 1997* • Sustainable use of the sea: - What is the socio-economic cost of a deterioration in the marine environment? - What risk is posed by the accidental discharge into the marine environment of oil or other chemical products?

Annex 4 The research topics of the various Programme Phases (continued).

Phase	Title of programme phase and topics covered
	Targeted actions Call 1 - September 1997 • Feasibility of regular analysis (monitoring) of volatile organic compounds in the products of ocean fishery. • The feasibility of 'restocking' threatened fish stocks in the North Sea with the assistance of aquaculture • The feasibility of a system of ecotoxicological monitoring for the long run management of Belgian coastal waters. • Evaluation of the potential impact on North Sea ecosystems of substances capable of disturbing hormone balance • Evaluation of new standardised and validated methods for determining and monitoring the evolution of hydrocarbons and micropollutants in the marine environment • Evaluation of chemical contamination of the North Sea • Marking out the marine areas affected by eutrophication • Estimating marine contamination of telluric origin *Targeted actions Call 2 - November 1998* • The feasibility of regular analysis (monitoring) of volatile organic compounds in the products of ocean fishery • The feasibility of 'restocking' threatened fish stocks in the North Sea with the assistance of aquaculture • The feasibility of a system of ecotoxicological monitoring for the sustainable management of Belgian coastal waters. • Marking out the marine areas affected by eutrophication • Defining a 'point zero' in the evolution of the ecosystem of the North Sea • Study of the natural sand displacements on the Belgian Continental Shelf • Intensive monitoring of the development of a protected benthic habitat (HABITAT) • Evaluation of the situation at the 'Paardenmarkt' marine site *Targeted actions Call 3 - 2001* • Feasibility study on monitoring the presence of toxic algae in Belgian coastal waters • Impact of offshore structures on marine ecosystems • Evaluation of displacements within the macrobenthic communities of the Belgian continental shelf due to anthropogenic influences • Development of fast analytical methods for determining dioxins, furans and dioxin-like PCBs in marine matrices. • Specific action (programme-management)
6	Scientific support Plan for a Sustainable Development, Phase II: Global Change, Ecosystems and Biodiversity *Strategic actions – Call June 2001* • Marine ecosystems - Sustainable management of the North Sea: - Study of processes - Pollutants - Evaluation of sedimentary systems and development of new evaluative technologies with a view to sustainable management of the Belgian Exclusive Economic Zone (EEZ) - Social and economic dimensions of sustainable management of the North Sea - Operational oceanography • Marine biodiversity

[1] During this consultation with the Regions, in conformity with art. 6bis par. 3 of the special law of institutional reforms of 08-08-1980. the national authority and the Flemish Executive decided to co-ordinate the research in marine sciences organised by the two authorities. Therefore, it was decided to formulate a common Call for proposals. The two research themes are the concern of the Flemish Executive and are outside the 4,2 M euro of the national authority:

Annex 5.1 Ecosystems and Marine Biology

BELSPO Programme: **Project Sea 1970-1976**	**Contract no.**: 1
Project Title: Vol 3. Modeles Hydrodynamiques	
Participants:	
Editors of Final Report: J.C.J. Nihoul, F.C. Ronday Laboratory of chapter author is not given	Modèles hydrodynamiques F. Ronday.
Budget: Not mentioned	**Project Start/End Dates**: Nov 1970 – Dec 1975

Objectives: Specific objectives of the project not known, although the author specifically refers to the main objective of the work at least twice: 'Le but final de ce travail est d'établis un modèle hydrodynamique pour l'étude de la circulation à long terme en mer du Nord'.

Were Objectives Met?: Very definitely.

Content and Quality of Report: As for the other reports in Project Sea this is a well written and structured report. In the first chapter the historical evolution of research on tides, storm surges and residual currents is outlined pre and post the production of the first computer mathematical models. Chapter 2 outlines how the various factors such as viscosity, friction, interaction with the surface and bottom are tackled and their equations outlined and in particular how the calculation of the residual current is calculated. The chapter focusses in particular on the error of the calculation of the residual current and how the new method of calculation developed in the report reduces this to 20% of the earlier figure. Chapter 3 outlines the simplifications that need to be included in the models to enable them to operate on computers in a realistic time frame and outlines the equations used. A carefully argued case is put forward as to why the methods developed are most appropriate to model the tides and storm surges of a shallow continental sea. Chapter 4 focuses on the North Sea, noting good accord with the work of Radach in Germany. The author also concludes that the strong tides in the North Sea are forced by tides in the Atlantic Ocean and not locally by astronomic forces. Chapter 5 applies the model to the study of times and storm surges in the North Sea raising the issue of boundary conditions and how these are overcome. Model calculated and observed tidal amplitudes were highly correlated. Comparisons between modelled residual current calculations and current meter data were difficult because of the short term nature of the available mooring measurements. Chapter 6 undertakes a series of comparisons between modelled and observed measurements of residual currents and found a good relationship and an especially good agreement with the earlier calculations of authors such as Böhnecke, Laevastu, and Ramster. Finalloy spatial comparisons are made with plankton, turbidity and nutrients to help explain their distributions.
The model described was clearly a significant improvement on previous hydrodynamic modelling in Belgium. A number of other modelling projects were underway at this time by other North Sea states and there is clear and excellent collaboration with these other national teams in the procurement and utilisation of data needed for the construction and testing of the model. As I am not a modeller I am not in a position to provide a comparative assessment of the state of the art in Belgium against other countries at the time. However, I understand that the model produced formed the foundation for subsequent operational models used to forecast tides and storm surges; work that has huge practical, economic and social relevance. A major finding of this modelling exercise was, for the first time, the identification of the occurrence of a residual current gyre off the coast of Belgium that plays a key role in the retention of plankton and particulate material and is the site of a zone of sedimentation. The modelling results also showed that tidal and storm surges can induce currents of the same magnitude as the wind. An excellent report.
Report completed ?March 1976 and printed May 1976 well after the project ended.

Scientific Quality: This work was of a high international calibre.

Scientific Output: The bibliography is comprehensive and well researched although only two references by Ronday are cited. A total of 8 additional papers with Ronday as first or subsequent author are listed in Nihoul's book (Project 13), which includes references up to to 1981 and is possibly a good reflection of work undertaken during Project Sea. Most of the papers are sizeable contract reports in the grey literature. Only one is in an international journal. It is unfortunate that this excellent work did not receive a wider circulation.

Publications by year:						**Publications from the Contract**:
1971:	1	1976:	2	1981:	1	Belgian Journals: 2
1972:	1	1977:				Paper in Book: 1
1973:	1	1978:	1			International Journals: 1
1974:		1979:	2			Grey literature reports 6
1975:	1	1980:				Other products: A major new model

Social Impacts: The modelling reported in this contract had high social and economic importance as it provided the basis for an improved understanding of the circulation of the North Sea and idejntified an area off the coast of Belgium that was a site of sedimentation of relevance to plankton, pollution and nutrient studies.

Strongest Point: Identification of a residual gyre off the coast of Belgium
Weakest Point: Poor international publication of the substantial work undertaken during the project.

BELSPO Programme: **Project Sea 1970-1976**	**Contract nos.**: 1, 2, 5	
Project Title: Vol 2: Acquisition and compilation of data		
Participants:		
Editors of Final Report: J.C.J. Nihoul & G. Pichot Laboratories to which the chapter authors are attached are not given.	1. Acquisition automatique de donnees en mer. G. Pichot, A. Pollentier and H. Picard	2. La banque de donnees. Y. Adam, H. Laval, P. Closset, J-P. Foguenne, W. Keutgen
Budget: Not mentioned	**Project Start/End Dates**: Nov 1970 – Dec 1975	
Objectives: No reference to the objectives in the report.		
Were Objectives Met?: In terms of the titles of the two subprojects yes.		
Content and Quality of Report: I thoroughly enjoyed reading this report as it is a well written and structured period piece that is full of information. Thirty to twenty five years ago Belgium was clearly in the forefront of the development of remotely operated buoys telemetering data back to a base laboratory and in the design and construction of a database to store the resulting data. Sophisticated programmes to record, format and memorise the various data produced by telemetering buoy systems, current moorings and a fixed station were developed during the project. The electronics, engineering and computing required to undertake this work was at a relatively early stage of development for the sophistication of the work that was undertaken. Mooring technology was also at a developing stage at this time and the vulnerability of moorings deployed in the shallow coastal waters of the Belgian shelf is well seen by the 20% that were lost of the 25 deployed. Trawling by fishing boats and storms were main factors in the loss of moorings. In one example the termination of a mooring deployment, after 26 days of successful operation, was caused by the anchorage giving way. The problems inherent in developing the type of sophisticated technology and computing required in projects of this type are well outlined in the report with an emphasis on the viability, repeatability, precision and low power consumption of the various measuring devices utilised. Some of the sensors used were constructed in-house. The problems inherent in the development of a complex project like this were also seen in a breakdown in computers from overheating of the computer room at the shore base that received the telemetered data - hard to imagine at the present day. When problems in sensors occurred, repair and servicing were major exercises because in many cases it was difficult to undertake repairs in situ. The database report was again of a high standard with clear evidence of considerable international collaboration. Shared data between countries was and is essential for the development of models. This work drew attention to the problems of exchange of data between a number of different North Sea countries. The Belgian team played a key role in resolving these problems by translating the different datasets into a format that was readable by all countries and played a key role in the development of a new international standard for data exchange. Liege acted as the central depository for all current meter data acquired during the international project JONSDAP 73 and INOUT of JONSMOD as the computers there were more sophisticated and capable of accepting data in a variety of different formats. In addition the scientific team had obtained a reputation for its skill in overcoming problems of intercalibration. However, by the time of the report international exchange formats had only been agreed for current meter results. In the subsequent JONSMOD project which involved even more countries, each country was using different computer formats so the problems of the earlier intercomparisons and exchange were repeated. Encoding the data into a readable format for wider use was a delicate operation that was time consuming as it required many manual corrections to the data. Much data thus became inaccessible and a plea was made for further standardisation of exchange formats, with a recommendation that GF2 as promoted by Liege be used. An excellent report.		
Scientific Quality: The two sections included in this report outline work that is of the highest international calibre. Belgium was in the forefront of telemetered buoy systems and database development at the time.		
Scientific Output: It is difficult to derive an indication of the output from the project as only a limited list of publications are given in the references to one of the reports. Many of these references refer to Project Sea reports; in general an apparently poor scientific output as publications.		
Publications by year: 1974: 1	**Publications from the Contract**: Belgian Journals: ? Article in Book: 1 International Journals: ? Other products: Models and budgets	
Social Impacts: This report had potential high relevance at the time to developing Belgium's marine scientific infrastructure. It is unfortunate that the advanced state of databasing that existed in Belgium at the time was not developed progressively by the establishment of a National Oceanographic Data Centre in the 1970s. This report emphasises the need to develop a national integrated data archiving system at present.		
Strongest Point: International collaboration and major role that Belgium played in the collaboration. **Weakest Point**: Apparently poor publication output.		

<table>
<tr><td colspan="2">BELSPO Programme: Project Sea 1970-1976</td><td colspan="2">Contract nos.: 1, 5</td></tr>
<tr><td colspan="4">Project Title: Modélisation des systèmes marins</td></tr>
<tr><td>Participants:</td><td></td><td></td><td></td></tr>
<tr><td>Editor: J.C.J. Nihoul
Laboratories to which each of the chapter authors are attached are not given.</td><td>1. Imperatifs d'une gestion de la mer et necessite d'un modele mathematique. J.C.J. Nihoul.
4. Validation experimentale du modele, un exemple. O. Beckers, R. Wollast and J.C.J. Nihoul</td><td>2. Analyse des systemes marins, construciton d'un modele mathematique interdisciplinaire. J.C.J. Nihoul.</td><td>3. Parametrisation, calibrage et adjustement du modele, application à la mer du Nord et au Southern Bight. J.C.J. Nihoul</td></tr>
<tr><td colspan="2">Budget: Not mentioned</td><td colspan="2">Project Start/End Dates: Nov 1970 – Dec 1975?</td></tr>
<tr><td colspan="4">Objectives: No reference to the objectives in the report. Report comprised of a French text of part of Nihoul's book in English: Modelling Marine Systems. 1975. Elsevier, Amsterdam. From one of the references on page 37 this book appears to have originated from a NATO conference with the same title held in 1993.</td></tr>
<tr><td colspan="4">Were Objectives Met? It is not known if the report complied with the contractual objectives as a copy of the contract document could not be found in the BELSPO archives..</td></tr>
<tr><td colspan="4">Content and Quality of Report: The report comprises four chapters of Nihoul's 1975 book on marine modelling. A brief introductory chapter gives the background to the extensive surveys that were carried out in Project Sea between 1971 and 1976. These surveys led to a much improved understanding of the marine processes taking place in the Southern Bight and the resulting data provided the building blocks for mathematical models. The valuable role that modelling can make to understanding relationships between contaminant inputs, concentrations and effects was outlined as well as the application of such models to prediction and management of the marine environment. Both the monitoring and the modelling were carried out within a strong international framework of collaboration co-ordinated by the International Council for the Exploration of the Sea. Chapter 2 outlines the various steps followed in the development of mathematical models of a marine systems and a 'simple' outline of the various stages followed in model construction. Chapter three outlines a modelling application to dispersion in the southern North Sea., noting the lack of data coverage for many variables necessary to properly build such a model.. Chapter 4 outlines the key role that experimentation and theory have in the validation of models. Examples are given for residual circulation, physico/chemical characteristics of water quality, fluxes from the Scheldt and water mass characterisation in a coastal gyre. This report provides an excellent account of the various stages followed in the construction and testing of mathematical models. The science undertaken was of the highest international calibre.
Attached at the rear of the report is a list of the 270 participants in Project Sea from 12 institutions, ministries or agencies. This is an astounding statistic and clear evidence of the fundamental role that Project Sea played in Belgian marine science in the 1970s.</td></tr>
<tr><td colspan="4">Scientific Quality: High international calibre research. The published book that this report forms part of was a key text in the developing field of modelling in the mid 1970s. It provided a comprehensive coverage of marine system modelling and has proved to be essential reading for more than a generation of oceanographic students. A key factor in the impact of the book was its publication in English and consequent wide distribution. Given this situation submission of only parts of the book in French for contractual reasons and solely for internal use by BELSPO seems absurd. If there was a need to provide translations why was a version in Dutch not also produced?</td></tr>
<tr><td colspan="4">Scientific Output: It is not clear if the full book by Nihoul was the product of the contract or only the part reproduced in French. The book was a substantial product that received wide circulation. There is no attribution of any other publications to the contract. citation.l</td></tr>
<tr><td colspan="2">Publications by year:
?</td><td colspan="2">Publications from the Contract:
Belgian Journals: ?
Books, others: 1
International Journals: ?
Other products: Models and budgets</td></tr>
<tr><td colspan="4">Social Impacts: As an instructional and learning tool this contract had wide impact. The work undertaken has helped to train two generations of Belgian modellers and was the basis for the establishment of a number of operational models.</td></tr>
<tr><td colspan="4">Strongest Point: Well described outline of how models are constructed and their component parts and application.
Weakest Point. No reference to original contract documentation or acknowledgement of BELSPO.</td></tr>
</table>

BELSPO Programme: **Project Sea 1970-1976**		**Contract nos.**: 1, 5, 7, 11, 20	
Project Title: Sedimentologie			
Participants:			
Editors of Final Report- 'Sedimentologie': J.C.J. Nihoul & F. Gullentops Laboratories to which each of the chapter authors are attached are not given	Chap. 1. F. Gullentops, M. Moens, A. Rinegele & R. Sengier Chap. 2. R. Wollast Chap. 3. G. Lebon	Chap. 4. G. Billen, P.P. Vanderborght & R. Wollast Chap. 5. A. Bastin & M. Meeussen	
Budget: Not mentioned		**Project Start/End Dates**: Nov 1970 – Dec 1975	

Objectives: Not defined in the report. The report was divided into five chapters covering geological aspects of suspension of sediments, physicochemical properties, thermodynamic and diagenetic modelling and sediment absorption.

Were Objectives Met? Not clear.

Content and Quality of Report: The final report for this contract summarises in a highly professional way a large amount of field and laboratory data obtained during the contract. It is a well prepared report which gives a comprehensive account of the offshore sedimentology of the eastern sector of the Southern Bight of the North Sea. I enjoyed reading the report as it is well structured and provides in a summary form the product of the analysis of a great many sediment analyses including comprehensive details on the associated molluscan fauna. The resulting maps are highly revealing both for their summary of the sedimentology results and on page 6 in Chapter 1 for the synthesis of the postglacial history of the southern North Sea. The later chapters in the report discuss processes and outline the results of modelling studies. The science presented was of a very high standard for the time and all the contributed papers to the report are well written. The presentation would have been better if the main reports had been preceeded by an introduction outlining the need for the work, how it fitted in to Project Sea and how the report was structured. As for other contract reports in this series it is inadequate in that it makes no reference to the original contract and its objectives. Sampling programmes undertaken as part of the project are generally poorly documented. For example the locations of the 1000 grab sites used for the sediment analyses are shown in Fig. 3. Page 10, but information on the cruises used to take these samples and when they occurred is not provided. It may be that such information was included in the annual reports. If so these reports should have been cited.

Chapter 2 outlined the physicochemical properties of the sediment, their suspension, zones of preferential sedimentation and heavy metal and organic content. The techniques used are superbly described. The paper concludes that the general accumulation rate of clays in Belgian waters is of the order of 5 cm per year and that the samples analysed thus represent an average for a thirty year period. On the basis of Pb 210 analyses only a quarter of the sediment in suspension is incorporated into the bottom sediment, the rest is exported towards the German Bight a reflection of the high remobilisation of sediments in the region. Another important results of the work is the recognition of the high levels of degradation of organic matter based on a reduction by half of the concentrations of organic matter in suspended sediment compared to recently deposited sediment and the much higher levels of heavy metals in the suspended sediment.

Chapter 3 is very clearly presented and is an exception in that it makes reference to Belgian support and the value of the work, which examines through modelling sediment erosion processes. Equations used to describe relevant processes are well documented. The same applies to Chapter 4 which outlines through modelling the diagenetic processes involved in nutrient cycling in the sediments through an analysis of vertical profiles of nutrient concentrations in interstitial water. The paper is well presented, giving the results of experimental and model simulations for cores representative of a sandy and muddy bottom. Sophisticated science resulting in the calculation of early nutrient budgets and the recognition that diagenetic processes affecting nutrient cycling are taking place most actively in the sediment close to the sediment water interface. Chapter 5 gives an outline of the application of radioactive tracers to lithological studies.

Scientific Quality: The papers in this report are of an excellent scientific calibre. The survey work was clearly completed to a rigorous plan and substantial subsequent laboratory analyses undertaken to a high standard. The modelling studies appear to be state of the art for the period. As is to be expected for the time there is no reference to quality control.

Scientific Output: It is not possible to derive a true indication of the output from this project as a list of the publications and their publication status was not provided in the report. Based on the references 9 publications and a Ph.D may have derived from the work. Only two of these by one author were in international journals. A minimal output for a five year project especially given the number of people involved in the work. However, it would seem that this project was fundamental for much subsequent research in Belgium as a number of the participants have gone on to be highly productive scientists.

Publications by year:	**Publications from the Contract**:
1971: ?	Belgian Journals: 2
1972: 2	Books, others: 1
1973: 2	International Journals: 2
1974: 2	Other products: Models and budget
1975: 3	Ph.D. 1

Social Impacts: This report had high policy relevance. It provided, I believe for the first time, a comprehensive assessment of the sediment properties of Belgian waters, the processes governing their evolution and from modelling likely future change. The work was of key importance for navigation, the siting of offshore structures, oil and gas exploration and for studies of coastal erosion/deposition patterns

Strongest Points: Production of comprehensive maps of the sediment lithologies of the eastern Southern Bight.

Weakest Point: The report, with one exception, makes no reference to the original contract, not even as an acknowledgement.

BELSPO Programme: **Project Sea 1970-1976**	**Contract nos.**: 1, 5, 9, 11, 20

Project Title: Scheldt Estuary

Participants:		
Editors of Final Report-'L'estuaire de l'Escaut': J.C.J. Nihoul & R. Wollast Laboratories to which each of the chapter authors are attached are not given.	Chap. 1. J.J. Peters & A. Sterling. Chap. 2. J.C.J. Nihoul & F.C. Ronday Chap. 3A. G. Billen, J. Smitz, M. Somville, R. Wollast Chap. 3B. O. Beckers & R. Wollast	Chap. 3C. S. Wartel Chap. 5. R. Wollast Chap. 6. G.Billen, I. Elskens & J. Smitz

Budget: Not mentioned	**Project Start/End Dates**: Nov 1970 – Dec 1975

Objectives: The report does not refer to contract objectives. The report is written in the form of a book on the Scheldt estuary with 5 chapters covering hydrodynamics and sediment transport, an estuarine model, the physicochemistry of the estuary, transport and accumulation of pollutants and impacts of thermal discharges. If the aim of the original contract was to cover these topics it has been well met.

Were Objectives Met?: Yes apparently so.

Content and Quality of Report: The final report is superbly presented and organised. It was a pleasure to read this document based on research of thirty years ago; many of the findings have not been superceeded since. The science undertaken was cutting edge and all the contributed papers to the report were of a high standard. The report follows a logical sequence in the form of a book from a basic description of the hydrodynamics and sediments of the estuary to a brilliantly expounded outline of estuarine models with each equation discussed, to reviews of organic material, carbonates, nutrients and heavy metals and thermal pollution. The short, excellent introduction gives some idea of the volume of outcome information that has been covered in this substantial report and the many original findings that were an of the research.

The report falls down in one respect as a contract report as it makes no reference to the original contract and its objectives. Sampling programmes undertaken as part of the project are I believe only referred to once in the text (p26). It may be that such information was included in the annual reports. If so these reports should have been cited. I particularly liked the map on page 55 outlining Belgium land in Roman times, which if anything emphasises the need for Belgium to continue to place emphasis on marine research in a time of rising global sea levels.

The key to the estuary are the profound changes that occur in physicochemical and sediment properties from river to mouth, which in turn are responsible for a series of transformations in chemical species affecting their distribution. Heterotrophic microbiological activity and primary production have a key impact on oxygen levels which controls much of the estuarine chemistry. A key finding of the study was the discovery of high diatom production in the lower estuary and consequent silicon limitation leading to a nutrient imbalance in the ratios of Si to N to P in the waters flowing into the North Sea. The modelling and budget calculations were especially interesting and I don't think I have seen a better exposition of a nutrient budget for an estuary than in Chap 4. Note especially the finding that only half the nitrate coming in via the river is reaching the North Sea and that the greater part of the particulate nitrogen is sedimented out in the estuary. These findings have not been bettered since and if anything the science might have gone backwards.

Report completed? October 1976 and printed December 1976 one year after the contract ended.

Scientific Quality: There is no doubt that this work was of the highest international calibre. Belgium was leading the world in estuarine research, especially in the modelling field. Production of a similar document giving our understanding of the Scheldt estuary 30 years later would be a most useful exercise.

