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SUBMISSIONS RECEIVED BY THE SECRETARIAT CONCERNING THE CONSERVATION AND SUSTAINABLE USE OF MARINE AND COASTAL BIOLOGICAL DIVERSITY

(Submissions have been reproduced as received by the Secretariat)

Content

II On the conservation and sustainable use of marine and coastal biodiversity

There has been set up 4 nature reserve areas for the coastal biodiversity, occupying a total area of 3.26 billion ha, in which areas, there practice a policy of designation of fishery-forbidden area and fishery-forbidden period, apart from that, there have been also formulated a lot of laws and regulations on the conservation of marine environment and resources. In 1992, Chinese government enacted China's Marine Biodiversity Conservation Action Plan, in which, it has been prioritised for the conservation. In the first draft of China Biodiversity Country Study newly concluded, it elaborates on the conservation and use of marine and coastal biodiversity.

Coastal and Marine Ecosystems

Coastal and marine ecosystems. China's seawaters cover three climatic zones (warm-temperate, subtropical and tropical), and are influenced by many oceanic currents, such as the continental coastal currents and the Kuroshio warm current. Broad intertidal flats and shallow shelfs stretch along the coastline, receiving more than 1,500 large and medium rivers. There are a number of coastal and marine ecosystems, such as the coastal flat, estuarian, coastal wetland, mangrove, coral reef, marine island and oceanic ecosystems.

The Yellow Sea and the Bohai Sea constitute the warm-temperate marine ecosystem, with coastal ice covers formed in the winter and clear seasonal changes in biotopes. Many marine animals such as *Phoca largha, Clupea harengus, Gadus macrocephalus, Mytilus edulis, Haliotis discushannai, Ophiura sarsii* and other species of the temperate zone, find their feeding and breeding grounds in these seas.

- The East China Sea and the northern section of South China Sea, including Guangdong, Guangxi and the northwest of Taiwan, are part of the subtropical marine ecosystem. Coral reef and mangrove ecosystems are developed in this region. In addition, at the mouths of the Yangtze and Pearl Rivers, estuarian ecosystems are formed. The recorded number of mangrove subspecies accounts for more than 40 percent of the world's total.

The vast seawaters south of Hainan and southeast of Taiwan constitute the tropical marine ecosystems, with high richness in marine species. This ecosystem is characterized by well-developed coral reefs. Some 185 *Zooxanthellate* corals are recorded in these areas, accounting for 22–25 percent of coral species in the Western Indian Oceanic region.

Priority Coastal and Marine Ecosystems and Nature Reserves

Island Ecosystems

- Nanji Island nature reserve, Zhejiang Province
- Miaodao Archipelago nature reserve, Shandong Province
- Xisha Archipelago nature reserve, South China Sea
- Weizhou Island nature reserve, Guangxi Zhuang Autonomous Region
- Nan'ao island nature reserve, Guangdong Province
- Dazhou Island nature reserve, Hainan Province
- Zhoushan Archipelago nature reserve, Zhejiang Province
- Laotieshan Snake Island nature reserve, Liaoning Province

Coral Reef Ecosystems

- Sanya nature reserve, Hainan Province
- Donshan nature reserve, Fujian Province
- East Island of the Xisha Archipelago
- Yushu Reef nature reserve, Nansha Archipelago

Estuarian Wetland Ecosystems

- Shuantaizhi (Liaohe estuary) nature reserve, Liaoning Province
- Yancheng nature reserve, Jiangsu Province
- Quanzhou Bay intertidal flats nature reserve, Fujian Province
- Zhongmin Island nature reserve, Shanghai Municipality
- Jiaozhou Bay intertidal flats nature reserve, Shandong Province
- Yellow River Delta nature reserve, Shandong Province
- Western Bohai Bay wetland nature reserve, Liaoning Province

Mangrove Ecosystems

- Shankou nature reserve, Guangxi Zhuang Autonomous Region
- Zhangjiang Estuarian nature reserve, Fujian Province
- Dongzhaigang nature reserve, Hainan Province
- Baichonghe Estuary nature reserve, Guangxi Zhang Autonomous Region
- Qinzhou Bay nature reserve, Guangxi Zhuang Autonomous Region

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DENMARK

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Ministry of
Enviroment and Energy

The National Forrest and
Nature Agency

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DENMARK

Conservation and sustainable use of marine and coastal biological diversity is regulated by a great number of international agreements and by national legislation. Primary attention should be given to ensuring that the provisions of the CBD are taken fully into account by relevant existing agreements and legislation. Cooperation between relevant responsible authorities should be promoted at all levels, including at the global, national and regional level.

All policy and management measures to ensure the conservation and sustainable use of marine and coastal biodiversity should be based on sound scientific advise and should take into account all relevant biological, technological, economic (including viability and food security), social, environmental and commercial aspects.

Where knowledge on biological diversity is poor, research should be promoted, including research to establish the sustainable levels of utilization of different components of the biological diversity. A wholistic, multispecies and multicomponents approach should be applied, so as to enable fisheries management to take into account the full ecosystem consequences of decitions.