Scientific Output: It is not possible to derive a full indication of the output from this project as a list of the publications and their publication status was not provided as part of the report. From the bibliography the team seems to have been moderately productive for the time, although most of the publications were in grey literature. However, it would seem that this project was fundamental for much subsequent research in Belgium as many of the participants have gone on to be highly productive scientists.

Publications by year:	**Publications from the Contract**:
1971: 2	Belgian Journals: 1
1972: 2	Book 1
1973: 2	International Journals: 3
1974: 1	Grey Literature 10
1975: 9	Ph.D and Licentiate 2
1976: 1	Other products: Models and budgets

Social Impacts: This report had high policy relevance in many fields. It has provided Belgium with an excellent basis on which to assess the state of health of the Scheldt estuary over the last three decades and key input for international discussions on eutrophication and pollution. The modelling formulations presented and much of the other work has been copied and adapted by many other countries in their own programmes. The observation that much of Belgium was under the sea in Roman times stresses the close link that Belgium has with the North Sea and the importance of the work presented.

Strongest Points: The new and unexplained discovery of high phosphate sedimentation into muds in the upper estuary.

Weakest Point: Report makes no reference to the original contract, not even as an acknowledgement.

BELSPO Programme: **Project Sea 1970-1976**		**Contract nos.**: 1, 11, 16	
Project Title: Dispersion Models			
Participants:			
Editors of Final Report- 'Modèles de dispersion': J.C.J. Nihoul & Y. Adam The laboratories to which each of the chapter authors are attached are not given.	Part 1. Mathematical models of dispersion J.C.J. Nihoul Part 2. Numerical simulation of pollutant discharge Y. Adam	Part 3. In situ effects of marine discharges F. Redant, J. van de Velde & R. de Clerck Part 4. Simulation of plankton distribution D. Dubois	It is not known how many researchers were funded by this project or what their status was. Were the authors of the four reports parts the only participants?
Budget: Not mentioned		**Project Start/End Dates**: Nov 1970 – Dec 1975	
Objectives: No reference to the objectives in the report.			
Were Objectives Met?: In terms of the title yes.			
Content and Quality of Report: The final report is well presented and organised, but the two biological parts at the end of the report seem to sit uneasily with the overall theme. The first two parts (in French), which make up two thirds of the report are systematically structured and comprehensively describe the state of the art at the time, the methods used, limitations and the different schemes applied. It is a well documented debate on the relative importance of dispersion and advection and how the equations used to describe these processes can be resolved. A progressive evolution of the different key terms used in the equations makes the report informative despite the sophistication of the mathematics used. 'Precise, stable and easy numerical methods' were aimed for and this is clearly reflected in the report. For the time this was sophisticated applied modelling although the authors clearly recognised the limitations of their work as applied to the dispersion of discharged contaminants. The limitations were and largely still are down to a poor knowledge of the biochemical and physical interactions between contaminants and ecosystems and problems of numerical integratation of the equations that covered the state variables. The contract led to the successful development of a working simulation model with output in the form of tables and stored information in computer format on grid positions and levels of the discharged product. The developed model was applied to the dispersion of waste discharged from ships (primarily titanium dioxide); similar models were used to evaluate discharge of sewage from outflows for many years. The results allowed an estimate of the time and area over which a particular discharged material was neutralised, if local high concentrations remained and if effects were likely to occur outside the immediate area. The model was not yet fully operational at the end of Project Sea, but was well advanced and formed part of the basis which led to the formation of MUMM. The initial planned application of this model largely became redundant when discharges of waste was banned by international agreement under the Oslo Convention. The third part of the report (in Dutch) is a simple outline of benthic, fish and fish larval surveys carried out over the dump site. The surveys were of limited distribution and over too short a period to evaluate any effects. Part 4 is a theoretical study of the factors, which determine the dynamics of the spatial variability of planktonic populations, followed by a simulation modelling exercise. Parts of the earlier work are used, but the true interrelationship of the different parts of the report is hard to see. The main point coming from part four of the report is the difficulty of separating the frequency oscillations caused by ecosystems from those modulated by the environment. If this was meant to be one project the three separate teams do not appear to have communicated well.			
Scientific Quality: There is no doubt that most of this work is of the highest international calibre. Belgium with adjacent countries played a key role in the development of dispersion modelling.			
Scientific Output: It is not possible to derive any indication of the output from this project as a list of the publications and their publication status was not provided. Part 1 of the report includes as a reference the classic book on Modelling of Marine Systems by Nihoul. Part 2 of the report by Adam forms the meat of the report. Four of his papers in international journals, one with Nihoul as first author are included in the bibliography. Was he a Postdoc. and what subseqently happened to him? Most of the reports by authors of Part 3 in their bibliography are in grey literature. The three papers cited in Part 4 by Dubois are in conference proceedings and a Belgian journal.			
Publications by year: 1971: 1 1972: 3 1973: 5 1974: 5 1975: 8 1976: 4 1977: 1		**Publications from the Contract**: Belgian Journals: 1 Book: 1 International Journals: 5 Conf. Proc. 2 Grey Literature 18	
Social Impacts: This report had high policy relevance at the time. It provided Belgium with a sound basis on which to assess the dispersion and possible effects of the dumping of industrial waste products at sea. and for subsequent international discussions that led to the banning of the discharge of titanium dioxide waste.			
Strongest Point: The production of a working dispersion model. **Weakest Point**: Apparently poor interaction between the three teams contributing to the report.			

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 1
Project Title: Mathematical modelling for evaluating water quality of aquatic environments		
Participants:	ULB	
	M. Somville	
Budget: Not mentioned		**Project Start/End Dates**: Jan 1976 – Dec 1981
Objectives: Objectives not referred to in ICES CM report.		
Were Objectives Met? Not clear. The ICES CM report is not in the form of a contract report. While significant progress has been made it is only briefly summarised in the report.		
Content and Quality of Report: Report made available as an ICES CM publication, which would appear to be an abstract of the author's Ph.D and subsequent post-doc. Research. The report is well written as a summary of the author's work and by reference to her? thesis and other papers in press and published will have informed an international audience of this ongoing study. The report is missing in detail however, there is for example no outline of the field and experimental laboratory methods used to provide the data that are used as input to the model. Reference is made to pending international treaties in the first line,; more information on these regulatory developments should have been provided as background to the study. Figure 1 is at first difficult to understand and would have been clearer if it had been shaded into > and < 4mg/l O_2. The author recommends the use of deterministic mathematical models as management tools, but does not develop this idea in relation to the pending international agreements and how the model presented could be applied operationally. After a brief description of the role of oxydation and reduction processes on the water quality of the Scheld a carbon model is outlined. This model shows that even a 50% reduction in the input of particulate carbon to the Scheld estuary would not lead to an improvement in the oxydant content of the river. The fourth part of the text summarises a model of nitrification in the Scheld. Earlier work by the same author showed that planktonic nitrification formed more than 90% of the nitrate budget. Good quantitative relationships were obtained between field and simulated profiles along the estuary, with input from a limited number of ecophysiological results. Report completed ?August 1982 for ICES Annual Science Conference. Printed April 1983.		
Scientific Quality: High quality science, but a minimalistic report for a contract report.		
Scientific Output: Good for the time. A Ph.D, the ICES CM and one paper published and two others in press in international journals. It is not known if there were any other papers from the project.		
Publications by year: 1978: 1 1979: 1980: 1 Ph.D. 1981: 1982: 1 ICES CM + 2 papers in press.		**Publications from the Contract**: Belgian Journals: Books, others: 1 ICES CM International Journals: 1 + 2 in press Other products: 1 Ph.D
Social Impacts: When further developed of considerable use as a management tool for inputs to the Scheld estuary.		
Strongest Point: Good comparative profiles of nitrification along the Scheld between simulated and observed measurements. **Weakest Point:** A summary report only as a contract report.		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 1
Project Title: Hydrodynamic models of shallow continental seas		
Participants:	ULg	
Edited by: J.C.J. Nihoul & R. Wollast	J.C.J. Nihoul	
Budget: Not mentioned		**Project Start/End Dates**: Jan 1976 – Dec 1981
Objectives: Not known:		
Were Objectives Met? Not clear.		
Content and Quality of Report: This report as for the Project Sea reports that Nihoul drafted and co-ordinated is written in the form of a book. It is one of the first BELSPO reports to be drafted in English and in this respect was easily published and had a wide impact. It is a comprehensive review of both 2D and 3D models that had been developed at the time using the North Sea as a case study. The key microscale, mesoscale and macroscale processes involved in shelf circulation are succinctly described as are the solutions in terms of equations used to incorporate these factors into the models. At this time hydrodynamic models were divided into two, long-wave models for tides and storm surges and quasi-steady state models for the residual circulation. The storm surge and tidal models were later developed for operational use. The report is well illustrated with many maps, graphs and other figures. It also has a comprehensive and up-to-date reference list for the time showing that Nihoul had wide international connections and was well briefed on other ongoing modelling in Europe and elsewhere. This project report is a further example of the important way in which he stimulated mathematical modelling in Belgium and the rest of the world over decades. Over a long period of time he was a source of many original ideas, some later shown to be wrong, but still stimulating the progression of his research area. His annual Symposium has put Liege on the map and is recognised as the key annual symposium of dyamical modelling in Europe.		
Scientific Quality: Research of the highest international quality. Report in the form of a book and not a contract report, making no reference to the original contract or acknowledgement of BELSPO. The report was not completed until 1982 or printed until April 1993, in the latter case 3 years after the publication of his book with the same title. It would appear that the work for the contract was completed before the contract was let?		
Scientific Output: A comprehensive book. Nihoul, J.C. 1980. Hydrodynamic models of shallow continental seas. É. Riga Publ., Liège, 198 pp. It is not known if there were any other publications from the project.		
Publications by year: 1980: 1 1981: 1982:		**Publications from the Contract**: Belgian Journals: Books: 1 International Journals:
Social Impacts: Contributed substantially to the development of operational models that have improved safety from flooding by waves, and storm surges, are used to aid navigation and have improved understanding of pollution dispersion.		
Strongest Point: Comprehensive review document. **Weakest Point:** Does not appear to address a specific contract requirement.		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 4
Project Title: Determination of marine phytoplanktonic biomass.		
Participants:	ULB	
	Promoter: E. Post l. Goeyens A. Vandenhoudt	
Budget: Not mentioned	**Project Start/End Dates**: Jan 1976 – Dec 1981	
Objectives: Objectives not referred to in ICES CM report.		
Were Objectives Met? Not clear.		
Content and Quality of Report: A poor quality report that is thin and appears to be the product of an undergraduate student project. Analysis of only one sample taken by a bucket at the shore is highly inappropriate for a study of this nature. A number of samples would need to have been taken from a variety of different environments (plus controls) for the exercise to have been worthwhile. That this work was not considered as making a useful contribution to the debate on spectrophotometric versus HPLC measurements of chlorophyll is seen by its absence from the bibliographies attached to the review papers in S.W Jeffrey et al. 1999. (Phytoplankton pigments in oceanography: guidelines to modern methods. Paris UNESCO). A poor return for BELSPO's investment.		
Scientific Quality: Poor quality science and not in the form of a contract report.		
Scientific Output: Nil other than a grey literature ICES CM report that should not have been submitted.		
Publications by year: None	**Publications from the Contract**: None	
Social Impacts: Zero other than a contribution to a student's education.		
Strongest Point: None **Weakest Point:** Poor quality research.		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 4
Project Title: Nutrient uptake by marine phytoplankton		
Participants:	VUB	
	Promoter: L. Goeyens E. Post M. DeClerk W. Baeyens	
Budget: Not mentioned		**Project Start/End Dates**: Jan 1976 – Dec 1981
Objectives: Objectives not referred to in ICES CM.		
Were Objectives Met? Not clear.		
Content and Quality of Report: Report made available as an ICES CM publication as the fifth part of a programme called 'Carbon cycling in the Belgian coastal zone and adjacent areas'. It is not clear how this report relates to the overall programme as no background is given in any of the five documents. While C. Heip and Ph. Polk are listed as editors for the whole series of reports, which also includes benthic studies, they have not provided an introduction. A thin report that like Contract 11 may be the product of a student project. The experimental system was clearly already in existence in Goeyens' laboratory as it is described in his 1980 ICES CM paper. The results presented are only the product of running two laboratory experiments. Against this the scientific concepts and the results achieved are good science and the experimental system well thought. If the experimental setup had been run on a routine basis it would have provided many measurements of value in developing an understanding of nutrient uptake. The length of time taken to set up the experimental system and run the experiments is not indicated. Given the fast rate at which phytoplankton grow it is likely that each experiment only represented a few days work. As for Contract 11 a poor return for BELSPO's five year investment. The reports for the projects also seem to have been compiled well after the contract finished as the final report was not printed until March 1985 – a very considerable delay in reporting to BELSPO.		
Scientific Quality: Moderate quality science, minimal work undertaken for the project and the document available for review not in the form of a contract report.		
Scientific Output: Poor. Only one paper cited in the references including the names of the authors of the 1982 ICES CM, plus an earlier ICES CM in 1980. It is not known if there were any other papers from the project.		
Publications by year: 1980: 1 ICES CM 1981: 1982: 1 ICES CM + 1 paper in press.		**Publications from the Contract**: Belgian Journals: Books, others: International Journals: 1 in press Other products: 2 ICES CM
Social Impacts: Minimal other than as a contribution to a student's education.		
Strongest Point: Hard to find **Weakest Point:** Minimalistic.		

BELSPO Programme: **Concerted Research Actions 1976-1981**			**Contract nos.**: 4, 7
Project Title: Carbon cycling in the Belgian coastal zone			
Participants:	ULg ULB VUB MUMM	ULB	VUB ULg
	J.M Bouqegneau, G. Billen C. Joiris, M.H. Daro, C. Lancelot, J.H. Hecq, A. Bertels, J. Wehren M. Bossicart, M. Somville, J.P. Mommaert, J. Wijnant	C. Lancelot G. Billen M. Somville	M.H. Daro, J.H. Hecq M. Bossicart B. Van Gijsegem M. Tackx
Budget: Not mentioned		**Project Start/End Dates**: Jan 1976 – Dec 1981	
Objectives: To describe and understand carbon cycling in the Southern Bight of the North Sea, especially the Belgian coastal zone			
Were Objectives Met? Not clear. The objective above was estimated from the introduction to the report.			

Content and Quality of Report: 4separate papers as ICES CMs are provided under the heading 'Carbon cycling in the Belgian coastal zone and adjacent areas' with the contributors as part of a Workgroup 'Organic Matter'. The papers,in a volume, nclude benthic studies with the heading 'Biological Processes and Translocations edited by C. Heip and Ph. Polk. It is not clear how the papers relate to the overall programme as no background is given in the documents or at the beginning of the volume.

The authorship for the 4 eports is given above under the participants heading. Part 1 describes the 'General structure of the ecosystem' as a background to the subsequent parts. This is a collaborative exercise and what is particularly gratifying is the wide range of institutions involved. The report gives a good summary of the state of knowledge at the time, but is lacking in detail in many areas. For example, it refers to 'careful' sampling at West Hinder and four other stations. The position of only three of the five stations is given on Fig. 1. No details are given of the sampling strategies, times of cruises etc. and where any data are held. This lack of information also applies to many of the figures, where the dates and locations of the data included is not given, e.g. Fig 5 includes data from 'several years' (which ones?). The paper raises a number of key issues that need to be resolved before an improved understanding of carbon cycling will be possible, including a resolution of day/night variability, the utilisation of the low molecular weight fraction of DOM by bacteria, the proportion that phytoplankton detritus makes up of the higher fluxes of organic matter seen in near shore waters and the extent to which the calculated high phytoplankton respiration is real. The work led to important conclusions 1). that planktonic and benthic heterotrophs play the predominant role in recycling primary production in the Belgian coastal zone, 2). That terrestrial contributions of organic matter represent less than 1% of coastal primary production and 3). That only 20% of the phytoplankton is grazed by zooplankton. Cutting edge' science for the time.

Part 2 is a well argued paper complementing the introduction based on a series of experimental studies on the intra and extracellular metabolism of phytoplankton and especially *Phaeocystis.* The methods used are well introduced. The work shows that metabolites with a high turnover rate can be actively excreted by phytoplankton, that the protein content of cells is highly correlated with the nitrogen concentration in the surrounding medium and that chemical hydrolysis of DOM is likely to be an important process to make the organic matter available to bacteria. A well presented study.

Part 3 quantifies the role of mesozooplankton in the recycling of organic matter. Both field and laboratory experimentation were carried out to complete the work. As for many of the reports evaluated the methods used and the field work undertaken are inadequately presented. There appears to have been no plan to the work over the five years of the project; at least this is not indicated in the text. Daily samples were obtained at the West Hinder light vessel, but it seems only analysed once a week for a short period - March to mid July of one year and that year is not given. Samples for dry weight were preserved in formalin and a correction factor applied. There is no discussion of the need for this correction or the error limits which are known to be large. Ingestion was seen to be much lower in the summer months than in the spring leading to lower biomass and reduced egg production. An important conclusion in contrast to earlier studies, was that ingestion of small particles (bacteria) may be a more important component of the diet of coastal copepods than previously believed. A key finding was that the copepods occupy the lower water column in coastal waters where the highest levels of sedimented phytoplankton are found. The totality of the results obtained are not placed in context in a discussion/conclusion section at the end of the paper.

Part 4 expands on the important role that bacteria play in the utilisation of primary production in both planktonic and benthic phases. Importantly it is noted that higher levels of primary production in coastal waters, possibly from eutrophication, may not lead to an increase in fish production. A key new technique to measure exoenzymatic activity in sea water is presented plus initial results. Methodologies used are well described, including the results of newly developed models. As for the previous paper there is no overall discussion bringing the results and their implications together. Good science.

As a package the four reports provide a comprehensive final report, though the extent to which they represent five years work is not evident. The reports for the projects also seem to have been compiled well after the contract finished as the final report was not printed until March 1985 – a very considerable delay in reporting to BELSPO.

Scientific Quality: High quality international science leading to the development of new techniques and models. Details of much of the work presented not given and the report non in form of a contract report.

Scientific Output: Moderate, much in grey literature and surprisingly none in Belgian journals. Papers listed taken from the 1982 ICES CM references and includes these four reports.

Publications by year:		**Publications from the Contract**:
1977: 1	1982: 4	Belgian Journals:
1978: 2		Papers in Books: 2
1979: 2		International Journals: 7 (only 4 in high citation journals)
1980: 7		Other products: 7 ICES CM
1981:		These: s 2

Social Impacts: Of high relevance to developing management methods for Belgian coastal waters and estuaries.

Strongest Point: New method and modelling development and the two PhD theses completed.

Weakest Point: Lack of information on sampling, cruises. Where is the data stored? Quality control?

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**			**Contract no.**: 4
Project Title:Marine Geology.			
Participants:	UGent-RCMG		
	Seismic stratigraphy ?Prof R. Marechal Dr J.P. Henriet Dr F. Mostaert M De Batist (Ph.D. student?) Plus 10 other named scientists and technicians	**Lithostratigraphy** Dr P Jacobs ?Prof. W. De Breuck Plus 4 other named scientists and technicians	3 researchers and 3 technicians identified in contract for 5 years.
Budget: 1,459,225 EURO		**Project Start/End Dates**: Jul 1984 – Mar 1989	

Objectives: Split into 3 projects.

1. A study of the sediment dynamics and morpho-dynamics of the southern North Sea using, geomorphological, sedimentological and acoustic geophysical techniques.
2. Seismic stratigraphy of the Belgian. sector of the continental shelf
3. Lithostratigraphy of the subsurface shelf on the basis of borehole logs linked to the seismic results.

Were Objectives Met?: On the basis of the very general aims yes and especially by subsequent papers.

Content and Quality of Report: Two annual reports on seismic stratigraphy (1986, 1987 plus an appendix), and two on lithostratigraphy (1987, 1988) (all in Flemish) were written as annual reports of the respective laboratories and contain much information that is not relevant to the BELSPO contract including details of Antarctic research.

The first 1986 report on seismic stratigraphy largely consists of a description of the seismic and geophysical equipment obtained or available for the project, computing hardware and data processing with some examples of output. It is almost in the form of a manual with little or no description or interpretation of results. Most of the information included could have been attached as an appendix. Much is made of international contacts and collaboration with especial mention of the 48th Meeting of the European Association of Exploration Geophysicists which was organised by RCMG in Ostend. The subsequent 1987 report follows a similar format, consisting of an outline of the data acquisition system, digitisation and database structure (NORDATABASE) as well as an account of Antarctic cruise results. Large quantities of data have been acquired e.g. 12000 km of seismic profiles on the Belgian shelf. This is well illustrated by the map (Fig 2) in De Batist and Henriett (1995). Developing the geophysical and data handling expertise at RCMG has been a major investment apparently funded from a variety of sources over a long period. The contribution of this BELSPO contract to the ongoing work of the Centre is not made clear. The productivity of the work giving a detailed understanding of the Quaternary and Tertiary seismic stratigraphy and structure of the Belgian continental shelf is seen in the subsequent publications and especially the Monograph published in 1989 on the Southern Bight of the North Sea (Henriet and De Moor Eds). Finally, it is not known if reports for the years 1988 and a final report for 1999 were produced.

2 reports covering Lithostratigraphy for the years 1987 and 1988 are available, but out of phase with the reports cited above. The same comments as for the seismic documents apply although brief descriptions are given of 4 boreholes and in the annexes their logs. Grain size analysis procedures, analysis softwareand a database system are outlined. Again much text is written on international visits and symposia etc attended of minimal relevance to the contract. Publications are minimal and made up of Field Guides or abstracts.

The reports do not reflect the contract objectives; there is no or little information on geomorphology and the dynamics of surface sediments. No reference is made to progress in relation to the identified tasks to the long-term archiving of the data in the databases or to the extent to which it is available to other scientists.

Scientific Quality: Very high international calibre research as seen in subsequent publications and at a technical level in the contract reports. Highly skilled practitioners of a wide range of exploratory techniques.

Scientific Output: The reports were not adequate, but subsequent publications from the research was of a high quality. The productivity of the seismic stratigraphy group was high, with the development of new techniques, a great deal of software and a large database. Availability and access to the database is not documented. Subsequent publications after the contract finished reveal the important foundation that was put in place during the years of the BELSPO contract. The published paper output of the lithostratigraphy group was poor during the contract, but again some high quality publications have been produced subsequently.

Publications by year:		**Publications from the Contract**:
1984:	1987: Lith 2?	Belgian Journals: Lith 2? Seismic 1
1985:	1988: Lith 2 Seismic 2?	Books, others:
1986: Seismic 2		International Journals: Lith 1? Seismic 3
		Other products: Databases and software. Large database

Social Impacts: Key research to develop an understanding of the offshore geology and structure of the Belgian sector of the continental shelf for resource exploitation and engineering background for offshore structures and offshore sediment movement. The techniques developed also have wide geotechnical applications in the development of underground structures on land.

Strongest Points: Production of a 3D understanding of Belgium's offshore geology.

Weakest Point: Poor presentation of results in reports.

BELSPO Programme: **Concerted Research Actions 1982-1993**	**Contract no.**: 5

Project Title: Microbial study of the basic processes which govern the cycling of organic matter in marine and estuarine environments.

Participants:	ULB
	Promoter: G. Billen C. Lancelot P. Servais V. Rousseau S. Becquevort S. Mathot

Budget: 631,459 EURO	**Project Start/End Dates**: May 1984 – Apr 1990

Objectives: Poorly defined in the contract and divided, with a focus on estuaries and the sea, into 4 tasks:
1. Nutrient inputs into estuaries and the coastal zone. 2. Relationships between nutrients and primary production. 3. Relationships between organic matter /bacteria and primary production. 4. Recycling of nutrients and bacterial production
The final report considers them as themes covering the ecological functioning of the four groups: phytoplankton, bacterioplankton, microzooplankton and bacteriobenthos in a range of different aquatic environments for which functional ecological models were constructed.

Were Objectives Met?: Not in the contract report, but in publications probably yes.

Content and Quality of Report: The final report is short and not structured around the 4 original tasks identified in the contract. Instead it is divided into 1) an introduction, 2) a summary of the research themes considered by the authors, 3) methods and techniques 4) research results which are divided into a summary of the three models developed to represent the dynamics of phytoplankton, bacterioplankton, phagotrophic nanozooplankton and benthic recycling of nutrients 5) A number of examples of studies in which the modular form of the described models have been practically applied and 6) A list of publications arising from the work. While noting that the work carried out under this contract was essential for all the applications cited in section 5 there is no indication in the report of exactly what was carried out with these funds. All the various sources of funding appear to have been put into a melting pot to contribute to the whole product. This is not a satisfactory situation, despite the apparent high productivity of the team, as it is difficult to determine the real return on this specific contract. A major part of the problem was the loose way in which the original contract document was drawn up. The original tasks 1) 'Nutrient inputs into estuaries and the coastal zone', 2) 'relationships between nutrients and primary production' were not specifically covered in the research or report. Task 3 'Relationships between organic matter/bacteria and primary production is covered by reference to a number of publications, but the main results from these publications are not defined. The reviewer in the time available does not have the time to obtain and read all the cited publications. A synthesis of the main results under this heading should have been presented. In section 4 of the results key references describing the benthic model (Billen, 1978 and Billen and Lancelot, 1988) are not cited in the references. The description of the model used is brief and impossible to evaluate on the information provided. No reference is thus made to progress in relation to the identified tasks and one is left with the feeling that the researchers have forged their own way, focussing on the development of their models and their application to consultancy projects. The report is thin and lacking in substance, in contrast to the publication list which almost certainly covers all areas of the contract and includes important papers on the development of new techniques. No reference is made in the report to data obtained during the research, where the results are recorded and stored and or if they are retrievable.

Scientific Quality: Final Report poor quality. Publications very high international calibre research.

Scientific Output: Excellent publication record, a total of 43 published papers, 4 In press and one PhD thesis, although 10 of these papers were published in 1984 and not likely to have been produced during the period of the contract. Nearly all the papers are in International journals, a few in French journals and only 4 in Belgian journals. For the time this was an exceptional international output and reflects the peak of a collaboration between the prime movers Billen and Lancelot and the doctoral studies of Servais.

Publications by year:				**Publications from the Contract**:
1984:	10	1988:	8	Belgian Journals: 4
1985:	5	1989:	8	Books, others: 6
1986:	2	1990:	3 + 4 In press and	International Journals: 37
1987:	7		1 PhD thesis	Other products: 1 PhD and model development

Social Impacts: The developed models clearly demonstrated to have wide applications to the development of management procedures for fresh, estuarine and marine waters including studies of eutrophication.

Strongest Point: Modular development of process models to be applied in a range of ecological scenarios.
Weakest Point: Poor final contract report.

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**			**Contract no.**: 7
Project Title: Dynamics of coastal eutrophicated systems 1992-1996			
Participants:	ULB		
Promoter: Prof. G. Billen	C. Lancelot V. Rousseau S. Becquevort V. Schoemann J-M Dandois N. Daoud S. Van Eeckhout P. Duponcheel	Support for 1 ingénieur agronome, 1 licencié en sciences and 1 technician only mentioned in contract	Start and end dates not mentioned in contract. Guessed from information on personnel.
Budget: 470,998 EURO		**Project Start/End Dates**: Sep 1992 – Mar 1997	

Objectives: 1.To monitor, relative to the development of *Phaeocystis,* key biological and chemical components at coastal reference station 330. 2. Undertake experimental studies on the dynamics of phytoplankton, bacteria and protozooplankton dynamics: mechanisms and modelling. 3. To incorporate process results and data from other coastal sites in the Channel and North Sea into the MIRO model. 4. To describe riverine nutrient delivery to the coastal sea using the RIVERSTRAHLER model linking this to MIRO. 5. To apply these linked models to retrospective and future examples of nutrient reduction scenarios.

Were Objectives Met?: Yes

Content and Quality of Report: The final synthesis report is well presented and organised. It closely reflects the tasks defined in the original contract. Considerable progress was made by a small team in the five year project, though this is almost certainly in part due to parallel funding from the EU on a similar theme. Acknowledgement is made in the manuscripts appended to the report to funding from the EC although no comment is made on this additional support in the contract report.

The work presented has a high scientific and policy relevance to EU and North Sea states, although I have my personal doubts over supposed negative economic aspects of *Phaeocystis* blooms that only have 'transient' foam effects on Belgium's beaches from foam that is non toxic and made of sugar. The research has shown that any link between *Phaeocystis* and eutrophication is highly complicated. There is considerable interranual variability in the seasonal succession and levels of abundance of the organism and winter rainfall/runoff appears to play a key role in structuring the variability. Key ecological information was discovered including the importance of *Noctluca* in the regeneration of ammonia. Occasionally the language used in the report is inappropriate and non-scientific 'dramatic consequences', severe environmental and biogeochemical consequences' (p22). From the evidence presented it would seem that the organism is part of a normal seasonal cycle and that any effects of mass occurrence are likely to be transitory. Many valuable insights were obtained on the physiology of the organism. The section presenting the models was poor, only part of the modelled system was described and some of the numbered processes in Fig 20 were not identified in the text. The model application, as much of the other work, has raised as many questions as it has answered revealing considerable differences between observed and model results in the seasonal cycle of *Phaeocystis*, chlorophyll and nutrients and in the latter case even of magnitude. A key finding is that nitrogen reduction will have little impact on the coastal sea, but that phosphate reduction will have a major effect with potential consequences for living resources.

Scientific Quality: There is no doubt that this work is of the highest international calibre, and leading the world in many respects.

Scientific Output:

Moderate with 11 manuscripts. 4 in international journals, 2 in books of symposium proceedings, 2 in press, 2 submitted and 1 in preparation. Some of the lead authors are not from ULB and it is not possible to guage the relative contribution of this contract to these works from the information provided. It would have been helpful if a list of the publications and their publication status had been provided as a frontispiece to the annexed manuscripts. Two other ms cited in the references also appear relevant to this contract although not appended as manuscripts to the report and are added to the left column below.

Publications by year:	**Publications from the Contract**:
1994: 3 1995: 2 + 1 Lancelot 1995 Int. Journal 1996: 1 1997: 1998: 3 + 1 Becquevert et al. Int. Journal	Only ms appended to report considered. Belgian Journals: Books, others: 3 International Journals: 6 Other products: Continuing development of MIRO and other models

Social Impacts: High policy relevance of model findings. A 50% nutrient reduction to the sea if ever achieved would appear to substantially reduce Phaeocystis and especially diatom blooms with considerable implications for living resources in coastal waters. In contrast expected consequences to coastal waters of different treatment scenarios under the EC Urban Waste Water Treatment Directive on major river catchments suggests a minimal effect from substantial nitrogen removal, but large reductions of *Phaeocystis* after 90% phosphate removal. This is explained by the importance of diffuse sources of nitrogen.

Strongest Points: High policy and suggestion that much more research is needed before a sound scientific basis for nutrient reduction implementation measures can be formulated.

Weakest Point: Bioassays were not undertaken to test the 'nutrient limitation hypothesis in the microbial degradation of *Phaeocystis*.

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**			**Contract no.**: 9
Project Title: Modélisation et simulation de la pression de broutage du zooplancton dans l'écosystéme de la Mer du Nord, Approiche pratique et théorique			
Participants:	ULg		
Promoter: Dr J-H Hecq	J.H. Hecq A. Goffart C. Frangoulis F. Touratier S. Belkhiria C. Veeschkens?	Support for 1 licencié en sciences only mentioned in contract	Start and end dates not mentioned in contract. Obtained from contract listing provided by BELSPO.
Budget: 272,683 EURO		**Project Start/End Dates**: Oct 1992 – Mar 1997	

Objectives: 1) To determine the grazing pressure of zooplankton on phytoplankton in the North Sea in coastal and offshore zones. 2) To develop, calibrate and validate in relation to the residual circulation a numerical model of the pelagic ecosystem describing the export of organic material of phytoplanktonic origin by zooplankton grazing. (Emphasis to be placed on microbial, meroplanktonic and gelatinous zooplankton that are less well known. Use to be made of High Performance Liquid Chromatography to identify the food sources of the zooplankton.) A series of well defined tasks, including cruises and laboratory experimentation are included in the contract.

Were Objectives Met?: In part, but any deficiencies made up for by the quality of the work.

Content and Quality of Report: The final report of this contract is well structured, with a comprehensive index at the front and includes five annexes to give a total package of documents that is close to six cm thick. On first reading it appears to be the best organised report of the whole package that I have read and is the only one to have a specific section that documents scientific meetings attended, cruises undertaken, and publications arising out of the contract. Unfortunately it does not reflect in its structure the original objectives and tasks of the contract. Ecological modelling which makes up half of the contract tasks to be undertaken in the project is briefly introduced in the one paragraph of section 9 and said to be detailed in Annex 4 (should be Annex 5). This section should have given a comprehensive summary of the large Annex 5 and is a poor substitute. In fact Annex 5 comes closer to covering the original defined tasks at least of part A of the contract than the report itself, which focuses on faecal pellets, their breakdown and sedimentation. This latter subject was only one of the nine tasks of the original contract. The method of determining grazing pressure is briefly outlined in section 5, but there is no discussion of the differing grazing impacts of microbial, meroplanktonic and gelatinous zooplankton as well as copepods. The research undertaken has focussed on copepods despite a specific reference in the contract documentation that 'l'accent sera mis sur des groupes zooplanctoniques non copépodes, tels que les protozoaires et les gélatineux|'. The introduction in the report also appears to contradict the contract text in saying that because copepods comprise 70-80% of the herbivore grazers in the North Sea they have been given priority in this study. Given these failings Annex 5 more than makes up; it is a brilliant essay on ecosystem modelling that is up-to-date with a large reference list. It is a comprehensive study that has used the FLEX 76 dataset from the northern North Sea to develop three versions of the EcoMod model. Unfortunately there does not appear to have been any application of the models to Belgian waters, at least by the time of the contract report. Important emphasis is given to the application of HPLC techniques in the contract, but only a small part of the work undertaken seems to have applied these techniques and the only detailed study appears to have been undertaken in the Norwegian coastal current (section 5) despite the fact that most of the Belgica cruises (page 65) were undertaken in the waters of the southern North Sea. A key finding of the project is that material ingested by copepods is sedimented rapidly to the bottom in Belgian coastal waters, but resides longer in the water column in more northerly waters of the North Sea. Acknowledgements to two ministries for funding (Belgian Ministry of Education and Science Policy and National Ministry of Science Policy) are only given in one of the papers included in the report (section 8).

Scientific Quality: There is no doubt that this work was of the highest international calibre, and leading the world at the time in many respects.

Scientific Output: Poor on the evidence provided with only one paper published in an international circulated document, the 1993 North Sea Quality Status Report Symposium volume and that only appears to have been a one page abstract. One of the publications cited was from a Belgian workshop and would have been considered as grey literature on the information given, which gives the title in English and no journal reference. This paper is however the same as section 5 of the report and lists the publication location as Progress in Belgian Oceanographic Research. Thus only 33 pages of text were published in the five-year period of the contract, a very poor return and a poor international advertisement of the excellent work done in the project. A further paper forms chapter 8..Published in 1994 this work is based on 1988 data i.e. work prior to the contract. It would have been helpful if a list of the annexed ms and their publication status had been provided as a frontispiece to the annexes.

Publications by year:	**Publications from the Contract**:
1994: 2? 1995: 1996: 3?	Belgian Journals: 3 Paper in a Book: 2 International Journals: Substantial Mss attached to report. Publication status unclear. Other products:

Social Impacts: High relevance to understanding North Sea ecosystem dynamics and to the development of modelling skills. It is unfortunate that this modelling team did not collaborate more closely with the modelling team at ULB and vice versa.

Strongest Points: Superb Annex 5

Weakest Point:.Poor structuring of the final report in relation to the original contract objectives and tasks.

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 2
Project Title: *Amore* Advanced modelling and research on eutrophication			
Participants:	ULB	VUB	MUMM
	V. Rousseau T. Bouvier J.-Y. Parent C. Leblanc C. Bursi G. Deliat S. Van Eeckhout C. Lancelot S. Becquevort Y.H. Spitz	M.L.M. Tackx M.H. Daro S. Gasparini A Meyer E. Antajan	K. Ruddick Y. Lianwu J. Ozer
Budget: 594,944 EURO		**Project Start/End Dates**: Jan 1997 – Dec 2001	

Objectives: Split into 3 sub-projects with many well defined tasks under each. The laboratory responsible for each task is indicated in the contract specification.

1. Phytoplankton, bacteria and protozooplankton dynamics: mechanisms and modelling
2. Mesozooplankton feeding and food resources
3. Physical controls on plankton dynamics and associated spatio-temporal variability : direct and inverse modelling.

Were Objectives Met?: Yes

Content and Quality of Report: The project was started on the premise that coastal waters of Belgium as represented by the sampling station 330 were eutrophicated. By the third year of the project it was clear that this station was mostly influenced by 'nutrient-enriched' waters of Atlantic origin and occasionally the Rhine, but not by the Scheldt. To quote this 'greatly questions the merits of eutrophication cause-effect relationships involving the Scheldt. Also the status of station 330 as monitoring of the response of the marine ecosystem to future reduction of nutrients discharged the Scheldt become then highly questionable' There is no discussion of the position of station 330 in relation to the bottom topography which is shown to be important. (However, report 2 from year 2000 contradicts this statement by noting that station 330 'constitutes a good reference area for observing changes in the pelagic food web structure'.) Key findings of the research are 1) that *Phaeocystis* is negatively related to salinity and not to changes in nutrients from river inputs, 2) the determination of a light threshold of 12µ mole m^{-2} s^{-1} in the water column for the start of the spring bloom. However, light does not seem to be driving the dynamics of the system according to the results of data assimilation studies. *Phaeocystis* outcompetes diatoms later in the spring at higher temperatures. The green fingers needed to grow many of the phytoplankton species in culture for experimental studies has been a key factor in the success of this project. A wide range of experiments were undertaken to determine the nutrient requirements of the different species present in the spring as well as feeding experiments to establish trophic relationships. A further key conclusion is that most of the *Phaeocystis* bloom is biodegradable via the microbial loop and does not end up in the sediment; sedimentation rates appear to be negligible. Results obtained from the complex 3D MIRO model have required careful evaluation in consultation with the process experimental teams to ensure that the results are not spurious. The model results demonstrate phytoplankton succession and depletion of silicates and then nitrates. However, it was stated that true quantitative results may be difficult to achieve for the present due to the sensitivity of the model to poorly known parameters and boundary conditions. An important product of the project has been an upgrading of the MIRO model to version 2. It is not clear why monthly runoff measurements for the Thames were not used in 2000 model runs, as for other rivers, as this information is readily available. The model assimilation work by Yvette Spitz is revealing and a key part of the project. Some reference should have been made in the report to her role in the contract as a consequence of her location in the USA. The report for 2001 notes the lack of information on the temporal and spatial extent of *Phaeocystis* blooms. Reference should have been made to the work of Hardy in the 1930s and the results of the Continuous Plankton Recorder (Owens et al. 19xx). Four annual reports were available for the evaluation, but not the final report and together they form a substantial package of documents. Detailed results are given in each annual report, but not in the order of the originally defined tasks. Excellent project summaries. The report is not well structured, but made up of separate reports for each sub-contract with some additional annexes. As a result the impression given is of three teams working independently rather than in an integrated way towards the project aims. Once a year meetings of the project teams are not sufficient to encourage collaborative and integrated work programmes. The format of the reports differed from year to year e.g. in 2000 all papers were attached as annexes at the end of the report, in 2001 they were attached behind the separate project reports, but only from one group (ULB-ESA). No index is provided or reference made to progress in relation to the identified tasks of the contract. No reference is made to where the results are stored or if they are retrievable. The reports are not serially paginated

Scientific Quality: The research undertaken both at sea, in the laboratory and by the modellers is of a high international standard and includes the development of ground breaking new techniques.

Scientific Output: Scientific manuscripts on the research were not appended to the annual reports until the third year of the project. In the 2000 report 3 submitted ms were attached. No indication was given in the 2001 report as to whether these ms were accepted for publication. In the 2001 report 3 ms were attached to the ULB-ESA report (one in preparation). If this was the only publication output from the teams it was small for their size. Reference was obliquely made in the Spitz report for 2001 of a PhD dissertation by ? Tungeraza within AMORE. Why was this not given a more detailed exposition? As no reference is made to publications that are a direct product of the AMORE project it is difficult to determine the publication output. The impression is of a low output, which is unfortunate as this excellent work will not get the international recognition it deserves. References given in the various reports and annexes were scanned to give the publication numbers below, which are likely to be inaccurate. No references given in some ULB-ESA reports.

Publications by year:	**Publications from the Contract**:
1997: 1	Belgian Journals:
1998: 3?+1+1+1=6?	Books, others:3?
1999:	International Journals:1+1+2=4
2000: 2	Papers in books: 1+1=2
2001:	Other products: 3D MIRO model

Social Impacts: has a high policy relevance in giving Belgium quantitative scientific guidance in the development of a national approach to eutrophication issues in the framework of OSPAR and EU Directives, including the development of approaches for the Water Framework Directive.

Strongest Points: Identification that station 330 not likely to be affected by eutrophication attributable to Scheldt nutrient inputs and that *Phaeocystis* interannual variability is salinity and not nutrient related.

Weakest Point: Presentation of the results in the reports – not integrated and apparent poor publication output.

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 6
Project Title: IDOD: Integrated and dynamical oceanographic data assessment			
Participants:	MUMM	Ulg-SURFACES	KULeuven-UCS
	Promoter G. Pichot Serge Scory 1997, 1998, 2000 Mia Devolder 1997, 1999, 2000 K. de Cauwer 1998, 1999, 2000 S. Jans 1999 Inventory=3d, 2000	Promoter J-P Donnay 1997, 2000 F. Muller 1997, 1998, 1999,2000 F. Muller 1997, 1998, 1999,2000 Y. Cornet 2000	Promoter J. Billiet J Van Dyck 1997 B Plevoets 1997 No name 1998, 1999, 2000
Budget: 594,944 EURO		**Project Start/End Dates**: Jan 1997 - Dec 2001	

Objectives: To establish, manage and promote a marine environmental database for data sourced from routine monitoring, field and laboratory research and mathematical models for later use by marine scientists and policy makers.
Sub-project 1. IDOD: Information system design and establishment
Sub-project 2. IDOD: Database design and geo-referenced data handling tools.
Sub-project 3. IDOD: Quality control and data analysis tools.

Were Objectives Met? The objectives are being met in a systematic way though progress in the initial years at least was slower than expected. My main criticism over the establishment and running of the project was that there appears to have been no or very little discussion with other national database systems that have been developed by countries around the North Sea. There would also appear to have been minimal contact with ICES, although much of the data archived will in due course be passed to ICES. None of the members of the IDOD group appear to have participated in the ICES Working Group on Marine Data Management until October 2001 when I gather that one representative from Belgium attended. A more active role by Belgium in this Working Group should be encouraged in the future, to benefit from the experience of other countries and pass on knowledge gained in the IDOD project to others. It was good to read in the 4th Newsletter that MUMM has been designated as the Belgian NODC. With respect to the point made above I wish to quote from the last paragraph in the newsletter: 'A marine XML can provide a standardised data structure that can then support the creation of generic software, rather than the continuation of the present situation of building 'one off' applications for each user or agency, that presently results in 'islands of information' '. Is Belgium's new database reinventing the wheel and doing exactly what the IOC International Oceanographic Data and Information Exchange IODE) committee argues against? Some discussion of retrospective incorporation of data produced in BELSPO funded projects should have been included in the report.

Content and Quality of Report: Four annual reports received to Jan 2001 and one inventory report for the years 1997-1998. The annual reports are divided on all occasions into three separate sub-reports from the three contributing organisations. In this respect the annual report is not an 'integrated' project report. Other than in the first year the report for KULeuven-UCS gives no names for the contributors to the report. This is not appropriate as the people contributing to the report should receive appropriate acknowledgement of their work. It also facilitates the review process as a check, if necessary, can be made on their credentials. The reports are well structured other than the comment on integration above.

Scientific quality: High. Clear evidence of appropriate expertise at an international level.

Scientific Output: Much of the development is cutting edge and should have been contributed to the scientific literature, especially international journals. A poor return. The newsletters are well written and informative. The newsletters are an important means of communicating to the data contributors and potential users of the database and should be given a high priority. The excuse for not drafting one for the year 2000 does not stand up. The authorship is not always given.

Publications by year:	**Publications from the Contract**:
1997: No publications	Belgian Journals:
1998: 1 newsletter	Books, others:
1999: 1 paper in symposium proceedings	International Journals:
2000: 2 newsletters	Other products:
2001: 1 newsletter	

Social Impacts: Once operational will prove of immense value to Belgium in providing a central source of marine information.

Strongest Point: Establishment of a Belgian NODC
Weakest Point: Initial poor international collaboration or investigation of other NODCs.

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 13
Project Title: Evaluation of the 'Paardenmarkt' site			
Participants:	UGent-RCMG	G-Tec S.A.	IN.
	T. Missiaen Prin. Sci. J-P Henriet Promoter V. Van Lancker F. Charlet G. Moerkerke J. Lanckneus Magelas	L. Halleux S. Couvreur UGent : S. Degraer J. De Rouck J. Geraerts	E. Kuijcken J. Van Wayenberge E. Stienen N. Van Ham TNO NL A. Revil CEREGE U. Mar. F
Budget: 148,736 EURO		**Project Start/End Dates**: Sep 1999 - Oct 2001	

Objectives: By combining, geophysical, geochemical, sediment-dynamic, biological, engineering and ecological expertise

- Produce a detailed synthesis of availaable information on the study site.
- Analyse options for research and monitoring of the site and specifically the occurrence of biogenic gas.
- Examine engineering optionas and the possibility of turning the site into a nature conservation area.
- Evaluate strategies for public communication.