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IRELAND

BioMar

Marine coastal management: identification, description and mapping of biotopes

The BioMar project is funded under the EU LIFE Programme. Its aim is to develop and demonstrate a system for the collection, storage, analysis and dissemination of marine, ecological and environmental data for coastal management. The application of this system in coastal conservation management in particular will be demonstrated, but the system will have wider relevance.

The project started in 1992 and the final report will be available in June, 1997. Administrative co-ordination of BioMar is by the National Parks and Wildlife Service with technical co-ordination by Trinity College Dublin (TCD). The joint Nature Conservation Committee (JNCC) and University of Newcastle-upon-Tyne in the UK, are partners in the project. The company AIDEnvironment (the Netherlands) made a contribution during the first year of the project, and there are sub-contracts with specialist groups. The main tasks in the project (and the partner with primary responsibility) are:

- *Develop a marine biotopes classification (JNCC);*
- *Survey maritime biotopes in Ireland (NPWS);*
- *Survey marine biotopes in Ireland (TCD);*
- *Assess remote survey methods (Newcastle);*
- *Develop computerised data storage, analysis and dissemination systems (TCD with JNCC);*
- *Review marine protected areas in Europe (AIDEnvironment).*

By field surveys in inshore waters (<5Km. from shore), information is collected on inter and sub-tidal marine habitats and communities (=biotopes) from Britain and Ireland. To date, 22 areas in Britain and 9 areas in Ireland have been surveyed. These surveys will be completed in September, 1996. The field information is used to (a) develop and demonstrate methods for data collection, (b) develop a classification of marine biotopes which will be applicable to inshore areas of the North-East Atlantic (but not the Baltic and Mediterranean Seas), and (c) identify areas of marine conservation importance. Through the concurrent survey of maritime (land by the sea) areas of conservation importance in Ireland, the feasibility and value of linking maritime and marine areas within the same conservation area will be explored. The survey of maritime areas in Ireland has been largely completed. This was done as part of the Natural Heritage Area re-survey.

The classification will form the basis for describing, mapping and comparing the conservation value of in-shore marine areas. To ensure the classification will have wide application in the North-East Atlantic, several meetings and workshops have been held with European specialists in marine ecology and management in which the background, design and preliminary results of the developing classification are discussed and where necessary modified.

The high cost, in terms of time and money, of ground surveying is well known. To help alleviate this problem the use of remote survey methods for both inter and sub-tidal areas is being developed by BioMar. These remote survey techniques (eg. acoustic, photographic) allow point source data to be linked to larger coastal areas. To date, the 16 surveys conducted have covered a range of sea areas in Britain and Ireland, used different research vessels and equipment, and involved collaboration with different groups (BioMar partners and various government authorities). However, the comparability of the maps produced from the surveys demonstrates the wide application of the methods. From the experience in BioMar, it will be possible to recommend methods for the collection of marine data which may be used in other countries.

A database has been established for data storage and analysis, and can now be linked with computer mapping systems (Geographical Information Systems). In addition to its use in disseminating data, the use of GIS in predicting the occurrence of marine habitats from widely available coastal data (eg. coastline, bathymtry, wind direction and force) is being explored. A wave exposure index has been automated within the GIS so that the exposure for any piece of shoreline can be predicted. These predictions are now being tested with field data and the flexibility of the model to other data sets examined.

As a background to marine conservation management in Europe, a desk study of marine protected areas has been completed. Reports on this study, and internal reports on field surveys, have been submitted to the European Commission. There has been considerable effort in disseminating information about BioMar. The partners have made 31 presentations on the project at 10 international and 14 national meetings. In addition, there have been 18 papers published and a further 8 accepted for publication, arising from BioMar.

JIM KELLY

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BRIEF - COASTAL ZONE MANAGEMENT STUDY

1. Introduction

This consultancy is being commissioned jointly by the Departments of the Environment and the Marine and the Office of Public Works as an input to policy formulation concerning an overall framework for coastal zone planning and management covering land use planning and control, coastal protection, nature conservation, marine resource development (eg aquaculture and in-shore fisheries), marine environmental protection and the links between these. Coastal areas provide important shared resource benefits - recreational, aesthetic, economic etc. - as well as accommodating many sensitive ecosystems; such benefits and ecosystems could be endangered by future development if the coastal zone is not properly managed.

Ireland's coastline is 5628 kms long and the coastal zone contains our largest towns and cities, with about 70% of the urban population living at or near coastal areas. Much industrial and other economic activity takes place there. Various aspects of socio-economic activities are placing increasing pressures on the coastal zone. Particular concerns arise in relation to developmental pressures and encroachment, pollution of coastal waters, competition for space, over-exploitation of marine resources, and erosion.

It is intended to develop a comprehensive management policy for the entire coastal zone, both on the seaward and landward sides, and to provide a framework for conservation and sustainable use. Such management policy will come from a dynamic process and will be based on the premise that the coastal zone, as a unit for both use and planning purposes, is an area which requires special attention.