Develop international collaboration on studies of armament dump sites.

Were Objectives Met? Yes in a well ordered and systematic way. My first evaluation of this project was based on the annual report of 10/10/2000 which was a poor report based on many subprojects of different quality, some of which were highly speculative. The final report was made available in January and is a vastly improved document.

Content and Quality of Report: The final report is a well presented and structured document compared to the earlier annual report. It systematically covers the areas identified in the contract objectives. A useful summary is included and I liked the way the main conclusions were highlighted in each section. The summary should have been placed at the front of the document. However, the reasons why the study was initiated in the first place are not clearly stated and should have been included in the introduction. A recent history of political and local concerns is only presented later in section 1.1.1. What was the background to the Paardenmarkt site evaluation project? Did it originate as a response to the parliamentary questions of 1998? And why was there a need for a new study when a 'thorough investigation' of the site was commissioned by the MPHE as recently as 1995. To what extent is this report duplicating what was in the original report. Alternatively, is this work an extension of the earlier study and if so why was it funded by BELSPO rather than MPHE?

A useful account of the types of munitions and where they were dumped and on Belgium's destruction and dismantling procedures is given. An important section from the earlier report is missed out which gives the rate of destruction against the number of munitions added to the existing stockpile per annum. This is relevant as it should be a factor in the discussion of potential munitions recovery. Much of the information included in the geophysical, geochemical and sedimentological syntheses seems to be from the earlier contract. The evaluation strategies are really presented like carrots or bait looking for further funding and the section on biota is almost entirely speculative as no sampling has been carried out. Given the safety implications I agree with the comment made in the earlier report that 'Using infauna as a monitoring tool seems therefore absurd'. Section three is a useful review of the munitions toxicity and of gas behaviour in sea water. Some of the ideas proposed in the monitoring section seem ludicrous given their high cost and in some cases speculative nature. For example I cannot think of any chemical sensor that could be realistically deployed in the high-energy environment found near the shore. Surely a more realistic situation would be to put up signs warning the public not to handle any material on the beach and to have posters along the beach giving an outline of the site its history and potential danger. The signs could emphasise that the site is covered with three meters of sediment and unlikely to be a problem in the immediate and probably long-term future. The biological monitoring proposed is especially irrelevant, how are birds going to give warning of a potential threat from the site? Some of the language used in the conservation section is non scientific and inappropriate to a report of this nature e.g. 'which are now doomed'. I applaud the developing international links, but feel personally that the best thing that could be done is to leave the site as it is. It has not proved to be a problem for 80 years and is now buried by three metres of sediment. Limited surveillance monitoring should be carried out to watch for any change in the status quo. These ideas reflect the second para. On page 166 of the report (also on page 157) which should be its main conclusion. Why is there a Flemish and no French summary?

Scientific quality: Variable, most of a high international calibre.

Scientific Output: Ten papers and one MSc thesis as scientific products of the contract. Some of these papers bear little or no relevance to the project e.g. a paper on wind turbines and others appear to deal with a much wider area than the Paardenmarkt. Some technical papers may be describing equipment designed for the evaluation, but this is not clear without reading the papers. Papers given as 'in prep.' or 'submitted' should not have been cited as they may never be published. On this basis and being generous I estimate that 5 papers are relevant to the contract. Some of the citations only appear to be abstracts. A full citation should have been given. As the contract has only just finished more publications are likely to appear over the next few years.

Publications by year:	**Publications from the Contract**:
2000: 3 2001: 2	Belgian Journals:1 Articles in Books, others:1 International Journals: 2 Other products:1 Conference paper

Social Impacts: Of considerable local interest to the region of Zeebrugge.

Strongest Point: A valuable synthesis of existing knowledge on the Paardenmarkt site and of dumped munitions and their toxicity.

Weakest Point: At times overly speculative and providing suggestions that are unrealistic and hugely expensive. No discussion is included on the relative economics of the ideas proposed.

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 15
Project Title: Investigation of natural sand transports on the Belgian Continental Shelf: BUDGET			
Participants:	1. UGent-RCMG	2. UGent-RCMG	3. UGent-RCMG
Promoter J. Lanckneus Only promoters referred to in documentation although other listed labs part of network	Promoter M. De Batist SGIG, BMM, MAGELAS?	Promoter J. Lanckneus MAGELAS, BMM	Promoters J. Lanckneus & M. De Batist MAGELAS, SGIG
Budget: 49,579 EURO		**Project Start/End Dates**: Sep 1999 - Aug 2001	
Objectives: Three clear objectives are defined in the technical specification of the contract and broken down into 14 tasks. 1. To produce an inventory of relevant publications and work on the Belgian continental shelf. 2. To produce a critical analysis of archived data and methods used to study the shelf. 3. To examine new methods of cartography for the presentation of the data.			
Were Objectives Met? Yes, the three objectives have been met, but some of the tasks do not appear to have been fully addressed or were not completed to the planned timetable. Incorporation of the data into a multidisciplinary data bank may well have been undertaken within the contract, but there is no reference to this work in the final report. This task should have been a major part of the contract as the information then becomes available for further analysis in the future. Furthermore, information that is held in paper form or other less accessible formats will be secured for the future and not lost. Information on where the databank is held and how it may be accessed by other scientists should also have been provided. If the data cannot be freely accessed an indication of the data restrictions and a data policy should have been made available. I have not been provided with a copy of Annexes 2 and 3. The inventory Annex 1, is a valuable summary of the research and data sources reviewed in the report. The inventory in PDF format and the Endnote bibliography should be placed on the BELSPO web site and its availability advertised.			
Content and Quality of the Report: The date the final report was compiled and submitted to BELSPO is not given. By implication in the introductory note the project was completed four months late. The report is well drafted and informative with many references and the co-ordinator should be congratulated for the ordered way a synthesis of the results of the various participants in the network has been produced. Good links have been made with other Belgian non-participants through the use of workshops and with researchers from other adjacent countries. The description of the geological and physical characteristics of the Belgian continental shelf (Task 1) is well, described with appropriate illustrations. Much of the information on the maps produced is difficult to decipher as they have been reduced too much. Results from side scan sonar have been acquired, but no information is given on where and how the data is housed. There is no discussion of the GIS system used for the presentation of mapped information. A key observation is that, with prevailing hydrodynamic conditions, large bedforms, even near the coast are relatively stable. A potential key finding from this project for Belgium would be an estimate of the environmental conditions and the timeframe that might lead to a remobilisation of these large deposits. The project has pulled together much data and assimilated it in the production of maps. The key missing part of the project is any discussion and implementation of the long-term archiving of this information.			
Scientific quality: High. It is clear that a knowledge base has been developed and international contacts made at a high level.			
Scientific Output: Only one paper, in Dutch and in a book. A very poor output from a two year project involving so many partners. A minimal number of recent references including any of the authors of the report are given in the reference list. This publication record does not do justice to the considerable amount of work that has been undertaken in the project.			
Publications by year: None		**Publications from the Contract**: Belgian Journals: Books, others:1	
Social Impacts: Establishment of potential sediment movements in the offshore zone of Belgium is likely to be a critical requirement in a time of climate change. The research has high relevance to the selection of appropriate sites for aggregate extraction and for dumping of dredged spoil. The project thus has a high policy priority.			
Strongest Point: Attempt to synthesise information to develop a sediment budget **Weakest Point:** A lack of information on data management and archiving of the data used in the project.l.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 16
Project Title: Identification of marine zones affected by eutrophication (IZEUT)		
Participants:	ULB-ESA	ECOLAS
	C. Lancelot - Co-ordinator E. Breton V. Rousseau	B. De Wachter T. Bolsens D. Leroy
Budget 148,736 EURO	**Project Start/End Dates**: Jan 2000 – Dec 2001	

Objectives: Split into 3 sub-projects with many well defined tasks under each. The laboratory responsible for each task is indicated in the contract specification.

1. Phytoplankton, bacteria and protozooplankton dynamics: mechanisms and modelling
2. Mesozooplankton feeding and food resources
3. Physical controls on planktondynamics and associated spatio-temporal variability : direct and inverse modelling.

Were Objectives Met?: Yes

Content and Quality of Report The report provided for evaluation was for the first year of the contract, 2000 and only consisted of 7 pages of text and diagrams. It is too brief and not adequate for the purpose. The final report was not completed by the due date of 31 12 2001 and no reason given to the evaluator why this was the case so it is extremely difficult to evaluate this project. As a result some comments included will be based on the report given by Dr Roussequ at the Symposium 'Gestion durable de la mer du Nord on 22 january 2002. The report emphasises in bold on the first page that the datasets of the Flemish and Belgian institutes are 'quite disparate' for three main reasons: 1. Changes in mission of the different insitutes, 2. Changes in calculation methods of nutrient loads, and 3. Ongoing legal changes due to the rorganisation of regional and governmental authorities. If this is to be used as an excuse for the thinness of the report then the least that could have been provided would have been a listing of each of the different institutes with a breakdown of what they have available. Some indication of how this data differs from what is required and how these problems might be overcome should also have been included. The ten lines of introduction were extremely brief and should have given a full and detailed preçis of the OSPAR strategy to combat eutrophication and how it is to be implemented as well as an outline of the deliverables of the contract.

Screening Procedure – The first task updating data is summarised in the first paragraph of this section, but the text does not subsequently have a structure that reflects this short introduction. The main heading of Task 1 is inappropriate as it implies that all Belgian waters are enriched by nutrients, prior to the screening procedure. This may well prove to be true, but it should not be pre-assumed. Under the heading 'Sources of nutrients' most emphasis is placed on agriculture, then briefly on industry, transport and households, with no mention of natural or recycled sources. Information on agricultural inputs is only given for Flanders. While the statistics are revealing they need to be expanded to cover the whole of the country. How this will be achieved is not discussed. The disorganised state of the report is seen in the use of the headings 'Nutrient enrichment of the Belgian coast' twice and 'Nutrient loads to the Belgian coastal waters' twice. This implies that two separate inputs to the report have been produced and not edited to fit together. In the section on pages 6-9 there is considerable variability in the nutrient concentrations over time; minimal explanation of these changes is offered and no suggestion made that they may in part be due to natural variability. Task 1.2 is poorly conceived. A sampled group of 323 persons is very small with an overrepresentation of female responses. How was the design of the questionnaire and the questions it wished to answer formulated? Foam on beaches is a very short-term phenomenon and is not always a response to eutrophication. The estimated economic loss may therefore well be too high. Some indication of how these figures were calculated should have been included. At the symposium it was said that only 9% of the responses feel that foam is a problem; if so should it be considered as a key index of eutrophication? The same applied to interviews of fishermen who did not see *Phaeocystis* as a problem or in most cases a cause of a reduced income.

Comprehensive Procedure - The procedure proposals are reduced to the relationship between Phaeocystis and excess nitrate as the fishery enquiries could not be used. While the former approachl appears sound it is based on very few measurements and it is not making use of the considerable research undertaken by the Lancelot school in the past.

Scientific Quality: A poorly constructed and minimalistic report on what is a key policy issue.

Scientific Output: No products by the time of this review, but the final report if improved should form a key contribution to Belgian marine policy in the eutrophication field.

Publications by year:	**Publications from the Contract**:
None	None

Social Impacts: A high policy relevance although preliminary socio economic analysis in the study would indicate that social and possibly economic impacts of marine eutrophication in Belgian waters are minimal. What has not been looked at are potential whole ecosystem effects and economic assessment of biodiversity values and changes.

Strongest Point: Attempt to develop a quantitative methodology.
Weakest Point: Poor and largely unstructured report.

Annex 5.2 Marine Chemistry

<table>
<tr><td colspan="2">BELSPO Programme: Project Sea 1970-1976</td><td colspan="2">Contract nos.: 5, 9, 17, 22, 24, 26</td></tr>
<tr><td colspan="4">Project Title: Inventory of pollutants</td></tr>
<tr><td>Participants:</td><td>VUB</td><td colspan="2">ULg, VUB</td></tr>
<tr><td>ULg
A. Disteche -
Co-ordinator</td><td>I. Elskens - Co-ordinator</td><td colspan="2">J. Bouquiaux G. Van Binst
P. Herman C. Mortelmans
R. Vanderstappen G. Duyckaerts
P. Van Hoeyweghen G. Gillain
W. Baeyens J. Henriet
A. Vanderghinste M. Hoenig</td></tr>
<tr><td colspan="2">Budget: Not mentioned</td><td colspan="2">Project Start/End Dates: 1-1-74 to 31-12-78</td></tr>
<tr><td colspan="4">Objectives: The objectives of this project were to evaluate the levels of contaminants in the Belgium coastal waters by various contaminants.</td></tr>
<tr><td colspan="4">Were Objectives Met? Yes</td></tr>
<tr><td colspan="4">Content and Quality of Report: Very well structured report addressing efficiently the objectives targeted. A large part of the report gives an overview of the contaminants (nutrients, pesticides, trace metals) found in the whole hydrographic system. The conclusions are very comprehensive and detail the quality status of the whole Belgium hydrographic system. This section is very detailed and gives a excellent level of information of the level of quality. These reports are established on a very large amount of data collected with reliable protocols and include year to year variability. It is followed by a section on the analytical techniques used in this study which are again very informative and detailed. The techniques described for atomic absorption have been proposed to normalisation to the Belgium Institut of Normalisation. The rest of the report is followed by detailed description of nutrient evaluation, methods for the determination of pesticides by GC-Ms and for the determination of trace metal in sea water by ASV. It completed by an extensive and detailed study of pesticides and trace metals in the suspended matter and sediments of the Scheldt and of the North Sea collected on an extensive grid.
Here also the different part of the report are very clear and well written and give an excellent overview for the time of its realisation of high quality of data acquisition, analysis and reporting.</td></tr>
<tr><td colspan="4">Scientific Quality: The report is excellent throughout, both in terms of content, quality of the data obtained, quality of the results, giving an exact status of the quality of the hydrographic system of Belgium. This report was clearly intended for direct reporting and little to no scientific processing of the data have been attempted or reported.</td></tr>
<tr><td colspan="4">Scientific Output: At this level, it is clear that no scientific output was intend since the report was to establish the direct and plan contamination level of contaminants in the Belgium waters. The resulting level of information is none the less essential for any intent of efficient management of the North Sea and adjacent estuaries.</td></tr>
<tr><td colspan="2">Publications by year:
?</td><td colspan="2">Publications from the Contract:
?</td></tr>
<tr><td colspan="4">Social Impacts: Excellent in terms of public management. The output in terms of training and promoting young scientists is not given.</td></tr>
<tr><td colspan="4">Strongest Point: Excellent work, well performed and complete. Excellent reporting level.
Weakest Point: No apparent weak since the work and report performed were to establish the level of contamination without apparently any objectives of scientific validation.</td></tr>
</table>

BELSPO Programme: **Project Sea 1970-1976**	**Contract nos.**: 2, 9, 15	
Project Title: Contamination of seafood products		
Participants:	ULg	
	J. Nihoul - Co-ordinator A. Disteche - Co-ordinator	P. Herman R. Vanderstappen F. Noel-Lambot I. Elskens J.M. Bouquengneau
Budget: Not mentioned	**Project Start/End Dates**: 1-1-72 to 31-12-76	
Objectives: This report addresses some of the first investigation of the pollution of the Scheldt and the North Sea in the sea food product and with some first ecotoxicological studies. It is completed by a global study of accumulation of trace elements in fish and overall budget of the trace elements in the Southern Bight		
Were Objectives Met? Yes		
Content and Quality of Report: A very clear and efficient report achieving well its goals. The first part of the report addresses the levels of contamination of sea food products with total levels of Hg and methylated mercury and finally with other traces elements Cd, Cu, Pb, Zn and pesticides. It is a considerable load of work that has been performed and the major conclusions clearly highlight that the most polluted areas are clearly located along the Belgian coast line. A statistical study allows to have an in-depth evaluation of the variability of the data and their significance. This statistical approach has allowed also highlighting the important gaps in the approaches developed and making further recommendations for future projects. It is followed by a detailed study on the level of contamination of the phytoplankton by trace metals. The detailed study allows to concluded and give accumulation factors and for Hg, Cd, Cu, Pb, and Zn by plankton. This overall study clearly lists the importance of this compartment in the translocation of trace elements in the water column and makes reference to the different mechanisms likely to take place. This study is followed by a second part devoted to the ecotoxicological uptake of mercury species by eals. This detailed study leads to a schematic transfer of the different mercury species in the different organs of the fish. Similar studies follow either with other elements such as Cd or with different organisms. They are concluded with a mechanistic study the role of metallothioneins in the case of successive intoxication by Cd and Hg. Similar studies are conducted on the effect of trace metals on mussels and the sea star. These studies are conducted with radioactive mercury. Ecotoxicological studies were also conducted with heavy metals and pesticides on monocellular organisms. The ecotoxicological tests conducted in several areas of the North Sea also give a clear insight of the different contamination levels. All these approaches provide a good understanding of the ecotoxicologal risks associated with the different contaminants in the North Sea and possible translocation in the food chain. All these studies are concluded by a global model of transfer and accumulation of the different contaminants in the total biomass of the sea food in the North Sea with a critical assessment associated with the consumption of sea food.		
Scientific Quality: An excellent report well organized and experimentally well accomplished. It is again worthwhile noticing that the quality of the work is high and is very much in tune with the most advanced development of that time.		
Scientific Output: ?.		
Publications by year: ? All references quote mainly grey literature.	**Publications from the Contract**: ?.	
Social Impacts: Excellent in terms of public management. The output in terms of training and promoting young scientists is not given.		
Strongest Point: Excellent work well perform and complete. Excellent reporting level. **Weakest Point:** Most of the work quote grey literature and was oriented towards this grey literature		

BELSPO Programme: **Concerted Research Actions 1976-1981**			**Contract nos.**: 2, 3
Project Title: Distribution, transport and fate of heavy metals in the Belgian coastal marine environment			
Participants:	ULg	VUB	RBINS
	A. Disteche - Co-ordinator C. Gillain J.M. Bouquengneau F. Noel-Lambot C. Verthe	I. Elskens - Co-ordinator W. Baeyens M. Bogaert G. Decadt H. Dedeurwaerder F. Dehairs M. Dejonghe L. Goeyens	S. Wartel
Budget: Not mentioned		**Project Start/End Dates**: 1-1-78 to 31-12-82	
Objectives: This final reports represents a global integrated study of the fate of trace metals in the Belgian coastal marine environment, the transfer of these elements to the marine organisms and a molecular approach of their storage.			
Were Objectives Met? Yes extensively			
Content and Quality of Report: The report addresses in a series of 7 subchapters the overall aspects of the transport and fate of trace elements, their bioaccumulation in the marine organisms and their molecular storage. The fate of the trace metals is carefully evaluated with a critical discussion of the sampling and analytical methods highlighting the quality of the data generated. Speciation of elements were performed when ever possible (Sb) promoting also a most appropriate "speciation scheme" for the determination of trace elements in the particulate phase of sea water. Avery carefully realized section. It is followed by an evaluation of the spatial and temporal distribution of the trace elements in the water column to critically assess the quality of the data generated. The contribution of the river Scheldt is very well realised. These contributions are complemented by an assessment of the atmospheric inputs of trace elements to the sea. A series of mechanistic studies allows assessing the in-depth chemical ad kinetics wise behaviour of inorganic mercury between the dissolved and the suspended phase of the water column. These studies are finally integrated in a passive dispersion transport model (box model) of several elements to evaluate the possible mechanisms of transformation in the water column of the North Sea. The study is completed with excellent biochemical studies on the accumulation of heavy metals in marine organisms with a good assessment of the speciation effect of the elements studied. Finally, a most detailed study is undertaken on the accumulation, elimination of and storage of Cd in eals. All the chapters are very well written and illustrated.			
Scientific Quality: The scientific quality of the report is again excellent and most pertinent in terms of scientific achievements for its period of timing compared to other international advances. The overall integrated series of contributions present a most comprehensive and progressive understanding of the fate, impact and translocation of trace elements in the Scheldt and adjacent North Sea with its accumulation in biological systems. All analytical techniques, sampling strategies and incorporation in the biological systems are of high scientific achievements.			
Scientific Output: ?			
Publications by year: ?		**Publications from the Contract**: ?	
Social Impacts: Excellent in terms of scientific objectives to sustain public policies for environmental management. The output in terms of training and promoting young scientists is not given.			
Strongest Point: Excellent and homogeneous scientific level in general, at the forefront of international developments on these issues. **Weakest Point:** Lack of effective scientific dissemination. The quality of the work is very much under exploited in term of scientific validation. However despite of this restrictive point, this general type of work has promoted Belgium oceanic research in the leading groups internationally at this time.			

BELSPO Programme: **Concerted Research Actions 1976-1981**			**Contract no.**: 3
Project Title: Hydrodynamic and dispersion models boundary fluxes and boundary conditions			
Participants:	ULg	ULB	VUB
	J. Nihoul - Co-ordinator G. Gillain	R. Wollast - Co-ordinator	F. Dehairs H. Dedeurwaerder M. Dejonghe G. Decadt W. Baeyens I. Elskens M. Somville
Budget: Not mentioned		**Project Start/End Dates**: 1-1-84 to 31-12-89	
Objectives: Several objectives are achieved by different groups: 1) complete hydrodynamic modelling of the North Sea; 2) behaviour of organic carbon, nitrogen and phosphorus in the Scheldt estuary; 3) examination of the boundary conditions for heavy metals at the air-sea interface; 4) mathematical modelling of the water quality of aquatic environments.			
Were Objectives Met? Yes extensively.			
Content and Quality of Report: The report is made of 4 successive contributions of unequal importance in volume but highly homogeneous in scientific content and quality. All contributions represent an in depth evaluation of the topic. Each of these contributions are made in the format of excellent publications.			
Scientific Quality: The general scientific quality of this report is excellent. Each of the contribution could represent a direct scientific contribution for main publication or book chapter. Further to the homogenous excellent scientific contribution of the different group is the novelty of the scientific objectives achieved at the time of the report. All of these contributions represent the state of the art in the domain and certainly some of major advances internationally at this time. The report by J. Nihoul is extensively comprehensive and represents an exceptional example of hydrodynamic modelling which will later, together with the previous work for the same author will set the trend on this domain at the best international level. The same can be expressed to a lesser extend to the other contributions that are also of excellent and in-depth scientific quality. Both the contribution from R. Wollast and M. Someville also set the trend in the modelling of the behaviour and inputs of organic matter and nutrients in the Scheldt estuary and adjacent North Sea. Both contributions bring some most valuable information on the fate and processes, and their modelling in the different areas studied. The conclusions from the contribution of R. Wollast brings some most important results to be used for the management of organic matter input and transformation in the system studied. Finally the report from F. Dehairs et al. produce a complete evaluation on the comparative inputs of trace metals between river and atmospheric inputs emphasizing the major role of atmospheric contribution for elements such as Cu, Zn and Cd. In this contribution also, the work is of excellent quality and very up to dates with the major international biogeochemical concepts.			
Scientific Output: The scientific output is difficult to evaluate since no mention of the output is listed in the document. However, the quality of the scientific reports is excellent and this aspect could be a problem for the scientific validation of the results generated since the authors might have confined their contribution and efforts to this excellent report which is none the less of limited access.			
Publications by year: ?		**Publications from the Contract**: ?	
Social Impacts: Excellent in terms of scientific objectives to sustain public policies for environmental management. The output in terms of training and promoting young scientists is not given.			
Strongest Point: Excellent and homogeneous scientific level in general, at the forefront of international developments on these issues. **Weakest Point:** Lack of effective scientific dissemination. The quality of the work is very much under exploited in term of scientific validation. However despite of this restrictive point, this general type of work has promoted Belgium oceanic research in the leading groups internationally at this time.			

BELSPO Programme: **Concerted Research Actions 1982-1993**		**Contract no.**: 6
Project Title: Chemistry of the North Sea		
Participants:	UIA	
	R. Van Grieken - Co-ordinator	
Budget: Not mentioned		**Project Start/End Dates**: 1-1-84 to 31-12-89
Objectives: To study biogeochemical cycling of elements in the North Sea.		
Were Objectives Met? Yes		
Content and Quality of Report: The report is very concise and focused to the main objectives of the project. The report delivers minimal scientific results; All major conclusions call for the scientific papers published and going in much greater depth than that of the report. The project basically evaluate the potential of EPXMA and LAMMA probes to assess the individual composition of elements on particles of the water column or aerosols collected during North experiments and campaigns. The reports lists the different possibilities and results obtained on either EPXMA or LAMMA on individual suspended particles and the resulting geochemical association suggested. The same type of approaches is developed on aerosols particles collected over the North Sea. The work is followed by the description and concentrations of trace elements determined by X Ray fluorescence in suspended matter collected from the Scheldt estuary and the variability of the trace metals content in the sediments of the North Sea. All these studies include the effect of the grain size on the concentration of the elements determined.		
Scientific Quality: The scientific quality of the report is excellent and concise. It calls for the main conclusions by refereeing to the large numbers of publications issued from the work and relies on very well organized documents where all publications are called appropriately.		
Scientific Output: The scientific output is extremely high. There are no doubts that this programme has very seriously contributed to the international of this group and has brought some novel subjects to be investigated by the different members of the project. The scientific publications issues from this project have contributed to bioth develop the analytical expertise of the group to the highest standard has well as allowing them to unravel new aspects of biogeochemistry brought by the new use of EPXMA and LAMMA probes to this domain. There is also no doubts that the development achieved in the context of this programme have benefited to several other projects has it can be understood from the list of publications.		
Publications by year: Excellent 1985: 28 1986: 32 1987: 28 1988: 20 1989: 16	**Publications from the Contract**: Excellent Belgian Journals: 15 Books, others: 10 International Journals: 71 Other products: 28	
Social Impacts: The social impact of this project is very high since it has been the opportunity to train many students at the master level on most modern techniques and approaches as well has promoting 4 PhDs. Further, the expertise has been applied in other domains with great success has it can be derived from the list of publications.		
Strongest Point: Excellence in both the analytical and environmental issues addressed. Exceptionally high scientific output either by the very large number of primary scientific papers as well as in the levels of the papers addressed. Most remarkable scientific achievement. **Weakest Point:** If any? May a lack of integration with other Belgian scientists working of the same programme on the biogeochemistry of the North Sea.		

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 1
Project Title: Molecular dynamics of metal uptake, accumulation and elimination in marine organisms.		
Participants:	UGent	
	L. Moens - Co-ordinator	
Budget: Not mentioned		**Project Start/End Dates**: 1-96 to 12-96
Objectives: Detection and identification of metal ligands by 2 dimensional electrophoresis and microanalysis Development of a method for the 2 D electrophoresis determination of metal ligand in biotissues		
Were Objectives Met? Yes..		
Content and Quality of Report: The reports is very synthetic and illustrates well the development made. The work is state of the art at the time it was developed. The content of the report addresses both the different analytical steps involved to optimise the 2 dimension electrophoresis (optimisation of the different of the reagent concentration, quality and parameters) to maximise the separation. The results and best condition are applied to real samples with success.		
Scientific Quality: The work is of high quality and well reported and completely fits with the objective of the programme. Further, the work is well validated in publications for a one year project.		
Scientific Output: 3 publications are mentioned in this project (2 published and one in press). The work listed can certainly directly attributed to the project supported.		
Publications by year: 1996: 2 1997: 1	**Publications from the Contract: none** Belgian Journals: Books, others: book chapters International Journals: 3 Other products: Participation to international meetings	
Social Impacts: Excellent analytical development in the focus of the Impulse programme. The applicability of the method to real environmental issues will be of significant value.		
Strongest Point: Excellent analytical development and high scientific output. **Weakest Point:** Not appearing. Excellent work and validation all-around.		

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 3
Project Title: Pathology and ecotoxicology of seabirds and marine mammals of the North Sea and adjacent areas		
Participants:	VUB	ULg
	CR Joiris- Co-ordinator L. Holsbeek	F. Coignoul JM Bouqueneau
Budget: Not mentioned	**Project Start/End Dates**: 1-10-92 to 31-12-96	
Objectives: Three objectives were targeted: 1° - Identify the cause of the death after anatomo-pathological and ecotoxicological analysis of animals found dead on the North Sea shores, assess the state of the populations involved; 2°- establish a link between the contamination of the North Sea and the level of contaminants in top predators; 3° - Study the mechanisms of uptake, accumulation , excretion and detoxification in marine top predators		
Were Objectives Met? Partially. There is a good description of the possible causes of death of the organisms collected and interesting positioning of the levels of contaminants founds with respect to that of normal populations. However, point 2 and 3 still need to be addressed.		
Content and Quality of Report: The report quality is weak for a 4 year report. The text addresses the full description of the contamination levels found in the different organisms stranded on the beaches of the North Sea. Most of the work is performed on marine birds (mainly Uria aalge). Level of trace metal, organic contaminants, methallothionines were determined over time. The report consists of a general introduction and a series of papers submitted for publication in the different annexes. The quality of the papers is however excellent but stay in general in global descriptive stage of the levels of contaminants encountered.		
Scientific Quality: The work performed and reported in the paper submitted give an excellent insight of point 1° of the initial objectives of this work. If this first aspect is very well addressed, the objectives 2 and 3 are seriously lacking, making difficult the overall objectives of linking the contamination status of the North Sea to the death of the animals collected. This lack of aim certainly relates to the lack of open collaboration with other chemical research groups in Belgium. Most of the collaborative effort is oriented towards other similar research groups allowing them to have a good global evaluation of the contamination of the population studied. Mechanistic studies are also lacking in order to critically evaluate the dynamic evolution of the contaminants in the organisms studied. Same remarks with ecotoxicological approaches. The overall feeling related with this work is that it is some excellent and well organised descriptive work but referring to old analytical methods and with a lack of dynamic translocation and fate of the contaminants in the organisms studied.		
Scientific Output: The scientific output is good in term of quality but low in terms of level of the journals targeted. In general, this programme would result on average in 1 paper, 1 report for international meeting, and one report for a master student. This is obviously far too low.		
Publications by year: 1992: 1993: 1994: 1 1995: 1996 3	**Publications from the Contract**: Belgian Journals: 2 Books, others: International Journals: 2 Other products:	
Social Impacts: No direct social impact listed despite of the potential of the study. Any potential links with the global contamination of the North are seriously lacking. This programme has promoted 1 PhD thesis and several master level theses.		
Strongest Point: Quality of the work performed but a rather descriptive aspect. **Weakest Point:** Lack of integration with North Sea data.		

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**	**Contract no.**: 4
Project Title: Intercompartment distribution of monocyclic aromatic hydrocarbons and C1-C2 organochlorines in the North Sea environment	
Participants:	UGent
	H. Van Langenhove - Co-ordinator J. Dewulf - Co-ordinator B. Heireman W. Vyncke K. Cooreman P. Rooose
Budget: Not mentioned	**Project Start/End Dates**: 1-10-92 to 31-12-96
Objectives: The objectives of the programme were the assess the complete distribution of monocyclic aromatic hydrocarbons and the C1-C2 organochlorines in the different compartments of the North Sea. The contract had several objectives: To make a critical review of the literature on the study, evaluate and develop the appropriate analytical methods and finally apply them in the environment of the North Sea.	
Were Objectives Met? Yes completely.	
Content and Quality of Report: The report is very detailed and complete. All of the different aspects listed above are fully developed at length with extensive coverage. The first part of the report is a very comprehensive review of the methods developed for VOCs determination in a wide variety of matrices, critically addressing the whole analytical chain for sampling up to the detection. The second part of the report deals with the critical evaluation of the different analytical techniques routinely used with great care of the quality control of the data generated. All sections recommend the use of a specific analytical technique which will be used later in the monitoring stage of the programme. The final part of the report deals with distribution of the VOCs in the different compartment of the North Sea.	
Scientific Quality: The overall sections of the reports are all excellent in every aspects, content, format and completeness of the information. The first part of the report referring to the comprehensive review is excellent and most complete. This excellent review has been validated by the publication of a review paper in an international journal. The second part of the report is also excellent. All the analytical techniques used for the VOCs in the different compartments are carefully listed, and critically discussed for all the environmental compartments. All the methods have undergone careful data quality control procedures. The different analytical routes retained are carefully listed and applied in the different monitoring programs for the CHCs, MAHs and VOCs in the estuaries and the North Sea areas. The final part of the programme addresses the distributions of the different CHCs, MAHs and VOCs in the different compartments of the North Sea and adjacent estuaries. All data are carefully reported and are fully evaluated with rigorous statistical processing. The bioaccumulation factors in the different organisms have been evaluated as well as the possible reactive routes of the different compounds evaluated. In general, it is an excellent report covering in depth all the aspects of the problems, from the critical review, the the development of appropriate methods and they full use to critically address the behaviour and fate of the the CHCs, MAHs and VOCs in the estuaries and the North Sea areas.	
Scientific Output: The general scientific output is excellent and completely relevant with the subject. All aspects of the programme have been published in main scientific literature and reported to many meetings.	
Publications by year: 1995: 2 1996 5	**Publications from the Contract**: Belgian Journals: Books, others: International Journals: 7 Other products: 7
Social Impacts: Excellent validation of the work both scientifically and in the training of young scientists. Training of a PhD student and several Thesis subject for Master's students.	
Strongest Point: Complete in depth covering of the subject from all aspects. **Weakest Point:** No new method developments.	

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 5
Project Title: Geochemical cycling from particulate trace metals and organic micropollutants in the North Sea		
Participants:	UIA	
	R. Van Grieken - Co-ordinator W. Jambers L. De Bock K. Torfs K. Gysels J. Injuk H. Struyf S. Hoornaert H. Van Malderen	
Budget: Not mentioned		**Project Start/End Dates**: 1-10-92 to 31-12-96
Objectives: The objectives of this project were to evaluate the potential of various spectrochemical methods to unravel the geochemical pathways of traces metals on particulate matter collected in air (aerosols), in rain water and in the water column of the North Sea. The overall results allowed to calculate budgets of flux deposition of trace elements in the North Sea		
Were Objectives Met? Yes extensively.		
Content and Quality of Report: The report is in general comprehensive and addresses all critical listed in the objectives of the programme. It is however not very well structured. The emphasis being put on the general scientific output in the format of publications. It covers none the less all aspect of comprehensive literature review, date quality evaluation, critical assessment of the analytical techniques uses and their application on real samples from the North Sea.		
Scientific Quality: The scientific quality of the report is focused to the necessary information related to the programme realized. Most of the efforts have been turn to the extensive validation of the work by a most complete sets of publication derived from the programme. All methods reporting and evaluation represent some of the best advances at the time of development on an international level.		
Scientific Output: The scientific output of this programme is excellent since it resulted in an impressive amount of publications in leading international journals referring to both major analytical or environmental journals. This programme and its application to the North Sea have confirmed the leading position of this research group in this domain on an international basis.		
Publications by year: 1992: 1993: 1 1994: 8 1995: 6 1996: 7	**Publications from the Contract**: Belgian Journals: Books, others: International Journals: 22 Other products:	
Social Impacts: The social impact of this programme goes well beyond the direct scientific information on the initial objectives of the North Sea programme. It has allowed training a large number of international students and has confirmed the leading role of the research group in this specific scientific domain.		
Strongest Point: Exceptional scientific output. **Weakest Point:** Lack of organisation and structure of the report. This point is very minor with respect of the large amount of leading scientific publications resulting from the programme.		

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 6
Project Title: Transfert et comportement des métaux traces dans l'estuaire de l'Escault		
Participants:	ULB	
	R. Wollast - Co-ordinator K.T. Dotanski V. Herzl M. Loijens	H.Paucot Regnier N. Roevros
Budget: Not mentioned	**Project Start/End Dates**: 1-10-92 to 31-12-96	
Objectives: To study the distribution of trace elements Cr, Mn, Co, Cu, Zn, Cd, and Pb) in the dissolved and particulate phase in the Scheldt estuary. The second part of the study was focused on the mechanisms and kinetics of transfer of these elements between the 2 phases with a special insight on the role of biological activity. This second part was evaluated with radioactive tracers. Finally the data were integrated in a mathematical model coupling hydrodynamics and biogeochemistry in the Scheldt estuary		
Were Objectives Met? Yes		
Content and Quality of Report: Extremely well structured and clear rteport. It consists of 6 main sections discussing the different methodological approaches, the validity of the analytical techniques used, the distribution of the different (dissolved and particulate) trace elements studied (critical discussion), the quality of the material collected in the sediment trap, the kinetics study of the elements between the 2 phases, and finally the modelling aspect. In general the report is very comprehensive with an in-depth discussion associated with each section. All aspects of the work are carefully evaluated from all analytical procedures to a global discussion of the levels of results compared to that of other estuaries in Europe and in the world. The results clearly highlight the role of anthropogenic contamination in the system. The last part of the document is certainly the most novel aspect of the work and brings some very interesting information on the role of biological activity in the transfer mechanisms between dissolved and particulate phases. The report is very complete in both the quality of the work as well as its valorisation aspect.		
Scientific Quality: Excellent quality of the data generated and of their integration in a global model. This work is a follow up of an extensive body of work performed on the Scheldt estuary initiated in previous programs. The quality of the data generated is of high quality and really complement the work made previously and brings some new insights particularly with study of the role of the biology in the transfer of the metals between the different phases. The whole integration of the different aspects represent of the state of the art in this domain.		
Scientific Output: The scientific output of the programme is also excellent. It has been validated by a large number of publications, participations in conferences and has been the support of numerous masters thesis and licentiate work as well as several theses.		
Publications by year: Excellent 1993: 1 1994: 3 1995: 1996: 1 1997: 5	**Publications from the Contract**: Excellent Belgian Journals: 1 Books, others: International Journals: 10 Other products: 4	
Social Impacts: Excellent impact since the work generated allows having a complete model to anticipate the fate of trace elements in the Scheldt estuary. This topic has been developed over the years by the same group. The impact is also excellent in the training of young scientists. Further is has allowed to strengthen international collaboration and comfort the role of leading world expert on this domain.		
Strongest Point: Excellent and complete approach of the problem. Excellent decomposition and validation of the different aspects of the work. **Weakest Point:** Such studies have already been performed by the same groups over the year on the same estuary. It results that the work performed is extremely complete and well planed. However, there is only little novelty in term of overall results and the most interesting part of the work is that performed in the last 2 sections of the biology and the integration of the data in a well established model.		