The intent of this comprehensive management policy for the coastal zone is the promotion of sustainable use, the balancing of demand for coastal resources, and the promotion of both environmentally sensitive use of, and strategic planning for, the coastal zone. Implementation of such a policy will require co-ordinated decision making in respect of the management of coastal and land resources for urban, industrial, agricultural, tourism and conservation interests; the management of coastal waters for fishing, aquaculture, harvesting of self-renewing resources or minerals, dredging, navigation and leisure activities; the management of living marine resources, and the provision of coastal defences. A co-ordinated strategy for the allocation of resources to achieve the conservation and sustainable

3.1 International Developments

The European Union's policy on Coastal Zones is reflected in the Fifth Action Programme "Towards Sustainable Use". This programme has been published in the Official Journal under the reference 93/C 138/01.

The European Commission's Communication 'Europe 2000' deals at some length with the environmental importance and development potential of coastal zones and islands. It points out that the natural assets of the coastal environment constitute a key aspect of their development potential but that these natural assets are put under increasing pressure by urbanisation and the tourism, transport, industry, energy, agriculture and fisheries sectors, although in the case of the latter sector, a conservation strategy is embodied in the Community's Common Fisheries Policy.

The Council of Ministers (Environment), in a Resolution adopted on 25 February 1992, requested the European Commission to propose an overall (Community) Union strategy for the integrated management of coastal zones, with a view to providing a coherent environmental framework for integrated and sustainable forms of development. The Council of Ministers approved a further Resolution on 24/25 March 1994 which, inter alia, invited the Commission to bring forward its strategy proposal within six months.

The Council of Ministers also adopted (24 March, 1994) conclusions regarding a wide range of matters pertaining to maritime safety and prevention of marine pollution, many of which concern the coastal zone.

The Habitats and Birds Directives oblige Member States to designate Special Areas of Conservation and Special Protection Areas and to take appropriate steps to avoid deterioration of the habitats and disturbance of the species for which the areas have been designated. Any plan or project likely to have a significant effect on the site will be subject to an appropriate assessment of its implications. Many other adopted Council Directives (in regard to shellfish waters, bathing waters, urban waste water treatment, dangerous substances, nitrates etc) require measures to be taken to protect and improve waters, including marine waters.

The United Nations Conference on Environment and Development (UNCED) in June 1992 included commitments to the control and reduction of degradation of the marine environment so as to maintain and improve its life-support and productive capacities. The World Coast Conference Output Document (The Hague November 1993) is intended to form an input into the UNCED process.

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The Government is committed in its Programme to the drawing up of a National Land Use Policy Plan to provide guidelines for both national policy decisions and planning authorities in relation to location of agricultural, industrial, forestry, aquaculture and tourism developments and to the preparation of a National Sustainable Development Strategy to address all areas of Government policy which impact on the environment.

3.3 Other initiatives at national level

Other relevant initiatives at national level include

- the establishment in 1993 of eight regional authorities who will provide the coordination of public services in the region by, inter alia, articulating the development needs of the region - primarily through the preparation of a regional plan - and thereby providing an important framework for development planning.

- establishment in 1992 of the Marine Institute and establishment in 1993 of the Environmental Protection Agency,

- amendment in 1992 of the Foreshore Act to strengthen protection of beach material and eco-systems of the seashore.

- establishment of the Irish Marine Emergency Service to provide emergency humanitarian and pollution responses.

- County and City Engineers report on coastal management and protection needs, published by Eolas, 1992.

- ECOPRO - under the EU's LIFE programme (chaired by the Department of the Marine),

- the BioMar project which involves a survey of marine habitats and their communities around the Irish coast, co-funded by the EU LIFE programme (Trinity College Dublin and Office of Public Works).

- the re-survey of Areas of Scientific Interest and their designation as Natural Heritage Areas, co-funded by the EU LIFE programme (Office of Public Works)

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manner, for the purposes of applying coastal zone management policy to the coastal zone (or zones) in Ireland;

- the strategy should provide a coherent framework for sustainable forms of development, while having regard to existing responsibilities and structures (such of those of Central, Regional and Local Government) in the elements of coastal zone management concerned in the study i.e. land use planning and control, coastal protection, nature conservation, marine resource development, and marine environmental protection;

- the strategy should enable clear objectives to be set which would provide for a coherent overall policy for managing the coastal zone based on the principles of conservation and sustainable use. This should include definition of criteria for the identification of vulnerable areas whose biological diversity, landscape value, ecological quality and capacity to sustain life, health, natural and cultural heritage, economic activities, environment and social well-being are under threat. This strategy should include practical recommendations on how economic, physical planning and environmental policies are fully integrated.