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 10
Project Title: Macrobenthic populations along the estuarine gradient of the Scheldt estuary: role of abiotic (natural and human) environment		
Participants:	IN	
	E. Kuijken - Co-ordinator T. Ysebaert P. Meire	
Budget: Not mentioned		**Project Start/End Dates**: 1-10-92 to 31-12-96
Objectives: The objectives of the project were to perform an integrated approach combining population dynamic studies of benthic macroinvertebrates on intertidal locations and along the Scheldt estuary with the occurrence of micropolluants in the sediments and porewaters of the similar environments		
Were Objectives Met? No. If all the studies have been performed to some extend in a rather parcelled approaches, there is a clear lack of integration of the data to obtain the initial aims listed in the objectives.		
Content and Quality of Report: The report is well organized in 5 different subchapters that deals with the :1° distribution of the macrobenthic populations along the Scheldt estuary; 2°the waterbirds distribution along the same estuary; 3° the abiotic characterization of the intertidal mudflats, 4° the distribution of the organic contaminants in the Scheldt estuary and 5° the ecotoxycological evaluation of the sediments in the Scheldt estuary. Each subchapter is presented in the format of a short publication highlighting the major findings on the topic discussed. However, the series of subchapter are rather some good biometric and population dynamic studies of an array of macrobenthos species up to bird colonizing the Scheldt estuary. The abiotic characterisations of the different locations selected do not bring any additional information or the relationship between the biogeochemical constituents of the sediments and the distribution of the benthic organisms is not apparent. The report ends with a series of short papers on the distribution of contaminants in the different sampling locations. The overall objective of the project is clearly lacking all along the way. If the organisation of the reports allows to clearly allocate the responsibilities of the tasks, it does not however get into much scientific depth.		
Scientific Quality: Very low. The organisation in different subchapters similar to small publication give a good view of the considerable work undertaken but also reflects the lack of integration of the data.		
Scientific Output: Very little. The main innovation of this work would have been an in depth integration of the whole work but this main part is not present in the report. Also, there is a clear lack of integration ofthis work with regards to previous work already performed by other Belgian teams on the Scheldt estuary. It is also impossible to evaluate the publication from the 4 years of work.		
Publications by year: ?	**Publications from the Contract**: ?	
Social Impacts: Little to none. The initial objectives were excellent but is a considerable body of work has been performed but the integration of the macrobenthos distribution and potential relationship with contaminants from the sediments are completely lacking. One PhD thesis has been mentioned as part of the output of the programme.		
Strongest Point: Excellent description of the benthic population of the Scheldt estuary including the birds with good variability evaluation of the data generated. **Weakest Point:** Lack of integration of the data with the chemical burden in the sediments. Lack of integration these data with that of previous work or that of other teams.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 1 year 1997
Project Title: Biogeochemistry of nutrients, metals and organic micropollutants in the North Sea			
Participants:	VUB	UGent	ULB
UIA R. Van Grieken - Co-ordinator	W. Baeyens L. Goeyens	H. Van Langenhove	R. Wollast
Budget: Not mentioned		**Project Start/End Dates**: 1-1-97 to 31-12-97	
Objectives: Develop different combined approaches to study the behaviour of nutrients, trace metals and micro-pollutants in the North Sea			
Were Objectives Met? Yes. The different projects all started with development of new analytical procedures and all of them performed intercalibration studies.			
Content and Quality of Report: The report is in general well written and the objectives of the programme are well focused. Since this project was at its first year, most of the different participants developed new analytical approaches. All of them made efforts to participate to the EU QUASIMEME intercalibration programme highlighting the interest for the quality of the data. The work from IUA focused on the optimisation of aerosol sampling, development of improved microanalysis methodologies and of bulk analysis techniques. All approaches are state of the art and are well integrated in the normal excellent development of this sector at IUA. Results from the V.U.B. focus on intercalibration exercise for both mercury and nutrients with global improvement of methods. The group from the Uni. Gent improved method to VOC determination and studies of exchange between water and air. Finally, the work performed by ULB addressed more particularly the speciation of trace elements by selective dissolution procedures. If all approaches were excellent in the objectives, there was during this first year of the programme (as highlighted by the co-ordinator) little integration of the research objectives. Each group more or less continued its research strategy and put the result under the label of this programme. This can be understood when it is the first year of a programme with different partners.			
Scientific Quality: The quality of the research under taken is really excellent and to "the state of the art " for the time of if not really at this part f the programme really integrated.			
Scientific Output: The scientific output is weak in general for the first year of the programme. This is normal. There are 3 publication listed in international journal but only 2 of them can be related directly to the programme currently running.			
Publications by year: 1997: 3		**Publications from the Contract**: Belgian Journals: Books, others: International Journals: 3 Other products:	
Social Impacts: No direct social impact listed except for the departures of PhD and post-doctoral student to the Industry leading to difficulty of execution of the programme forecasted. This reality is a weak point in general of the research activities of the Belgium oceanographic research.			
Strongest Point: Quality of the work performed **Weakest Point:** Lack of co-ordination for integrated field study for example.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 1 year 1998
Project Title: Biogeochemistry of nutrients, metals and organic micropollutants in the North Sea			
Participants:	VUB	UGent	ULB
UIA R. Van Grieken - Co-ordinator	W. Baeyens L. Goeyens	H. Van Langenhove	R. Wollast
Budget: Not mentioned		**Project Start/End Dates**: 1-1-98 to 31-12-98	
Objectives: Study the behaviour of nutrients, trace metals and micro-pollutants in the North Sea.			
Were Objectives Met? Yes, Many results produced with again very even output between the groups and little intergration in sampling.			
Content and Quality of Report: Progresses were made on metal measurements on aerosols collected above the North Sea channel (UIA). Methods were developed to collect wet fallout under good conditions to study wet and dry deposition fluxes with good success. Simultaneously the groups from VUB developed method for the speciation of trace elements (Hg & As) together with a method to study the fractionation of dissolved organic nitrogen. All previous efforts have been expressed in global field study looking at gaseous emission of Hg in the North Sea. These results were accompanied with research efforts focused on experiment to mimic the volatilisation of mercury by abiotic reduction. A full description of the Hg distribution in the North Sea is provided. All these data are of high scientific work. Simultaneously, Total Dissolved Nitrogen (TDN) and the dissolved organic matter were studied along estuarine profiles for the Scheldt estuary. These cruises were used to collect a maximum of pluridisciplinary approaches. Incubation experiments were also performed on-board to study the uptake rate of nitrogen in different areas. Similar efforts were also made for the trace metals. Similar efforts were made by other groups to study the uptake rate of trace metals under different conditions. Here again, excellent work and quality of the result ad very little output from some of groups declared in the programme.			
Scientific Quality: Here also, very good individual group resulting in a totally different way of seeing the data quality dealing with the North Seas.			
Scientific Output: The Scientific will be output is here again very within a very limited time frame.			
Publications by year:		**Publications from the Contract**: Belgian Journals: Books, others: 1 International Journals: 15 Other products:	
Social Impacts: No direct social impact listed.			
Strongest Point: Quality of the work performed and of the science produced which for all partners are "state of the art". **Weakest Point:** Lack of co-ordination and heterogeneity of the excellent research efforts developed by different groups. High heterogeneity of the scientific outputs for the different research groups involved. Despite of the quality of the science produced little translation to international journal takes place except for the UIA and VUB.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 1 year 1999
Project Title: Biogeochemistry of nutrients, metals and organic micropollutants in the North Sea			
Participants:	VUB	UGent	ULB
UIA R. Van Grieken - Co-ordinator	W. Baeyens L. Goeyens	H. Van Langenhove	R. Wollast
Budget: Not mentioned		**Project Start/End Dates**: 1-1-99 to 31-12-99	
Objectives: Study the behaviour of nutrients, trace metals and micro-pollutants in the North Sea.			
Were Objectives Met? Yes. There were in general a lot of results produced by the different groups involved. It is to be noticed that the integration factor of the different partners through common sampling campaigns is rather weak.			
Content and Quality of Report: The report is in general well written. The binding of the report of the different participants really demonstrates that the integration between the different groups is weak but the quality and the output of t he science during this period is excellent. The different approaches used modern sampling and analytical techniques for direct solid analysis of the aerosols for inorganic elements. The contribution from the Uni. Gent continued the analytical development of VOC determination but used it on the field and started to report global environmental results. Similar progress were made also in the determination of organic micropollutants and again also with excellent field results on the sea to air exchange processes. Continuous progresses could also be reported from the group from the VUB both on the aspect of method development for speciation of As and Hg in the environment. Field results were obtained for both nutrients in estuarine and coastal waters with considerable development and improvement of analytical methods to fractionate dissolved organic nitrogen in seawater or Monomethylmercury in estuarine and coastal waters. Excellent series of results were produced in the Scheldt estuary for trace metal behaviour and As speciation. They highlight the none conservatory aspect of theses species in such estuarine environment . First series of field results for mercury speciation were also mentioned highlighting here also the non-conservative behaviour of these species in the environment studied. The work reported by the ULB continued on the aspect of metal speciation using selective dissolution approaches. Many field campaigns were performed on the close continental shelf.			
Scientific Quality: The quality of the research under taken is really excellent and to "the state of the art " for the time of if not really at this part f the programme really integrated. There is little to no integration between the different groups working in this programme			
Scientific Output: The scientific output is very high. Most groups published many papers in 1998 in good quality journal. Some of them can be directly related to the current programme under evaluation. Many appear as the normal output of previous research efforts. Even if the direct relation with the programme is not always obvious, there is a large discrepancy between the different scientific output o the different groups. In all cases the quality of the science is excellent.			
Publications by year:		**Publications from the Contract**: Belgian Journals: Books, others: 1 International Journals: 15	
Social Impacts: No direct social impact listed.			
Strongest Point: Quality of the work performed and of the science produced which for all partners are "state of the art". **Weakest Point:** Lack of co-ordination and heterogeneity of the excellent research efforts developed by different groups. High heterogeneity of the scientific outputs for the different research groups involved. Despite of the quality of the science produced little translation to international journal takes place except for the UIA and VUB.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 1 year 2000
Project Title: Biogeochemistry of nutrients, metals and organic micropollutants in the North Sea			
Participants: UIA	VUB	UGent	ULB
R. Van Grieken - Co-ordinator	W. Baeyens L. Goeyens	H. Van Langenhove	R. Wollast
Budget: Not mentioned		**Project Start/End Dates**: 1-1-00 to 31-12-00	
Objectives: Study the behaviour of nutrients, trace metals and micro-pollutants in the North Sea.			
Were Objectives Met? Yes, excellent set of results with high quality			
Content and Quality of Report: The overall programme again lacks integration but all individual contribution achieve remarkable sets of results with, whenever possible, an excellent concern for the intercomparability of the data. The report is however not structured and consists in the binding of the different report as previously observed in the preceding years.			
Scientific Quality: The scientific quality is usually very high and among the highest level published in the series a report. Excellent sets of results are produced for the qualification of aerosols on a series of cruises on the Belgian continental plate. Both sea to air fluxes and emission were studied as well as wet and dry deposition processes. These approaches would later lead at a good estimation of the global air/sea exchanges processes. This period did also see a considerable improvement in the development of As speciation issues and their applications to direct societal problems. An organic speciation method has been developed, validated and applied to a wide range of coastal biological samples of direct interest for food consumption. The distribution of nitrogen in the North Sea presents remarkable sets of results. Field results are closely correlated with direct incubation experiments to study the factor promoting the up-take of limitation of the N integration in the food-web. This later section has been very productive in terms of papers. This is not the case with all other research groups. Here also some excellent science is produced by with very little return to "the tax-payer".			
Scientific Output: Too low of the research objectives performed and achieved. The only noticeable sets of publication appear under W. Baeyens authorship.			
Publications by year: No new publication to be evidenced by the different groups. Very inhomogeneous output between the different participants		**Publications from the Contract**: Belgian Journals: Books, others: 1 International Journals: 15 Other products:	
Social Impacts: Direct social impacts could have been derived from the arsenic speciation developments however little is mentioned on its direct application for direct social contribution.			
Strongest Point: Quality of the work developed by each partner **Weakest Point:** Global lack of integration between the different partners			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 3 year 1997
Project Title: Impacts des métaux lourds et des biphényls polychlorés associés aux sédiments sur les organismes de la mer du Nord		
Participants:	ULB	UMH
	P. Dubois - Co-ordinator	M. Jangoux R. Flammang
Budget: Not mentioned	**Project Start/End Dates**: 1-97 to 12-97	
Objectives: Impact of heavy metals and PCBs in sediments on organisms of the North Sea		
Were Objectives Met? Yes. The first year has allowed all the teams to define an integrated approach going for field sampling definition, definition of the biological parameters to be studied and organisation and setting up of the analytical procedures for the PCBs.		
Content and Quality of Report: The report is rather synthetic but illustrates well the different approaches taken by the different partners of the programme. However, the report is very informative of the work undertaken. There is little to no critical discussion of the results and strategy used by the different partners. There is also no listed output of the report in terms of publication, people trained,… The direct out put of this report is difficult to evaluate but it is also to be mentioned that this is the first operating year of this programme and the overall objectives are well targeted.		
Scientific Quality: The scientific quality of the work is in general excellent. The different partners have promoted originals approaches where biological tests have been developed either on the cellular level on Aster rubes and on the direct relationship at the macroscopical state: addressing the skeleton growth of the same organism. The level of heavy metals and PCBs were determined in different parts of the organs of the organisms collected has well has in the sediments. Similar biological tests were also performed on larvae sea urchins, which were optimised for this first year of the programme. Finally, the group of chemical analysis promoted the analysis of PCBs by GC/MS. They have optimised their analytical procedure on sediments and biological samples. No mention is made of intercalibration exercise or the use of reference material to insure the quality of the data generated. In general, the three groups involved use innovative approaches and sate of the art ecotests.		
Scientific Output: The scientific output of this first year is difficult to evaluate. No publications are mention even in preparation. The format of the report does not allow having sound criteria of scientific output. This phenomenon can be eventually understood since it is the first year of the programme.		
Publications by year: None	**Publications from the Contract**: None	
Social Impacts: Difficult to evaluate since no mention is made on these issues.		
Strongest Point: Sound integrated approach for the first year. Integration between the different partners. **Weakest Point:** No scientific output.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 3 year 1998
Project Title: Impacts des métaux lourds et des biphényls polychlorés associés aux sédiments sur les organismes de la mer du Nord		
Participants:	ULB	UMH
	P. Dubois - Co-ordinator	M. Jangoux R. Flammang
Budget: Not mentioned	**Project Start/End Dates**: 1-98 to 12-98	
Objectives: Impact of heavy metals and PCBs in sediments on organisms of the North Sea		
Were Objectives Met? Yes. The second year of the programme presents significant advances with all participants. Many interesting results are presented by the different authors and illustrate the coherent progresses of the different research groups.		
Content and Quality of Report: The content and the scientific format of the report are excellent. The results are well presented and illustrated. The organisation of the overall report could have lead to an interesting pluridisciplinary publication of the topic developed by the different participants. In general, a general discussion of the table and the graphs presented are missing together with an in-depth discussion of the results presented. Also lacking is the positioning of these results with regards to other works in the same area.		
Scientific Quality: The scientific quality of the results is very good for the 3 research groups involved. They clearly illustrate that considerable work has been performed and that good progress by all teams was achieved in all domains. 3 different scientific complementary objectives were meet during this second year of the programme. 19 stations of the North Sea have been samples and analysed with regard to its total metal or PCB content taking into account the grain size partitioning of the contaminants studied. The impacts on these contaminants was assessed on the different organisms collected mainly A. Rubens. Finally, embryo-toxicity tests clearly demonstrate the deleterial effects of these sediments on either embryo- or larvae tests. The importance of the grain size was also demonstrated. Results tend to highlight the higher toxicity of the sediment samples collected along the Belgium coastal areas as well as those originating form the western part of the Scheldt estuary. In general, the work is well reported and well documented including reference to the use of certified reference materials illustrating the general care taken in the sets of data generated. If the general reporting of the data is very good, a clear comparison of the level of the contaminants in the sediments and in the different organs of the biological samples with regards to other areas is clearly missing. The embryotoxicity tests are also very carefully undertaken and underline the good sensitivity of the test developed. These results are clearly positioned with regards to other work. The overall reporting of the different team is homogeneously reported and give an overall well integrated view of the extend of the work and detailed co-ordinated approaches developed by the different teams.		
Scientific Output: The scientific output is rather weak. The participation to international meeting does not necessarily make direct reference to the work presented under the current programme.		
Publications by year: None	**Publications from the Contract**: Belgian Journals: Books, others: International Journals: Other products: Participation to international meetings but on results not directly related with the programme.	
Social Impacts: Little impact via direct communication by the presentation of the research programme undertaken on a WEB site " Vivre ou Survivre"		
Strongest Point: Sound integrated approach for the second year. Significant progresses made by all the teams in an integrated effort. . **Weakest Point:** Still too little scientific output.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 3 year 1999
Project Title: Impacts des métaux lourds et des biphényls polychlorés associés aux sédiments sur les organismes de la mer du Nord		
Participants:	ULB	UMH
	P. Dubois - Co-ordinator	M. Jangoux R. Flammang
Budget: Not mentioned	**Project Start/End Dates**: 1-99 to 12-99	
Objectives: Impact of heavy metals and PCBs in sediments on organisms of the North Sea		
Were Objectives Met? Yes. The third year of the programme presents some very interesting results from the different partners involved. The data and results generated fit very well with the main objectives of the research programme. The main conclusions of the report give some excellent conclusions on the quality of the sediments collected and their impact on the benthic fauna.		
Content and Quality of Report: As in the previous sets of reports, the one for the 3 rd year of the programme is very well written and integrates also the different contribution of all authors. All participants have made remarkable progresses and the "global picture" given by the combined results is excellent and fully relevant with the objectives of the programme. The text is in general well written and illustrated.		
Scientific Quality: This 3rd year of the programme gives a very good view of the contamination levels of the different sediments studied and of their effect on the biota either via direct evaluation of the organisms collected on these sediments or via the sensitive bioassays developed during the previous years. The main results show that for metals, the coastal areas are the most contaminated together with some estuarine sites. The PCBs are more concentrated in the estuarine sediments of the Scheldt. The study presents a good description of the occurrence of the contaminants and the presence of absence of the targeted organisms. A global ecotoxicological sets of approaches making use of the EROD activities and other ecotoxicological response allow to have an in depth view of the potential toxicity of the different site studied. Kinetics of uptake of PCBs allows having clear insights on the contaminant routes. All bioassays developed are very well conducted and pertinent bringing a clear view of the contaminant status of the sediments and their effects on the associated biota. The conclusion of the synthetic report is most clear and brings some important social conclusions. Significant contamination and toxicities of the fauna and bivalves can be located in specific estuarine areas heavily submitted to the direct fishing on the bivalves by local population in these areas.		
Scientific Output: Very little again despite of the high quality of the results generated. The format of the report may not allow evaluating the scientific output if any is produced.		
Publications by year: None	**Publications from the Contract**: None	
Social Impacts: Important potential impact with the recommendation of the warning of the contaminated sites studied. However, no mention is made with regards to the application or recommendation of the facts observed in this study.		
Strongest Point: Excellent sets of results of high scientific quality, very well presented and showing a good integrated progression of the different teams involved. **Weakest Point:** Still too little scientific output.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 3 year 2000
Project Title: Impacts des métaux lourds et des biphényls polychlorés associés aux sédiments sur les organismes de la mer du Nord		
Participants:	ULB	UMH
	P. Dubois - Co-ordinator	M. Jangoux R. Flammang
Budget: Not mentioned	**Project Start/End Dates**: 1-00 to 12-00	
Objectives: Impact of heavy metals and PCBs in sediments on organisms of the North Sea		
Were Objectives Met? Yes. The fourth year of the programme clearly illustrate the full maturation and achievements in the initial scientific objectives. It is the most comprehensive report of the series with the highest level of integrated science and quality of objectives. Not only are the initial objectives met but also the different partners have generated an integrated and elaborated strategy of experiments to complete the field observations.		
Content and Quality of Report: The report is very well written and detailed. The participation of the different partners in the text is excellent. The focus of the text clearly reports of the experimental design used and direct reports. The whole text is a format of a report with little to no critical discussion of the results reported and with very little reference to other similar studies.		
Scientific Quality: The sets of results are excellent and represent well the good achievement of a well-driven programme. The scientific levels of the data generated are of excellent international quality standards. In this year report, the global aspect of the contamination of surface sediments is well reported for both heavy metals and PCBs. A clear contamination gradient of heavy metal contamination has been evidenced ranging from the mouth of the Elbe estuary to the open North Sea. For the PCBs estuarine samples are highly contaminated. These studies are completed by a much larger ecotoxicological approaches than during the previous years. Further to the dynamic bioaccumulation studies in Asteria Rubens, a array of molecular bioassays are been developed (study of the induction of metallothioneins, of the alteration of the immuno-functions of A. Rubens) together with toxicity tests of sediments on larvaes of the sea urchins P. Miliaris. These complementary studies are completed by the beginning of an ecological study of the populations of A. Rubens. This 4th year of the reports really brings complete excellent integrated sets of experiments, which allow the group to bring forward some essential conclusions on the contamination of the coastal sediments of the North Sea and their effects on the benthic fauna. The embryotoxicity of some sites appears to be extremely high and complete the global contamination and mode of transfer and mobility of the contaminants in this area. The value of the work perform here is excellent and has even more scientific and social impact by the validity and complementarity of the results produced.		
Scientific Output: Again, it is difficult to evaluate the scientific output of this programme since nothing is mention in the reports and little publications have been supplied by the different authors.		
Publications by year: ?	**Publications from the Contract:** ?	
Social Impacts: The overall meaning and quality of the results have a high societal impact. However, nothing is mentioned with regards to the translation and actions requested on the basis of the results produced.		
Strongest Point: High quality and significance of the results produced. Excellent overall progression and integration of the research efforts developed. **Weakest Point:** Still too little scientific output.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 5 year 1997
Project Title: Birds and marine mammals of the North Sea : Pathology and Ecotoxicology			
Participants:	ULg	VUB	IN
	J.M. Bouquegneau - Co-ordinator F. Coignoul	C. Joiris	E. Kuiken
Budget: Not mentioned		**Project Start/End Dates**: 1- 97 to 12 – 97	
Objectives: Etudes pathologiques des oiseaux et des mamifères marins dans la mer du Nord et les régions avoisinantes.			
Were Objectives Met? Yes. The first year of the programme as seen several meetings from the different participants to organise their research.			
Content and Quality of Report: The content and the quality of this first year report is very low. The general objectives are only briefly highlighted and a series a tables giving the concentrations of heavy metals in different organs of birds and marine mammals are simply listed without comments. The listing of the stranding cases of all the organisms follows without any conclusion. The report is completed by a more organised but also brief report fom the F.U.B. stating of mercury speciation and PCBs concentrations in the organisms. The analytical techniques used appear to be old and the data produced certainly needs validation with reference materials.			
Scientific Quality: It is very difficult to evaluate the scientific quality of the data produced. It is only a listing of tables giving concentrations in biological systems. No reference is made of quality control. No comparison nor any conclusive statement is given.			
Scientific Output: Very difficult to evaluate. Neither participation to meetings nor any publications in progress are mentioned. This fact can be accepted for the first year.			
Publications by year: None		**Publications from the Contract**: None	
Social Impacts: Not appearing. The social impact cannot be evaluated since we do not know of the eventual formation of students. Also, their is no conclusions and the work can be difficulty positioned with regard to any social demand.			
Strongest Point: Excellent use of the marine animal stranded on the coast and integrated evaluation of the death causes. **Weakest Point:** Lack of positioning of this work with regard to the overall objectives of the North Sea Programme and eventual integration of these data with other set of data collected by other teams.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 5 years 1998-1999
Project Title: Birds and marine mammals of the North Sea : Pathology and Ecotoxicology			
Participants:	ULg	VUB	IN
	J.M. Bouquegneau - Co-ordinator F. Coignoul	C. Joiris	E. Kuiken
Budget: Not mentioned		**Project Start/End Dates**: 1-98 to 12-99	
Objectives: Etudes pathologiques des oiseaux et des mammifères marins dans la mer du Nord et les régions avoisinantes.			
Were Objectives Met? Yes. The second of the programme shows that a good integration between the different teas is taking place. The overall objectives are larger and better integrated.			
Content and Quality of Report: The report is a little chaotic. If the initial objectives of the different teams are clearly listed at the beginning of the text, the rest of the report is a series of short contribution or papers put together with very little organisation.			
Scientific Quality: Despite of the lack of organisation of the reports, the results reported and of excellent quality and conclusive. The first 2 years have clearly allowed demonstrating that the exceptional mortality of juvenile seals was the results of a viral infection. The Hg and PCBs concentrations in different marine mammals and birds are also briefly reported with very little comments. The rest of the reports consist of papers either published or submitted on the topic. Some of them report of data produced 4 years previous to the current programme and cannot be directly assigned as a direct output of the North Sea programme.			
Scientific Output: The general scientific output is of good quality but low in term of productivity considering the different groups involved. Here again, it is difficult to evaluate the net output of the programme since the format of the report does not allow it.			
Publications by year: 1999: 1		**Publications from the Contract**: Belgian Journals: Books, others: International Journals: 1 Other products:.	
Social Impacts: Not appearing. The social impact cannot be evaluated since we do not know of the eventual formation of students. Also, their is no conclusions and the work can be difficulty positioned with regard to any social demand.			
Strongest Point: Excellent use of the marine animal stranded on the coast and integrated evaluation of the death causes. **Weakest Point:** Lack of positioning of this work with regard to the overall objectives of the North Sea Programme and eventual integration of these data with other set of data collected by other teams.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 5 year 2000
Project Title: Birds and marine mammals of the North Sea : Pathology and Ecotoxicology			
Participants:	ULg	VUB	IN
	J.M. Bouquegneau - Co-ordinator F. Coignoul	C. Joiris	E. Kuiken
Budget: Not mentioned		**Project Start/End Dates**: 1-00 to 12-00	
Objectives: Etudes pathologique des oiseaux et des mammifères marins dans la mer du Nord et les régions avoisinantes.			
Were Objectives Met? Yes. The fourth year of the programme gives a better picture of the overall work performed by the different teams. However a general conclusion is missing.			
Content and Quality of Report: The report is again very uneven both in terms of progression and content. However, after careful dissection of the report, it is obvious that the funding of this programme as lead the different groups to generate some publications of international impact. This reports as for the previous ones lacks serious integration of the results.			
Scientific Quality: The general results of this programme are of international status since most of the work is published either in international journals, presented at conferences or as allow to promote the contribution of book chapter illustrating the international recognisance of the different teams involved. A large number of reports have been produced on the stranding of birds and sea mammals. A series of papers have been published as conclusion of this programme. In these papers, general comparison and conclusions are given. The series of journals in which these papers are published is of good international standard underlining the quality of the work produced.			
Scientific Output: The scientific output in the fourth year of the programme is excellent with many papers published or in the process of being submitted. Several contributions to international meetings are also mention. Finally several books chapters have been published. This final productivity contrast with the results of the previous years.			
Publications by year: 2000: Most publication or output of the programme appear in the year 2000		**Publications from the Contract**: Belgian Journals: Books, others: book chapters 3 International Journals: 5 Other products:. Numerous reports Participation to international meetings 7	
Social Impacts: Difficult again to evaluate the social impact of these sets of excellent results. There is a clear lack of integration of the different set of data produced by the different partners despite of the numerous meetings performed. However the whole work performed by the different groups has been validated scientifically via various publications. Despite of the significant output during the last year, the overall productivity of the different groups has appeared to be low during the pervious 3 years.			
Strongest Point: Good sets of data fitting the objectives of the programme and god scientific validation via publication of the work produced in the 4th year of the programme. **Weakest Point:**. Very inhomogeneous productivity of the different teams in the first year. Lack of general integration of the data.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 8 year 2000
Project Title: Evaluation of the pollution of North sea and of inputs from land			
Participants:	VUB	UIA	ULB
	W. Baeyens - Co-ordinator	R. Van Grieken	R. Wollast
Budget: Not mentioned		**Project Start/End Dates**: 1- 00 to 12 – 00	
Objectives: Evaluation of chemical contaminants from the North Sea and their inputs from land			
Were Objectives Met? Yes.			
Content and Quality of Report: The report is consisting of chapter of a publication making a comprehensive evaluation and dispersion of contaminants in the North Sea. This chapter (4) part of the publication Region : Greater North Sea is excellent and provides a most integrated view on the contaminants dispersion and inputs in the North Sea.			
Scientific Quality: The chapter is excellent and brings together long term sets of data from the different Belgium research groups in a comprehensive and integrated view between chemical, routes and biological impacts. Extensive comparisons are also provided with respect to international regulations. This document is certainly a stepping stone for future evolution of the contamination of the North Sea.			
Scientific Output: This synthetic document is not directly intended for scientific purposes. However, the quality of the data, their critical consideration, and comparative integration with regards to international regulation certainly promotes this document has a reference piece of work which would have tremendously benefited to be published in major international journals.			
Publications by year: 2001: 1		**Publications from the Contract**: Belgian Journals: Books, others: book chapters International Journals: Other products: 1 Participation to international meetings	
Social Impacts: Highest. This type of document is essential for further evolution of the contamination state of the North Sea; The different authors have succeeded in putting together an excellent integrated master piece.			
Strongest Point: Quality of the data summarised and presented. **Weakest Point:** Restricted access of this information since in it is published in a Belgian report.			

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 8 year 2001
Project Title: Evaluation of the pollution of North sea and of inputs from land			
Participants:	VUB	UIA	ULB
	W. Baeyens - Co-ordinator	R. Van Grieken	R. Wollast
Budget: Not mentioned		**Project Start/End Dates**: 1-01 to 12-01	
Objectives: Evaluation of chemical contaminants from the North Sea and their inputs from land			
Were Objectives Met? Yes.			

Content and Quality of Report: The work reported consist in a series of report written by different partcipants and the general set of data produced have been co-ordinated by Prof. Baeyens, Van Grieken and Wollast.

Report 1 : General summary	(W. Baeyens)
Report 2 : PCBs data collection	(R. Van Grieken and P. Joos)
Report 3 : PAHs data collection	(R. Van Grieken and P. Joos)
Report 4 : Organic solvents data collection	(J.P. Vanderborght and C. Piron)
Report 5 : Nutrients, Organic solvents and POPs data collection	(P. Koen, R. Van Grieken and P. Joos, J.P. Vanderborght and C. Piron)
Report 6: Organotins, mercury, Cadmium and lead	(P. Koen, P. Koen, J.P. Vanderborght and C. Piron)

Scientific Quality: All reports deals with the production, dispersion and accumulation of the different classes of contaminants selected. All reports are in general very well written, comprehensive and contribute to bring a global view that is expressed in a synthetic chapter. All aspects are very well covered and with a detail assessment of the different sources of the contaminants studied. Some elements have none the less been very much les covered than the others (mainly nitrogen and organotins). This deficiency does not appear however in the overall chapter published in a Belgium report and co-ordinated and put together by W. Baeyens

Scientific Output: The scientific output of this type of work is necessary low since the data produced and compiled where to be integrated in a comprehensive chapter.

Publications by year:	**Publications from the Contract**:
None:	Summary of all reports in an excellent Belgium Report on the status of the North Sea

Social Impacts: High with the publication of the synthetic chapter.

Strongest Point: Extensive quality of the data compiled.
Weakest Point: Difficulty of access of this exclusive set of data

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 9
Project Title: Endocrine disrupters : State of the art		
Participants:	UGent	
	C. Janssen - Co-ordinator G. Vandenbergh F. Comhaires	
Budget: Not mentioned		**Project Start/End Dates**: 15-12-98 to 15-12-99
Objectives: Gives a overview of the knowledge on problem associated with endrocrine disruptors and their effects on various biological targets. Status in Belgium		
Were Objectives Met? Yes. The report is very well written and provides an excellent overview of the state of the art in this domain.		
Content and Quality of Report: The report is written is a very well organised format. A first section refers to a critical discussion of the issue of endocrine disruptors and the interest of set up a data basis. The existing data basis is then critically listed. The endocrine disrupting effects are then reviewed on men, birds, reptiles, fishes, invertebrates in general. Then a interesting discussion follows on the knowledge existing in Belgium and the Netherlands. Their release in the environment is compared to that of other contaminants. The text is very well written and very informative.		
Scientific Quality: High scientific quality of the most extensive review on endocrine disruptors.		
Scientific Output: Apparently none since the report does appeared to have been published. This is however a mistake. One could ask why this important issue was only addressed so late in Belgium?		
Publications by year: None	**Publications from the Contract:** None	
Social Impacts: Excellent social importance of the review. However, it is a loss for the scientific community.		
Strongest Point: Quality of the coverage of the review **Weakest Point:** Restricted diffusion.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 10
Project Title: Développement de méthodes d'analyse des hydrocarbures et micropolluants organiques en milieu marin		
Participants:	ULg	
	E. De Pauw - Co-ordinator J.S. Houziaux	
Budget: Not mentioned	**Project Start/End Dates**: 1-98 to 1-2001	
Objectives: Develop a method for the determination of PAH and organic micropollutants in the marine environment.		
Were Objectives Met? Yes. The report is very well written and the applications are well focused. The general objectives of the programme that were to have a reliable method for the rapid determination of PCDD/Fs and cPCBs are achieved.		
Content and Quality of Report: The report details the set by step approaches developed by the authors to optimise and validate the analytical techniques for the determination of organic contaminants. This demand follows the "dioxine crisis" in the chicken. The development performed had as objectives to provide rapid and reliable data to other laboratories involved in the North Sea project. Its describes the analytical strategies used by the authors to develop and validate a method for the "dioxines-like" compounds in biological matrices. After justification of their analytical choices both in terms of sample preparation (ASE), the sample preparation, and the detection mode (by GC HRMS), the authors related their series of tests of finally select the optimal operating procedures. Each step of the analytical chain is carefully evaluated and simplified whenever possible. The method has demonstrated is applicability in a wide variety of matrices. Excellent effort in the control quality of the data and participation to the Quasimeme programme.		
Scientific Quality: High quality of the work done. Good optimisation of the different procedures and quality of the applications. The scientific quality of the report is excellent and very detailed. The authors have tried whenever possible to simplify or improve the current existing methods. The great care of participating in many intercomparison exercise highlight the quality of the work. After the analytical developments, the method has been applied to various samples collected by different teams.		
Scientific Output: Very little.		
Publications by year: 1998: 1999: 2000: 1 2001:	**Publications from the Contract: none** Belgian Journals: Books, others: book chapters International Journals: 1 Other products: Participation to international meetings : some	
Social Impacts: Excellent analytical work of great social impact. One could wander why such important developments have only be done so late in Belgium Important when the method will have applied to various organisms of the North Sea but little applications at present.		
Strongest Point: Quality of the work **Weakest Point:** Very little scientific output and no new developments in the analytical chemistry procedures.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 11
Project Title: Monitoring for volatile organic compounds in marine organisms		
Participants:	CLO	
	R. de Clerck - Co-ordinator M. Raemaekers	
Budget: Not mentioned		**Project Start/End Dates**: 1-00 to 12-00
Objectives: Develop a method for the determination volatile organic compounds in marine organisms		
Were Objectives Met? Yes. The report is brief and complete.		
Content and Quality of Report: The reports addresses all the issues dealing with the determination of VOCs is a very brief manner, synthetically describing the different steps of the analytical procedure. The report does not however compare the achievements made with regards to other authors.		
Scientific Quality: The work presented is of good routine analytical development. No mention is made at this stage of the application to marine organisms		
Scientific Output: No publication mentioned from this work		
Publications by year: None	**Publications from the Contract:** None	
Social Impacts: This analytical development for VOCs is not new and its social impact can only be evaluated when the work will be applied to organisms of the Norths Sea		
Strongest Point: Work well performed **Weakest Point:** Little novelty and no scientific output.		

Annex 5.3 Geology, Data management, Modelling and Socio-Economics

<table>
<tr><td colspan="3">BELSPO Programme: Project Sea 1970-1976</td><td colspan="3">Contract nos.: 11, 13, 16, 19</td></tr>
<tr><td colspan="6">Project Title: Trophic chains and nutrient cycles</td></tr>
<tr><td>Participants:</td><td>VUB</td><td>UGent</td><td>DVZ</td><td>ULg</td><td>ULB</td></tr>
<tr><td></td><td>Ph. Polk
G. Billen
M. Bossichart
N. Daro
C. Joiris
J.P.Mommaerts
D. Janssens</td><td>L. de Coninck
R. de Boever
J. Govaere
C. Heip
L. Thielemans
D. van Damme</td><td>R. de Clerq
P. Hovart
J. van de Velde</td><td>J. Hecq
G. Pichot
Runfola</td><td>G. Billen
Ch. Van beveren</td></tr>
<tr><td colspan="3">Budget: Not mentioned</td><td colspan="3">Project Start/End Dates: 11/1970 –12/1975</td></tr>
<tr><td colspan="6">Objectives: Determination of biomasses of various biological compartments in the North Sea ecosystem. Determination of changes in these biomasses. Determination of fluxes between compartments. Understanding the functioning of the ecosystem. Input of the previous data in a simulation model</td></tr>
<tr><td colspan="6">Were Objectives Met? Yes, but to a varying extent for the different compartments considered.</td></tr>
<tr><td colspan="6">Content and Quality of Report: Seen within its time this report contains the outcome of a study at the forefront of science. It was one of the first times that such a complete picture was sketched for a shallow coastal sea. The report contains three parts, viz. 1) a general consideration of ecosystems, 2) an analysis of the North Sea ecosystem, and 3) a description of a simulation model for the cycling of nitrogen in the pelagial system of the Southern North Sea. Part 2 contains chapters on: a general scheme of the North Sea ecosystem, the dissolved nitrogen compounds, the phytoplankton, the zooplankton, the bacterioplankton, the meiobenthos, the macrobenthos, the epibenthos, the microbial activity in the sediment, the pelagic fish, and on an annual budget of carbon and nitrogen in the North Sea.</td></tr>
<tr><td colspan="6">Scientific Quality: In general good to very good, but the fish chapter does hardly contain original data.</td></tr>
<tr><td colspan="6">Scientific Output: The report itself contains an extensive description (339 pages) of the entire study and thus forms a very valuable document. Here and there in the report MSc and PhD theses are mentioned which have resulted from this study and related other studies, but nowhere an exact list is given of this form of output. The same applies to papers in scientific journals: some papers are referred to but perusal of the literature published during and after the project shows that many more papers must have been published. However, it seems that not everything has been published.</td></tr>
<tr><td colspan="3">Publications by year:
?</td><td colspan="3">Publications from the Contract:
?</td></tr>
<tr><td colspan="6">Social Impacts: This study forms direct input for the North Sea model of MUMM. In addtion this kind of data is useful for many other aspects of the management of the North Sea.</td></tr>
<tr><td colspan="6">Strongest Point: Systematic approach to the collection of data for a North Sea model.
Weakest Point: Lack of data for commercial fish.</td></tr>
</table>

BELSPO Programme: **Project Sea 1970-1976**		**Contract nos.**: 11, 13, 16, 19	
Project Title: Inventory of the fauna and flora of the North Sea			
Participants:	UGent	VUB	DVZ
	L. de Coninck D. Van Damme C. Heip J.C.R. Govaere L.K.H. Thielemans R. De Boever	Ph. Polk M.H. Daro F. Redant C. van der Ben D. Van der Ben J. van Goethem	R. De Clerck J. van der Velde Affiliation? A. Boeye
Budget: Not mentioned		**Project Start/End Dates**: 11/1970 – 12/1975	
Objectives: Not clearly stated, but apparently the main objective was to prepare a quantitative inventory of the flora and fauna of the Belgian part of the North Sea.			
Were Objectives Met? Yes			
Content and Quality of Report: This is the final report on the inventory of the Belgian part of the North Sea made in the years 1971-1976. The first two chapters describe the meiobenthos and the macrobenthos, respectively, of a large part of the North Sea, not only including the Belgian part, but also considerable areas of the French part and especially the Dutch part . Chapters 3 and 4 describe the epibenthos (crabs, starfish etc.) and non-commercial fish species of an area up to 10 miles from the Belgian coast. Chapter 5 describes the plankton and the benthos of the sluice dock at Ostend as well as the phyto- and zooplankton of the same area of the North Sea as used in chapters 1 and 2. Chapter 6 describes the flora and fauna of three jetties at the beach near Knokke. Chapter 7 describes the larval and juvenile fish in the 10 miles zone off the Belgian coats. Chapter 8 describes heterotrophic bacteria from surficial sediments in the North Sea.			
Scientific Quality: Varying between good and very good. Especially the first two chapters are excellent.			
Scientific Output: In the text several MSc and PhD theses resulting from this project are mentioned. Also some publications in scientific journals are mentioned but these are not enumerated in a systematic way. However, a study of the international literature makes clear that in the project period as well as the years thereafter many Belgian papers on these subject have been published in international scientific journals. The report itself is very detailed and contains a lot of information which, certainly in 1977, showed that Belgian marine studies of the North Sea were comparable to what was going on in other countries. In the study of meiobenthos the Belgian scientists even belonged to the world top.			
Publications by year: ?		**Publications from the Contract**:. ?	
Social Impacts: This study delivered important basic information for the mathematical model of the North Sea. The same information also could be used for many other aspects of North Sea management.			
Strongest Point: The broad and detailed coverage of the flora and fauna of the North Sea. **Weakest Point:** The limited treatment of bacteria and bacterial processes (which reflects the worldwide state of the art at that time).			

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 5
Project Title: Energy flow through the meiobenthos		
Participants:	UGent	
	C. Heip P.M.J. Herman N. Smol D. van Brussel G. Vranken	
Budget: Not mentioned	**Project Start/End Dates**: 01/1976 – 12/1981	
Objectives: Not clearly stated, but apparently one wanted to estimate the energy flow through the meiobenthos.		
Were Objectives Met? Yes.		
Content and Quality of Report: The report gives information on the results of measurements of production, respiration, and biomass of meiobenthic animals. At that time these studies were at the forefront of science and fitted perfectly in the main stream of aquatic ecology.		
Scientific Quality: Very good.		
Scientific Output: The authors have published many papers on this subject but is is unclear which papers arose from this study.		
Publications by year: ?	**Publications from the Contract**: ?	
Social Impacts: No direct social relevance, but of course this study contributed to better understanding of marine and estuarine ecosystems.		
Strongest Point: Detailed measurements of processes in meiofauna. **Weakest Point:**		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 5
Project Title: Meiofauna of the Belgian coastal waters: spatial and temporal variability and productivity.		
Participants:	UGent	
	R. Herman M. Vincx C. Heip	
Budget: Not mentioned	**Project Start/End Dates**: 01/1976 – 12/1981	
Objectives: Not clearly stated, but apparently the study wanted to map the occurrence of meiofauna in the Belgian part of the North Sea in order to fill in gaps left by earlier studies.		
Were Objectives Met? Yes		
Content and Quality of Report: This is a thorough, descriptive study of the occurrence of harpacticoid copepods and nematodes in the Belgian part of the North Sea. It describes the species composition of these groups, spatial and temporal variation and it makes estimates of the productivity and the consumption required for this production. It is good work but not particularly innovative, also not in the period concerned.		
Scientific Quality: Good, but not exciting.		
Scientific Output: This group published many papers in this field but it is unclear what resulted from this study.		
Publications by year: ?	**Publications from the Contract**: ?	
Social Impacts: This study has no direct social relevance but it contributes to a better understanding and, hence, the modelling of the North Sea ecosystem.		
Strongest Point: Solid descriptive work. **Weakest Point:**		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 5
Project Title: Benthos of the Kwintebank (An exploited sandbank in the Southern Bight).		
Participants:	UGent	
	C. VanOsmael K. Willems M. Vincx D. Claeys C. Heip	
Budget: Not mentioned		**Project Start/End Dates**: 01/1976 – 12/1981
Objectives: Baseline study of the ecology of the benthos at an exploited sandbank.		
Were Objectives Met? Yes		
Content and Quality of Report: The report summarizes a number of studies on the meio- and macrofauna of a subtidal sandbank off the Belgian coast before sand extraction from this bank. The data are analyzed in an ecological context and contribute to a better understanding of the North Sea benthos.		
Scientific Quality: Very good		
Scientific Output: The studies resulted in three papers in a first-rate journal. The report gives an interesting analysis of the benthos of a remarkable biotope in the North Sea.		
Publications by year: 1982: 3		**Publications from the Contract**: Belgian Journals: Books, others: International Journals: 3 Other products:
Social Impacts: Relevant as a baseline study for the effects of sand extraction in the North Sea. Further this study contributes to the data base used for the modelling of the North Sea ecosystem.		
Strongest Point: Focus on one well-defined habitat. **Weakest Point:** No follow-up.		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 5
Project Title: Macrobenthos in the Western Scheldt estuary.		
Participants:	UGent	
	Y.M. Vermeulen J.C.R. Govaere	
Budget: Not mentioned		**Project Start/End Dates**: 01/1976 – 12/1981
Objectives: Not clearly stated. Apparently a description of the macrobenthos of the Westerschelde estuary was asked for. However, the report refers to two earlier reports (not seen) on the meiobenthic fauna which apparently were part of the same study.		
Were Objectives Met? Probably.		
Content and Quality of Report: Descriptive study of good quality of the results of one sampling campaign in the Westerschelde estuary in September 1980. Only twenty stations were sampled. The study confirms earlier Dutch work.		
Scientific Quality: Good.		
Scientific Output: Unclear. The two studies mentioned above were published as meeting documents of ICES.		
Publications by year: ?		**Publications from the Contract**:. ?
Social Impacts: Small project with hardly any social impact.		
Strongest Point: Description of Westerschelde benthos. **Weakest Point:** Limited number of sampling points; only one sampling date.		

BELSPO Programme: **Concerted Research Actions 1976-1981**	**Contract no.**: 5
Project Title: A summary of benthic studies in the sluice dock of Ostend during 1976-1981.	
Participants:	UGent
	L.K.H. Thielemans C. Heip D. van Gansbeke
Budget: Not mentioned	**Project Start/End Dates**: 01/1976 – 12/1981
Objectives: Unclear. Apparently a description of the ecology of the sluice dock, a stagnant saline habitat at Ostend.	
Were Objectives Met? Unclear.	
Content and Quality of Report: The report is very short (6 pages) and does contain some information on the main lines of the ecology and of changes in the ecology of the sluice dock. It looks as if it reflects competent science, but the report is to short to draw conclusions on this.	
Scientific Quality: Unclear.	
Scientific Output: Unclear; at least 3 MSc theses.	
Publications by year: ?	**Publications from the Contract**: ?
Social Impacts: The report gives sound advice how to improve the deteriorated environment of the sluice dock.	
Strongest Point: Report is too short to draw conclusions. **Weakest Point:** Report is too short to draw conclusions.	

BELSPO Programme: **Concerted Research Actions 1976-1981**	**Contract no.**: 6
Project Title: Trends in nursery rearing of bivalve molluscs.	
Participants:	UGent
	G. Persoone C. Claus
Budget: Not mentioned	**Project Start/End Dates**: 01/1976 – 12/1981
Objectives: Review of the present state of nursery rearing of bivalve molluscs	
Were Objectives Met? Yes	
Content and Quality of Report: The report is a literature review on the rearing of bivalve molluscs in nurseries to bridge the gap between hatchery-produced larvae and growth in the wild. Several bivalve species are considered. The report pays much attention to finding the right food for juvenile molluscs. It finishes with economic considerations on the costs of nursery-rearing. It concludes that nursery-rearing of juvenile bivalves is a viable option but that the economic margins are very narrow.	
Scientific Quality: Good literature review.	
Scientific Output: This review seems to be the only output of the project.	
Publications by year: None?	**Publications from the Contract**: None?
Social Impacts: Useful study for the aquaculture business in Belgium, but it is unclear how this study has been put into practice.	
Strongest Point: Good literature review. **Weakest Point:** No dissemination of the results?	

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 6
Project Title: Use and production of microalgae as food for nursery bivalves		
Participants:	UGent	
	N. de Pauw	
Budget: Not mentioned		**Project Start/End Dates**: 01/1976 – 12/1981
Objectives: Literature review of the use and production of microalgae as food for nursery bivalves.		
Were Objectives Met? Yes.		
Content and Quality of Report: This report is the result of a literature review. It does not contain any original work. It focuses on two options, viz. 1) completely controlled production of specific algal species, and 2) induction of blooms of natural phytoplankton in outdoor systems. Finally, it discusses the economic aspects of the production of microalgae, leading to a discussion of the design of large-scale algal culture facilities. The study concludes that induction of natural phytoplankton blooms is the most promising avenue.		
Scientific Quality: Good literature review.		
Scientific Output: No other output found.		
Publications by year: None?		**Publications from the Contract**: None?
Social Impacts: Useful study for the aquaculture business in Belgium, but is unclear how the results of this study have been disseminated.		
Strongest Point: Good literature review. **Weakest Point:** No dissemination?		

BELSPO Programme: **Concerted Research Actions 1976-1981**		**Contract no.**: 6
Project Title: Live animal food for larval rearing in aquaculture: the brine shrimp *Artemia.*		
Participants:	UGent	
	P. Sorgeloos	
Budget: Not mentioned		**Project Start/End Dates**: 01/1976 – 12/1981
Objectives: Literature review on the use of brine shrimp as live animal food in aquaculture.		
Were Objectives Met? Yes.		
Content and Quality of Report: The report is a mixture of a literature review and the results of enquiries among *Artemia* growers. It discusses the progress made in this field between 1976 and 1981. It gives the impression to be the text of a (key-note?) lecture at a conference.		
Scientific Quality: The contents is scientifically OK, but the structure of the report is unusual for a literature review.		
Scientific Output: None identified.		
Publications by year: None?		**Publications from the Contract**: None?
Social Impacts: The report may have been important for aquaculture, but it is doubted whether it has been disseminated.		
Strongest Point: **Weakest Point:** No dissemination?		

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**	**Contract no.**: 8
Project Title: Structure and function of the benthos in estuarine and coastal ecosystems in relation to actual and future anthropogenic impacts	
Participants:	UGent
	A. Coomans – promotor M. Vincx A.Dewike N. Fockedey J. Mees T. Moens M. Steyaert O. Hamerlynck Li Jian P.M.J. Herman A.Cattrijsse J. Wittoeck K. Soetaert M. Tulkens D. Van Gansbeeke
Budget: 470,923 EURO	**Project Start/End Dates**: 10/1992 – 03/1997
Objectives: Unknown	
Were Objectives Met? Unclear	
Content and Quality of Report: The final report is essentially a collection of reprints (up to October 1996) with short summaries of the results of tasks executed. The report does not make clear how the results of the study relate to the objectives set. The final report lists 22 publications, but after 1996 several other papers have been published.	
Scientific Quality: This study has produced many high quality papers published in high as well as medium ranking journals.	
Scientific Output: The scientific output of this project is large. The papers describe the structure and function of the meiobenthos and the hyperbenthos along an estuarine gradient in the Westerschelde estuary. Moreover, the hyperbenthos of the Westerschelde was compared with that of the Ems and the Gironde estuaries.	
Publications by year: 1993: 2 1994: 2 1995: 3 1996: 6 1997 and later: > 10	**Publications from the Contract**: Belgian Journals: 5 Books, others: International Journals: > 18 Other products:
Social Impacts: No specific impacts.	
Strongest Point: First European study on faunal interactions between saltmarshes and estuaries. **Weakest Point:** Papers could have been published in higher ranking journals.	