Conservation et utilisation durable de la diversité biologique côtière et marine

(Décision II /10 de la CDP 2 -Convention sur la diversité biologique)

Vues et informations de Madagascar

Note préliminaire :

Le présent document est établi pour contribuer à l'élaboration du document de base sur la conservation et l'utilisation durable de la diversité biologique côtière et marine, conformément à la décision II/10 de la 2ème Conférence des Parties et pour répondre à la recommandation I/8 de la première réunion de l'Organe subsidiaire (SBSTTA).

1- Description sommaire de la biodiversité côtière et marine à Madagascar :

La Grande Ile de Madagascar, pour une superficie de 587.000 Km^2 et une zone économique exclusive marine de 1 million de km^2, compte 6.597 km de côtes, lesquelles donnent sur le canal de Mozambique du côté occidental, de l'Océan Indien du côté oriental. A la latitude où se trouve Madagascar sous les Tropiques, les eaux sont chaudes en toutes saisons, créant des facteurs favorables pour le développement de la biodiversité marine et littorale.

Selon les estimations récentes (1990), l'ensemble des mangroves et des tannes de l'arrière-mangrove couvre 425.000 hectares, essentiellement sur la côte Ouest de l'Île ; ces mangroves constituent un réservoir d'animaux marins d'intérêt économique, tels que les crevettes.

Les récifs coralliens s'étendent le long de la côte Ouest sur un longueur totale de plus de 1.000 km ; il s 'agit pour la plupart de récifs barrières, situés à une certaine distance de la côte et formant des lagons de quelques km de largeur et une dizaine de km de longueur. Ces récifs présentent une grande diversité biologique (Invertébrés, Poissons) connue pour leur valeur alimentaire.

2- Les activités existantes :

□ Bien que n'ayant procédé que tout récemment à la ratification de la Convention sur la diversité biologique, Madagascar a pris des dispositions concernant l'environnement côtier et marin (EMC) dans la 2ème phase de son Plan national d'action environnemental (PAE). Les objectifs du programme environnemental (PE2) sont conformes à ce qui est envisagé dans l'annexe I de la décision II/10 de la 2ème Conférence des Parties, à savoir :

- la gestion intégrée et le développement durable des zones côtières ,
- l'exploitation durable et la conservation des ressources biologiques,
- la protection des milieux marins et côtiers, sans oublier l'appui aux institutions existantes.

Les approches se situent à 3 niveaux :

- approche nationale : élaboration d'une politique des zones côtières, d'un schéma directeur, mise en place d'un observatoire national,
- approche multilocale : élaboration et mise en oeuvre de schémas d'aménagement dans des sites déterminés (Nosy-Be, Tuléar....)
- approche au niveau de chaque niveau de chaque région du pays : zones côtières, d'un schéma directeur, mise en place d'un observatoire national,

□Ce PE2, prévu, pour la période 1996-2001, tient en compte :

- du Programme sectoriel Pêche, défini sur le plan national, financé par la F.A.O. Ce programme comporte plus d'une trentaine de thèmes prioritaires, axés vers le développement, l'augmentation de la production des ressources halieutiques et des revenus, ainsi que l'amélioration des conditions de vie des pêcheurs de manière durable et autonome.
- des programmes régionaux en environnement au niveau de la Commission de l'Océan Indien, volet Zone côtière sur financement F.E.D.

3- Les institutions et les organismes concernés par la conservation et l'utilisation durable de la diversité biologique côtière et marine sont :

- la Direction des ressources halieutiques, du Ministère de l'Agriculture et du Développement Rural, chargée de l'exécution du Programme sectoriel Pêche.
- les Centres nationaux de recherche (CNR) :

CNRO, situé dans le Nord-Ouest de Madagascar, chargé de la recherche océanographique en général sur tout le territoire. (les programmes du CNRO en matière de diversité biologique sont donnés en annexe).

CNRE (recherche en environnement), Département Ecosystèmes aquatiques et côtiers, qui effectue une étude intégrée des écosystèmes de mangroves dans le sud-ouest de Madagascar.

IHSM (Institut Halieutique des Sciences Marines) à Tuléar dans le Sud de Madagascar chargé de la formation en recherche océanographique.

- des sociétés privées de pêche.
- des associations de pêcheurs et de consommateurs.

4- Les domaines d'activités concernent :

- les bilans écologiques des ressources marines et côtières : crevettes, thons, langoustes et autres crustacées, holothuries, mammifères marins, algues et autres poissons de fonds).
- la prospection des zones de pêche
- l'utilisation des ressources de l'environnement côtier, notamment forestières,
- le développement de l'aquaculture, dont l'aménagement de zones d'arrière mangrove en sites agricoles de crevettes, /...
- l'algoculture et l'artémiculture

5- Les problèmes rencontrés concernent la conservation et l'utilisation durable de la biodiversité côtière et marine :

- surexploitation des ressources marines (sur pêche par des navires étrangers, par les industries et les populations locales)
- pêche en dehors des périodes et des zones autorisées,
- destruction des récifs coralliens en particulier le grand récif de Tuléar
- exploitation des bois de mangroves par les populations comme bois de chauffe,
- exploitation touristique par construction d'hôtels en bord de mer ; rejet de déchets et d'eaux usées dans la mer
- pollutions en général
- conséquences de la déforestation et de l'érosion des sols sur les bassins versants