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 9
Project Title: Modelling and simulation of zooplankton grazing pressure in the North Sea ecosystem: a practical and theoretical approach.		
Participants:	ULg	
	J.H. Hecq - promotor A.Goffart C. Frangoulis F. Touratier S. Belkhiria C. Veeschkens	
Budget: 272,683 EURO		**Project Start/End Dates**: 10/1992 – 03/1997
Objectives: The objectives of this study are not clearly stated in the final report. Apparently the researchers wanted to better understand zooplankton grazing in the North Sea in order to arrive at better simulation models of zooplankton grazing.		
Were Objectives Met? Not possible to answer this question.		
Content and Quality of Report: Available for inspection were a final report with five annexes. The fifth annex constitutes the PhD thesis of F. Touratier. The final report starts with an extensive review of the literature, then describes the development of methods to measure the downward flux of fecal pellets, and next describes measurements of this flux. In addition data are given on hydrography, chemistry, and phyto- and zooplankton biomass in the NE North Sea. The annexes contain the same information in more detail as well as a description of zooplankton diversity in the North Sea. The report does not state what the aims of the study were.		
Scientific Quality: The scientific quality in general is high.		
Scientific Output: The scientific output is very small. Apart from the PhD thesis of F. Touratier, only four papers have been identified; two of these are contributions to a Belgian symposium, one is a contribution to an international symposium, and finally one paper is published in a low-impact Belgian journal.		
Publications by year: 1994: 1 1995: 1996: 3 2000 2001		**Publications from the Contract**: Belgian Journals: 1 Books, others: 3 International Journals: Other products:
Social Impacts: Improvement of North Sea model.		
Strongest Point: Thesis of F. Touratier **Weakest Point:** Lack of publications		

<table>
<tr><td colspan="3">BELSPO Programme: Impulse Programme Marine Sciences 1992-1997</td><td>Contract no.: 10</td></tr>
<tr><td colspan="4">Project Title: Macrobenthic populations along the estuarine gradient of the Scheldt estuary: role of the abiotic (natural and human) environment</td></tr>
<tr><td>Participants:</td><td>IN</td><td>VUB</td><td>PIH/UGent/VITO</td></tr>
<tr><td></td><td>E. Kuijken - promotor
P. Meire
Dr. T. Ysebaert
N. de Regge
K. deVos
R. Strucker
R. Samanya
J. Seys
P. Meininger (RWS-Netherlands)
C. Berrevoets (Netherlands)</td><td>W. Baeyens
V. Srninetr</td><td>E. Rillaerts (PIH)
C. Janssen (UGent)
M. Vangheluwe (UGent)
I.Vandemoortel (UGent)
J. Van Waeyenberghe (UGent)
M.P. Goyvaerts (VITO)</td></tr>
<tr><td colspan="2">Budget: 264,577 EURO</td><td colspan="2">Project Start/End Dates: 10/1992 – 03/1997</td></tr>
<tr><td colspan="4">Objectives: A first attempt at a more integrative approach, in combining (1) a detailed field study on the community structure and population dynamics of benthic macroinvertebrates along the estuarine gradient of the Scheldt estuary with (2) field research on bioavailability of inorganic and organic microcontaminants in sediment and porewater and their accumulation in benthic macroinvertebrates.</td></tr>
<tr><td colspan="4">Were Objectives Met? The community structure and population dynamics of the benthic fauna along the Scheldt estuary have been reported and described in considerable detail. In addition the occurrence and distribution of waterbirds preying on benthic fauna has been described. The toxicological work has been the subject of three PhD theses of which rather short summaries are given. The first attempt at integration of work on the benthic macrofauna and field research on bioavailability of contaminants was not very successful; contaminants explained little of the variation of the benthic data.</td></tr>
<tr><td colspan="4">Content and Quality of Report: Only once a progress report is mentioned in the text of the final report but the former has not been seen. The final report contains extensive documentation of the work on benthic invertebrates and on waterbirds, but contains only summaries of the ecotoxicological work.</td></tr>
<tr><td colspan="4">Scientific Quality: The work on benthic macrofauna is ‘state-of-the art’. The bird studies are of more routine character and consist essentially of an analysis of censuses. The ecotoxicological work seems OK, but cannot be judged very well.</td></tr>
<tr><td colspan="4">Scientific Output: The scientific output is not listed in the final report. From other sources, however, it becomes clear that the principal investigators of the ecological study have published their results in several journals although not the best ones. We have no details on the output of the ecotoxicological work except that it has resulted in three PhD theses.</td></tr>
<tr><td colspan="2">Publications by year:
?</td><td colspan="2">Publications from the Contract:
?</td></tr>
<tr><td colspan="4">Social Impacts: Not clear.</td></tr>
<tr><td colspan="4">Strongest Point: Systematic study of the benthic macrofauna along the entire Scheldt estuary.
Weakest Point: Although attempted, there is little integration of the ecological and the ecotoxicological work.</td></tr>
</table>

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**	**Contract no.**: 11
Project Title: Definition and application of ecological criteria and economic indicators for the study of effects and the determination of costs of various types of pollution of the North Sea	

Participants:	UGent	ECOLAS
	G. Persoone – promotor N. de Pauw C. Janssen M. Vandenbroele M. Vangheluwe	P. Van Haecke D. Le Roy

Budget: 371,840 EURO	**Project Start/End Dates**: 10/1992 – 03/1997

Objectives: The objective of this study was to couple ecological criteria and economic indicators for the effects of oil and chemical pollution of the North Sea in order to assess the effect of pollution objectively and to improve the management of (the Belgian part) of the North Sea.

Were Objectives Met? A method was developed to estimate ecological and economic effects of North Sea pollution. In this method ecological effects are translated into economic effects and thus the final assessment is in economic terms. In addition a database has been created containing physico-chemical and ecotoxicological information on 220 chemical compounds. It is unclear if the method is used in the management of the North Sea.

Content and Quality of Report: Although the final report refers to earlier progress reports, only the final report was available for inspection. The final report consists of two parts. Part 1 contains an extensive report on the work done, part 2 contains a database on physical, chemical and ecotoxicological characteristics of 220 different chemicals. The final report does not refer to the original objectives but contains an extensive description of the work done. This consists of the development of an ecological impact model for which the chemical database is used. Next clean-up costs for oil pollution are estimated. Also the costs of reducing marine eutrophication are estimated. The next chapters contain descriptions of two case studies in which the use of the methodology is tested, one involving chemical pollution, the other one oil pollution. This results in a chapter in which a flowchart is described for the calculation of the impact of marine pollution based on a physico-chemical submodel, a biological submodel and an economic submodel. This finally results in an estimate of economic losses.

Scientific Quality: This study is a brave attempt to combine several different disciplines. Each discipline is applied in a 'state-of-the-art' manner, but the incorporation of ecological and ecotoxicological information into economic models requires too many simplifications and assumptions to result in a meaningful result. Hence, this study does not produce a methodology which can be applied in practice but it shows the way to be followed.

Scientific Output: Absolutely insufficient. The final report gives an acceptable documentation of the work done but beyond that it only announces two papers in a Dutch language, probably not peer-reviewed, Belgian journal. No publications in peer-reviewed international journals have been found.

Publications by year:	**Publications from the Contract**:
None	None

Social Impacts: Potentially this study has great value for the management of pollution in the (Belgian part of the) North Sea. It develops a concept which can be elaborated in future work.

Strongest Point: Combination of ecology, ecotoxicology, and economy.
Weakest Point: No peer-reviewed publications.

BELSPO Programme: **Impulse Programme Marine Sciences 1992-1997**		**Contract no.**: 12
Project Title: Towards a future Belgian policy with regard to the protection of the North Sea		
Participants:	UGent	
	E. Somers - promotor F. Maes A. Cliquet	
Budget: 210,709 EURO		**Project Start/End Dates**: 10/1992 – 03/1997

Objectives:

1. Assessment of the economic and ecological importance of the North Sea for Belgium;
2. Overview of the existing international regulations on the protection of the North Sea;
3. Analysis of the Belgian North Sea policy;
4. Comparison of the Belgian North Sea policy with that of a number of other North Sea states;
5. Formulation of options for future North Sea policy with indication of the ecological and economic consequences.

Were Objectives Met? The first four objectives were met; the fifth objective not due to lack of time.

Content and Quality of Report: No progress reports have been seen. The final report, however, amply compensates for this. It counts over 1255 pages with a map appendix. After a general introduction on the North Sea it provides a very thorough treatment of the legal definitions of nature conservation and pollution, of the Belgian jurisdiction in North Sea matters, the international approaches to the protection of the marine environment, and the sustainable development of the North Sea. After these chapters separate chapters are given on the regulation of fisheries, sand and gravel extraction, dredging, shipping, tourism, pollution, nature conservation, marine research, and some minor uses. Next the Belgian policy and management of the North Sea are compared with Great-Britain, the Netherlands, France, and Germany. Finally, a number of conclusions are drawn.
The report is an exhaustive description of everything of any importance with regard to the management of the North Sea. I doubt if any other country has such a complete description of its marine policy and management.

Scientific Quality: Excellent quality.

Scientific Output: The scientific output has been an atlas with wide distribution and a 733 pages book published by a well-known science publisher (Kluwer), but written in Dutch.

Publications by year:	**Publications from the Contract**:
1997: 1 book	Belgian Journals:
1998:	Books, others: 1
1999:	International Journals:
2000: 1 atlas	Other products: 1 atlas
2001:	

Social Impacts: This report should be basic reference work for anybody involved in Belgian North Sea policy and management. Also for Dutch readers it contains valuable information; it is very unfortunate that it cannot be consulted by readers from other countries (because of the language).

Strongest Point: Exhaustive treatment of 'everything' concerning policy and management of the Belgian North Sea
Weakest Point: Written in Dutch.

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**			**Contract no.**: 4
Project Title: Functional and structural biodiversity of North Sea Ecosystems			
Participants:	UGent	IN	KULeuven
	M. Vincx - promotor A.Cattrijsse D. van Gansbeke J. Vanaverbeke W. Bonne A. Dewicke S. Degraer M. Steyaert G. De Smet D. Schram A. Van Kenhove M. Beghyn G. van Hoey	E. Kuijken – promotor P. Meire M. Hoekstein (until July 1998) J. Seys (from July 1998) J. Van Waeyenberghe	F. Ollevier – promotor F. Volckaert B. Hellemans E. Gysels T. Huyse M. Zietara A. Geets
Budget: 1,248,441 EURO		**Project Start/End Dates**: 01/1997 – 12/2001	

Objectives: The project has three objectives:

- Assessment of the biodiversity of North Sea benthos and plankton;
- Assessment of the biodiversity of the bird fauna of the North Sea;
- Assessment of genetic biodiversity of ecologically important species in the North Sea ecosystem.

The relationships between these three themes appear to be weak.

Were Objectives Met? No final report has been seen, but the progress reports make clear that the three separate objectives very likely will be met.

Content and Quality of Report: Scientific progress reports have been seen for the years 1997, 1998, 1999, and 2000. In addition a administrative progress report over the second half of 1998 was read. No final report was available (apparently the project was not yet concluded). The progress reports were informative and presented detailed overviews of the progress in the various fields of study.

Scientific Quality: The work on biodiversity of the benthos and genetic diversity of marine organisms (= fish and fish parasites) is at the forefront of science. The bird work is good but not particularly impressive.

Scientific Output: The progress reports make clear that there is a steady flow of scientific publications but it is hard to detect the total output. I found two ornithological publications in low-status journals, one fish biology paper in a good quality journal, and one parasitological paper in a high-quality journal. In addition an atlas was published containing the results of 28 years of work on benthos and birds in the Belgian part of the North Sea. In addition some of the work resulted in a PhD thesis.

Publications by year:	**Publications from the Contract**:
1996: 1 1998: 1999: 2 2000: 1 2001:	Belgian Journals: 1 Books, others: International Journals: 3 Other products: PhD thesis, atlas

Social Impacts: The study contributed to the identification of sensitive areas in the Belgian part of the North Sea which will be (have been?) protected as Ramsar sites.

Strongest Point: Continuation of a long-term series of benthic studies in the North Sea.
Weakest Point: Relationship between three subthemes.

<table>
<tr><td colspan="3">BELSPO Programme: Sustainable Management of the North Sea 1997-2003</td><td>Contract no.: 7</td></tr>
<tr><td colspan="4">Project Title: MARE – DASM</td></tr>
<tr><td>Participants:</td><td>UGent</td><td>ECOLAS</td><td>MUMM</td></tr>
<tr><td></td><td>F. Maes – promotor
C. Janssen – promotor
H. Bocken – promotor
E. Somers</td><td>P. Vanhaecke</td><td>G. Pichot - promotor</td></tr>
<tr><td colspan="2">Budget: 198,315 EURO</td><td colspan="2">Project Start/End Dates: 10/1998 – 09/2002</td></tr>
<tr><td colspan="4">Objectives: The objectives of this project are:
- Identification and quantification of factors contributing to the degradation of the marine environment
- Development of socio-economic criteria to assess the magnitude of this damage;
- Development of measures for integrated, sustainable management of the sea;
- Development of models to determine the risk of and damage by accidental discharges of pollutants;
- Development of technical and legal procedures to asses environmental damage at sea and to charge this damage to the polluter.</td></tr>
<tr><td colspan="4">Were Objectives Met? The project is still underway, but from the available information can be concluded that considerable progess is being made towards the objectives.</td></tr>
<tr><td colspan="4">Content and Quality of Report: Two progress reports (1999, 2000) could be consulted. These reports provide detailed information on the progress made under the five tasks defined. Input of pollutants into the Belgian part of the North Sea has been quantified, methods to assess socio-economic damage have been developed, oil slick modelling has been improved and legal instruments have been listed and assessed.</td></tr>
<tr><td colspan="4">Scientific Quality: In most areas the science is ‘state-of-the art’. Especially the combination of ecological, socio-economic, technical, and legal studies is a tour de force which is not often encountered.</td></tr>
<tr><td colspan="4">Scientific Output: Not found.</td></tr>
<tr><td colspan="2">Publications by year:
None?</td><td colspan="2">Publications from the Contract:
None?</td></tr>
<tr><td colspan="4">Social Impacts: Potentially, this study is of great societal importance because it may lead to a mechanism to let polluters pay for environmental damage at sea.</td></tr>
<tr><td colspan="4">Strongest Point: Combination of four very different scientific disciplines.
Weakest Point: Combination of four very different scientific disciplines.</td></tr>
</table>

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 12
Project Title: Evaluation of the quality of turbot fry on the restocking success in the North Sea		
Participants:	UGent	DZV
	P. Sorgeloos – promotor P. Dhert K. Dierckens A.Van Dereecken M. Wille R.A. Rueda	R. DeClerck D. Delbare
Budget: 148,538 EURO		**Project Start/End Dates**: 10/1999 – 12/2001
Objectives: The objective of this study was to produce turbot fry of sufficient quality to be used for restocking North Sea populations.		
Were Objectives Met? The study resulted in methods to enhance the quality of turbot fry for restocking purposes. The study also identified genetically slightly differing turbot stocks in European seas. Finally, it is concluded that turbot larvae can only be cultivated in closed recirculation systems.		
Content and Quality of Report: Only a final report has been inspected. It describes the effect of water quality and of the parental stock on turbot larvae as well as the effect of selected, beneficial bacterial strains on the production of larvae. Next an optimal food composition and feeding regime are developed. Methods are developed for the quality assessment of larvae. The genetic differentiation of West-European turbot populations is investigated. Finally, a feasibility study for a turbot larviculture is described.		
Scientific Quality: This study places itself at the forefront of aquaculture science.		
Scientific Output: Apparently only a Dutch language report. The Sorgeloos group is actively publishing the results of its research, for example in the journal Aquaculture, but in none of the publication reference is made to funding by the programme 'Sustainable management of the North Sea'.		
Publications by year: None	**Publications from the Contract**: None	
Social Impacts: This study is of great importance for establishing sound aquaculture of turbot in Belgium.		
Strongest Point: Thorough analysis of the conditions required for larviculture of turbot. **Weakest Point:** Report in Dutch language.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 14
Project Title: Intensive monitoring of the evolution of a protected benthic habitat: HABITAT		
Participants:	UGent	MAGELAS
	M. Vincx – promotor P. Jacobs – promotor S. Degraer G. Van Lancker G. Moerkerke J-P. Henriet	
Budget: 73,922 EURO	**Project Start/End Dates**: 09/1999 – 12/2001	
Objectives: The general objective of the project is the provision of data necessary for the definition and the management of a Marine Protected Area situated in the southernmost corner of the Belgian part of the North Sea. The study focuses on the distribution of macrobenthic communities in relation to sedimentological, bathymetrical and hydrodynamical characteristics.		
Were Objectives Met? Although only a scientific progress report is available, it is likely that the objectives are going to be met.		
Content and Quality of Report: Only one scientific progress report has been seen. It provides a detailed description of the work done. It shows a logical sequence of tasks and the execution of these tasks seems to be on schedule.		
Scientific Quality: The benthic and sedimentological work is 'state-of-the-art'.		
Scientific Output: One paper in a good quality journal was identified. In addition there is a number of published contributions to international workshops. The project also resulted in, or contributed to, to two PhD theses.		
Publications by year: 1997: 1998: 1999: 1 2000: 2001:	**Publications from the Contract**: Belgian Journals: Books, others: 3 International Journals: 1 Other products: 2 PhD theses	
Social Impacts: Important contribution to the definition and management of a future Marine Protected Area in the Belgian part of the North Sea.		
Strongest Point: Well developed integration of ecological and sedimentological work **Weakest Point:** Short duration of the study.		

BELSPO Programme: **Sustainable Management of the North Sea 1997-2003**		**Contract no.**: 19
Project Title: The collection 'Gustave Gilson' as a reference framework for the Belgian marine fauna: feasibility study.		
Participants:	RBINS	
	J.L. van Goethem – promotor H. van Loen?	
Budget: 123,947 EURO		**Project Start/End Dates**: 01/2000 – 12/2001
Objectives: The objective of this study is to investigate whether the collection of marine organisms collected in the Belgian part of the North Sea from 1898 to 1939 can be used as a reference for present and future studies on the fauna of the North Sea.		
Were Objectives Met? The study is still in progress, but the first results promise that the objective may be met.		
Content and Quality of Report: The report provides a detailed desciption of the work done sofar. The task executed consists of the compilation of a bibliography on the biodiversity of the North Sea, the design of a database, and taxonomic revision of the material of a few species groups in the Gilson collection.		
Scientific Quality: The project looks scientifically sound.		
Scientific Output: No publications sofar.		
Publications by year: ?		**Publications from the Contract**: ?
Social Impacts: This project may result in an important reference for present and future studies on the ecology of the North Sea by showing the ecosystem composition in a period when the North Sea was less influenced by man than at present.		
Strongest Point: Well-planned investigation of a rare marine biological collection. **Weakest Point:** None.		

Annex 6.1 Administrative origin of the research teams active in North Sea research

Institutional participation	Phases						Total	
	1	2	3	4	5	6 [1]	no.	%
University:								
- Dutch-speaking	9	4	6	8	15	11	25	51,0
KUL	2				2	2	5	10,2
RUG	2	2	3	4	9	6	11	22,4
UA			1	3	1	1	3	6,1
VUB	5	2	2	1	3	2	6	12,2
- French speaking	6	3	3	6	9	7	13	26,5
UCL	1						1	2,0
ULB	2	1	1	3	3	3	3	6,1
ULG	3	2	2	3	4	2	7	14,3
UMH					2	2	2	4,1
- total	**15**	**7**	**9**	**14**	**24**	**18**	**38**	**77,6**
Public research institute:								
- Federal	6			1	3	1	8	16,3
DVZ	1			1	1		1	2,0
ERM / KMS	1						1	2,0
IHE	1						1	2,0
IRC / ISO	1						1	2,0
IRSNB / KBIN	1				1		2	4,1
MUMM					1	1	1	2,0
SP	1						1	2,0
- Flemish				1	1	2	1	2,0
DVZ [2]						1		0,0
IN				1	1	1	1	2,0
- Walloon								0,0
- total	**6**			**2**	**4**	**3**	**9**	**18,4**
Private research institute:								
- Flemish				1	2		2	4,1
ECOLAS				1	1		1	2,0
MAGELAS					1		1	2,0
- Walloon							0	0,0
- total				**1**	**2**		**2**	**4,1**
Total number of teams	**21**	**7**	**9**	**17**	**30**	**21**	**49**	**100,0**

[1] Including foreign participation, the total number of research teams becomes 24.

[2] Since January 2002, DVZ was transformed from a Federal to a Flemish public research institute.

Annex 6.2 Institutional involvement in North Sea research contracts

Institutional involvement in contracts	Phases 1	2	3	4	5	6 [1]	Total no.	%
University:								
- Dutch-speaking	9	4	6	8	24	15	66	45,5
KUL	2				2	3	7	4,8
RUG	2	2	3	4	15	9	35	24,1
UA			1	3	2	1	7	4,8
VUB	5	2	2	1	5	2	17	11,7
- French speaking	8	3	2	6	14	8	41	28,3
UCL	1						1	0,7
ULB	2	1	1	3	6	4	17	11,7
ULG	5	2	1	3	6	2	19	13,1
UMH					2	2	4	2,8
- total	**17**	**7**	**8**	**14**	**38**	**23**	**107**	**73,8**
Public research institute:								
- Federal	10			1	9	4	24	16,6
DVZ	1			1	3		5	3,4
ERM / KMS	1						1	0,7
IHE	3						3	2,1
IRC / ISO	1						1	0,7
IRSNB / KBIN	3				1		4	2,8
MUMM					5	4	9	6,2
SP	1						1	0,7
- Flemish				1	3	2	6	4,1
DVZ [2]						1	1	0,7
IN				1	3	1	5	3,4
- Walloon							0	0,0
- total	**10**			**2**	**12**	**6**	**30**	**20,7**
Private research institute:								
- Flemish				1	7		8	5,5
ECOLAS				1	4		5	3,4
MAGELAS					3		3	2,1
- Walloon							0	0,0
- total				**1**	**7**		**8**	**5,5**
Total number of contracts	**27**	**7**	**8**	**17**	**57**	**29**	**145**	**100,0**

[1] Including foreign participation, the total number of contracts becomes 34.

[2] Since January 2002, DVZ was transformed from a Federal to a Flemish public research institute.

Annex 6.3 Distribution of grants per institute in North Sea research contracts

Distribution of grants	Phases						Total	
	1	2	3	4	5	6 [1]	no.	%
University:								
- Dutch-speaking	1.473.538	1.772.439	4.185.137	2.271.721	4.720.131	4.000.000	18.422.966	51,7
KUL	204.243				619.734	351.000	1.174.977	3,3
RUG	322.320	741.202	2.553.006	1.422.537	2.128.848	2.978.000	10.145.913	28,5
UA			677.989	559.149	664.356	157.000	2.058.494	5,8
VUB	946.975	1.031.237	954.142	290.035	1.307.193	514.000	5.043.582	14,2
- French speaking	2.078.251	1.638.576	1.164.430	1.738.651	3.136.102	2.191.000	11.947.010	33,6
UCL	97.992						97.992	0,3
ULB	658.821	490.829	631.459	1.138.674	1.579.083	1.556.000	6.054.866	17,0
ULG	1.321.438	1.147.747	532.971	599.977	1.110.811	356.000	5.068.944	14,2
UMH					446.208	279.000	725.208	2,0
- total	**3.551.789**	**3.411.015**	**5.349.567**	**4.010.372**	**7.856.233**	**6.191.000**	**30.369.976**	85,3
Public research institute:								
- Federal	845.430			245.662	1.387.212	1.077.000	3.555.304	10,0
DVZ	202.984			245.662	167.576		616.222	1,7
ERM / KMS	12.395						12.395	0,0
IHE	284.262						284.262	0,8
IRC / ISO	28.756						28.756	0,1
IRSNB / KBIN	178.848				123.947		302.795	0,9
MUMM					1.095.689	1.077.000	2.172.689	6,1
SP	138.185						138.185	0,4
- Flemish				264.577	583.740	309.000	1.157.317	3,3
DVZ [2]						94.000	94.000	0,3
IN				264.577	583.740	215.000	1.063.317	3,0
- total	**845.430**			**510.239**	**1.970.952**	**1.386.000**	**4.712.621**	13,2
Private research institute:								
- Flemish				65.912	454.351		520.263	1,5
ECOLAS				65.912	366.349		432.261	1,2
MAGELAS					88.002		88.002	0,2
- total				**65.912**	**454.351**		**520.263**	1,5
Total of grants	**4.397.218**	**3.411.015**	**5.349.567**	**4.586.523**	**10.281.535**	**7.577.000**	**35.602.858**	100

[1] Including foreign participation, the total number of contracts becomes 34 and the total sum of grants 7,875,000 Euro.

[2] Since January 2002, DVZ was transformed from a Federal to a Flemish public research institute.

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