6- Les mesures à envisager :

dans le cadre de l'exécution de la Convention sur la diversité biologique

- nécessité de recherches opérationnelles pour le respect des périodes de pêches (cycle biologique des ressources) et le respect des zones d'implantation;
- établissement de cartes relatives aux zones sensibles et menacées;
- programmes de recherche adaptées en vue de l'exploitation rationnelle des ressources;
- aménagement intégré des zones côtières et marines dans chaque région;
- zones à sauvegarder sous forme de réserves et de parcs marins et/ou en sites économiques; protection des plages;
- mise en place de mécanismes institutionnels, administratifs et législatifs ;
- intégration d'un plan d'aménagement des zones côtières et marines dans le plan national de développement
- compte tenu de la disparité des projets et des programmes en cours, une structure de coordination s'avère nécessaire, réunissant des responsables des divers Ministères de tutelle technique , des organismes et institutions concernés. L'Office National de l'Environnement a un rôle essentiel dans cette coordination.
- application des Conventions régionales et internationales :
    * mise en oeuvre de la Convention sur la diversité biologique (Centre d'échange et d'information) ;
    * pour le moment, Madagascar n'a pas adhéré à la Convention sur le Droit de Mer ni à la Convention sur les mers régionales (PNUE);
- participation à l'Initiative sur les récifs coralliens en danger ;

ANNEXE

Programme du C. N. R. O. (Centre National de Recherche Océanographique)

Département halieutique et Département Océanographie biologique

1- Etude biologique et socio-économique de la pêche artisanale et traditionnelle de Madagascar :

- typologie de la pêche artisanale et traditionnelle ;
- pêche crevettière
- ressource crevettière et aspect socio-économique de la pêche
- étude des holothuries présentant un intérêt commercial

2- Projet Thonier régional de la Commission de l'Océan Indien (phase II) en relation avec l'Association thonière , la Direction des Ressources Halieutiques, Ministère de l'Agriculture,

3- Suivi statistique et évaluation des stocks à Madagascar

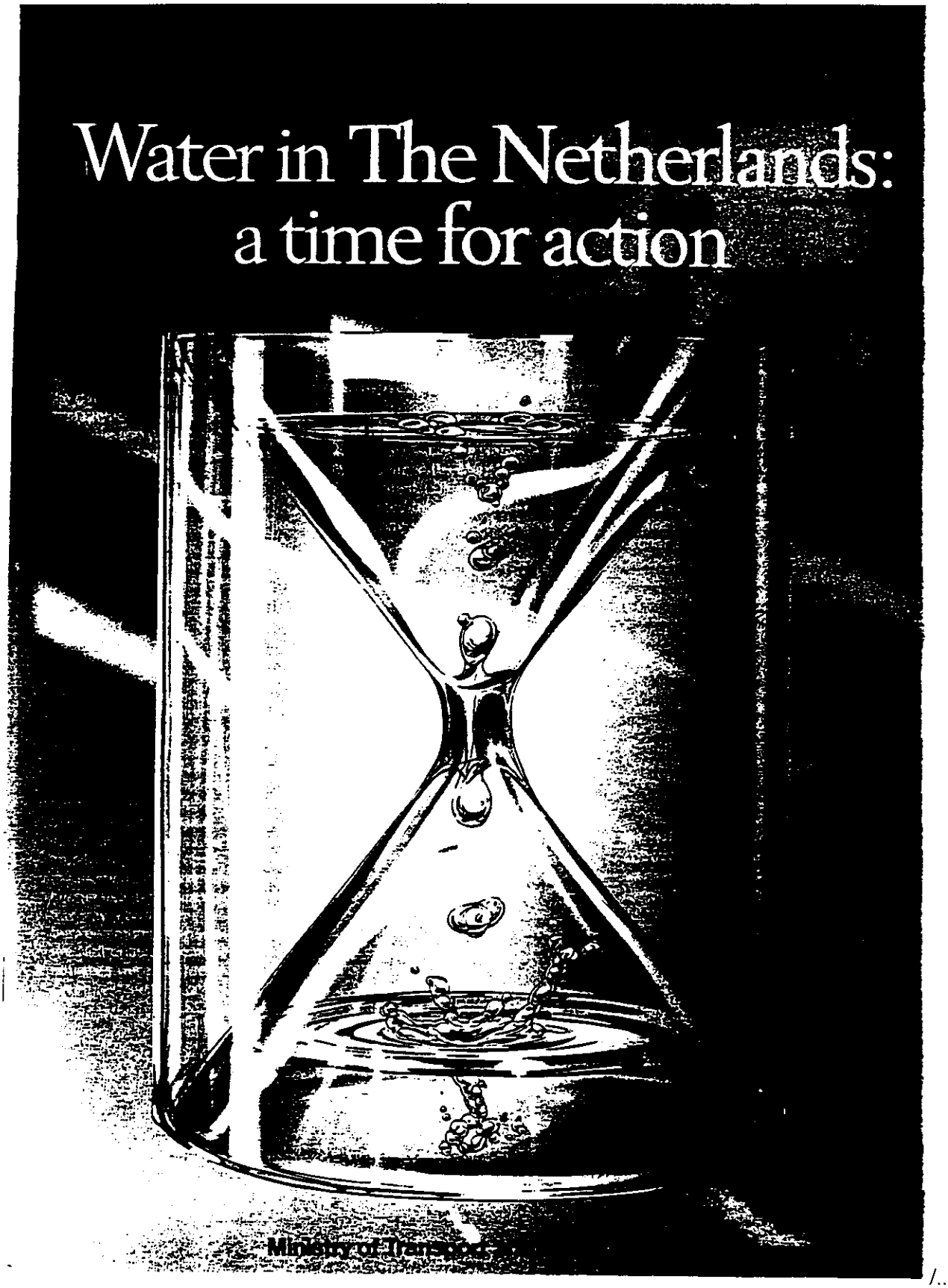
4- Etude des stocks des langoustes néritiques à Madagascar

5- Projet PERCE relatif aux requins de la côte Est

- production d'ailerons de requins
- surveillance des requins toxiques

6- Livre sur la biodiversité marine de Nosy Be

7- Mise en place d'un Musée océanographique régional pour les espèces marines de la région Sud Ouest de l'Océan Indien


Water in The Netherlands:
a time for action
Ministry of Transport

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INTERMEZZO

Amoeba, thermometer for aquatic ecosystems

Since the start of the century the sea and the big rivers have changed radically. There are clear signs that things are not going well with these waters: fish diseases, toxic algae, seal mortality and the disappearance of the sea otter and salmon.
As yet no complete picture of the situation is given by these signals. How do the North Sea, Wadden, Delta and big rivers look now? This is shown by the «Amoeba», A general Method Of Ecological and Biological Assessment.
There are many species of plants and animals in the sea and the big rivers. Sixty of these species, which form a reasonable cross-section of the whole system, have been selected. The numbers in which these species occur give a picture of the ecological condition and an indication of the health of these water systems. It has been ascertained what these figures were in the past, when the pollution was not so serious and use was less intensive.
These unaffected -or almost unaffected- systems are used as a reference. 1930 has been chosen as the control year for the sea and 1900 for the rivers. This is a pragmatic compromise between available knowledge on the one hand and a situation in which man had relatively little influence on the other. The reference systems are considered to offer guarantees for some fundamental values which man assigns to his environment, namely the durability of:
1. production and harvest
2. diversity of species
3. self-regulation

These values are closely related to the concept of «sustainable development» introduced by the Brundtland committee.

After counting and measuring, the current numbers are also known for the same species. By comparing the present with the earlier figures one can see how the «health» of the sea and the big rivers has developed. This is easy to visualize with the aid of the Amoeba figure. For each species the distance from the centre point to the circle represents the reference number, e.g. 9,000 seals or 16,000 hectares of sea grass. The current numbers are superimposed on this: 1,000 seals and 3,000 hectares of sea grass. The points are joined together by a line which has an amoeba like shape.
It can clearly be seen that:
- the algae floating around in the water have grown rampant
- shore and water plants, seawrack, kelp and sea grasses have decreased dramatically. While some bottom-dwelling animals such as shellfish and some fish seem to have profited from the changes
- sea mammals and some fish species have almost disappeared completely.

This overview clearly shows how unintentionally drastic human use of the water systems has been for the state of ecology in the last sixty years.
In summary, there is a shift from long-living to short-living species. Our water systems are incomplete and unbalanced in composition. With a continuation of current policy the disruption will proceed and there are no guarantees of sustainable development.

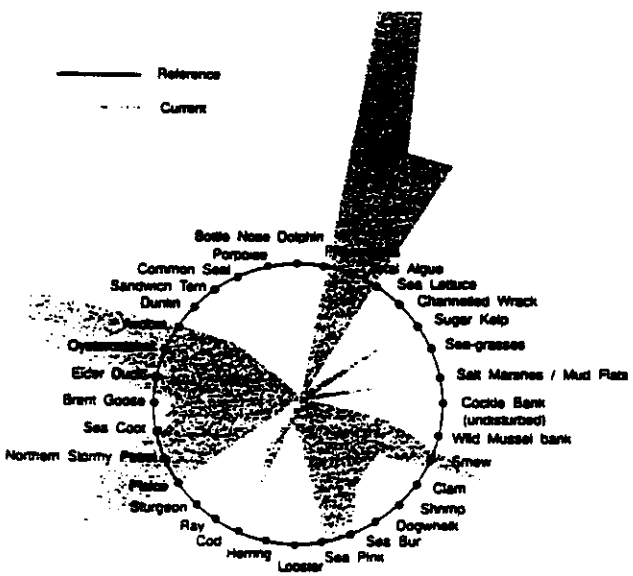

Figure 7 Sea amoeba, situation 1988

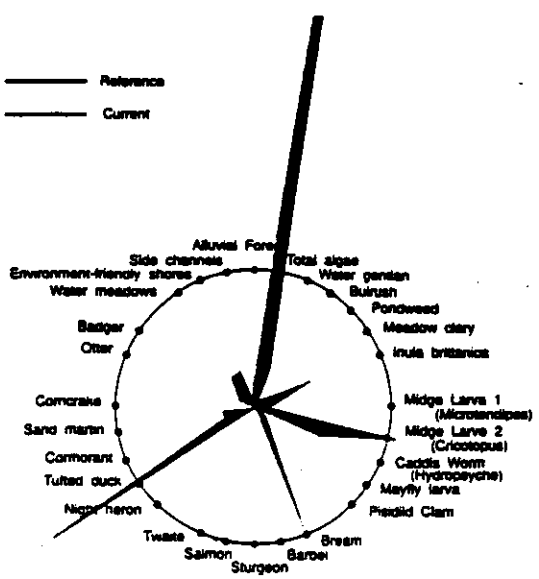

Figure 8 River amoeba, situation 1988

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Funding problems

In the field of water quality management, right from the start, the originators of pollution have paid the costs of dealing with it. In the past twenty years there has been a shift away from combatting pollution from oxygen-consuming substances towards taking the necessary steps to decrease pollution from phosphates, heavy metals and organic micro-pollutants.
This makes the call for the broadening and elaboration of the levy based on the Pollution of Surface Water Act increasingly stronger.
As far as groundwater management is concerned the problem is that there is too much or too little: groundwater nuisance in urban areas and dehydration symptoms in nature areas. As well as the problem of obscure administrative responsibilities in this area, the non-optimum use of existing funding options and a too narrow legal foundation of the funding instrument are named as bottlenecks.
Many of the bottlenecks in the funding of various water management tasks arise out of the fact that some tasks have an interface with the responsibilities which others have or which they could take upon themselves.
The management of shores or shipping routes are examples. Considering the high standards which the water system approach demands of the water authorities, the bottlenecks in the present funding structure will become even more obvious and the call for solutions will intensify further.

Total balance-sheet

Descriptions of the past and the present give a chequered image of the condition of water systems in the Netherlands and their use. Drawing up a balance-sheet gives the following picture.
Protection against flood will be achieved in the next ten to fifteen years with the execution of the last dyke reinforcement programmes. Concern about maintaining the invested capital now has priority. The consequences of the rise in sea level and the time at which this will take place are still uncertain.
The supply and drainage of water is almost optimalized for use by humans. Concern for maintaining the capital investment is also a priority here.
But the nature and extent of the problems are also coming to the fore: the total pollution, unbalanced hydraulic design and excessive use have led to a situation in which there is no longer any question of healthy, sustainably functioning water systems.
Not only surface water, groundwater and sediment have been polluted with innumerable substances for generations, but after sixty years of intensive use the biotic component of the waters is also the worse for wear.
Finally, every water authority at different administrative levels, State, provincial, municipal and district water board, will have to look further than just at his own policy area.

in the peaty areas of the lower Netherlands the groundwater maintains the surface level. There it forms a condition for the existence of various species of plants and animals. It is also an important production factor for agriculture.

Target objective per type of water system

The national target objective is composed of target objectives per type of water system. The essential points of the target objectives now follow, expressed as keywords. They indicate implicitly the focus of policy in this context.

Groundwater in the central and upper Netherlands and the dunes
- No dehydration
- No groundwater pollution
- Dunes as storage places for drinking-water
- Botanical quality of dune valleys unique in Western Europe

Springs, streams and meres
- Natural gradients, banks and drainage
- Oligotrophic and isolated meres

Rivers
- Transport arteries
- Salmon in the Rhine and the Meuse in the year 2000
- Green ribbons winding through the landscape

Groundwater in the lower Netherlands
- A responsible management of groundwater level
- Sustained use of the peaty soil

Pools and lakes
- Away with the green soup
- Sanctuary for fish, birds, otters and anglers

Excavated waters
- Migration as well as transit and passage
- Ditches as a richly spread table for stork and heron

Estuaries
- Ocean shipping without problems, creative use of spoil
- Seal and porpoise return to the delta area
- Important attraction for anglers, swimmers, surfers and sailors

Seas
- Healthy fish and seals in a healthy sea
- North Sea as a source of raw materials and energy
- A tourist attraction

3 Strategy

3.1 Policy analysis

During the planning period a step should be taken in the direction of the target objectives. In order to realize this goal a strategy has been outlined which aims at bridging the gulf between the present state of affairs and the target situations (figure 12).
In order to find a good strategy a policy analysis has been carried out, in which the effects and costs have been calculated for a great number of measures.
The main conclusion arising from this policy analysis is:

Not enough will be achieved by only applying emission measures. Emission reduction is important in the prevention of further ecological decay and the lifting of blockades on sustainable development. However, its combination with -relatively cheap- hydraulic design measures is then necessary to achieve a satisfactory recovery.

3.2 Multi-track approach as strategy

A strategy has been determined based on the results of the policy analysis. This strategy, apart from a continuation of existing policy lines, contains a number of new ones.
The following principles also played a part in the choice of strategy:
- risk prevention: the «precaution» principle
- keeping good that which is already good: the «stand-still» principle
- coordination with:
  - other policy documents, for example realization of the ecological main structure mentioned in the National Nature Policy Plan, detailing the concept of «the Netherlands a Waterland» (Fourth Report on Physical Planning in the Netherlands), the realization of the environmental quality objectives of the National Environmental Policy Plan;
  - current initiatives, for example agreements encompassed by integral policy planning, anti-eutrophication projects and the execution of the projects within the framework of the integrated area-directed policy and of policy in the area of physical planning and environment;
  - international developments, with particular reference to Rhine and North Sea developments and also necessary developments within the scope of consultation with Belgium concerning the Meuse and the Scheldt.
- best prospect: greater efforts in the more favourable areas in order to achieve a visible improvement within the planning period.

The results of the policy analysis and these principles lead to the following strategies for the planning period:

a continuation of current policy, as expressed in the second National Policy Document on Water Management and the Water Action Programme 1985-1989;

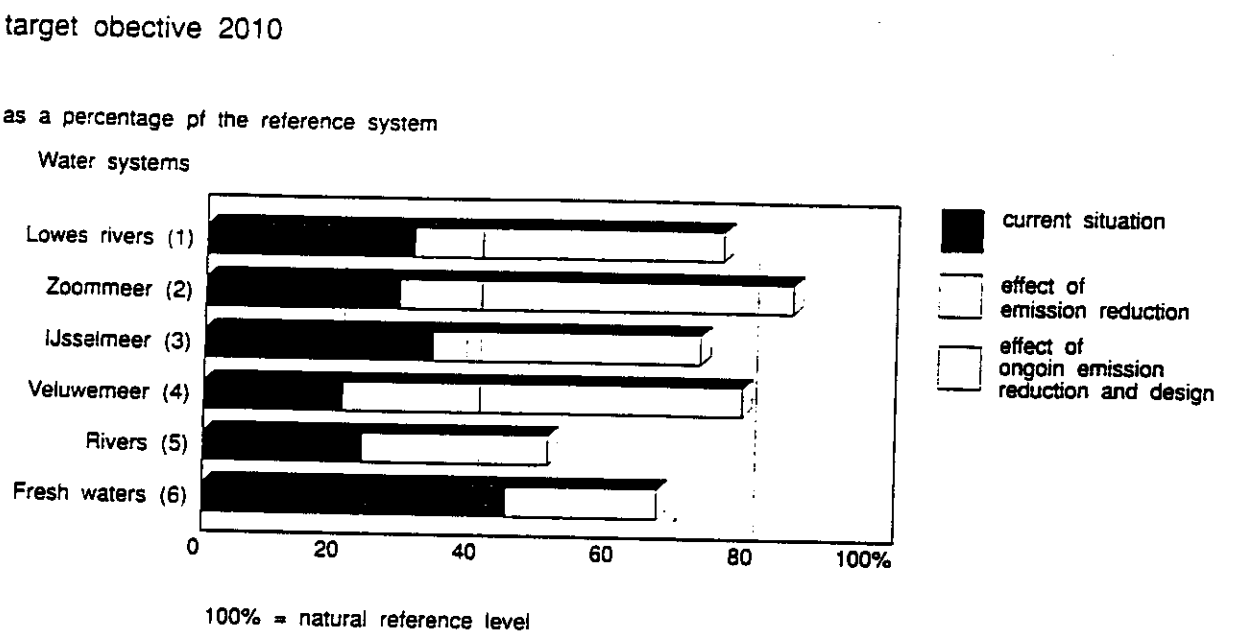


Figure 13 Relationship between measures and ecological recovery

In order to achieve the goals which are formulated on behalf of the development of water systems, a multi-track approach is very effective in most cases.
The figure illustrates the degree of ecological recovery for a number of water systems -expressed as a percentage of the reference level- which will be achieved through measures directed at a drastic reduction of pollution (ca. 90 percent). Also shown in the figure is the result which can be achieved through a combination of differentiated emission reduction (nitrogen 70 percent, phosphate 75 percent, organic micro-pollutants 90 percent, remaining substances 50 percent) and hydraulic design measures.
It appears that much better results can be achieved with the latter approach.

4 Floodplains (Lower Rhine), a characteristic river ecosystem.

supplementary policy. The policy analysis shows that the target objectives will be achieved eventually by the current policy as well as - depending on the water system - the application during the planning period of a combination of the following measures:
- *accelerated reduction of pollution;*
- *guided use;*
- *hydraulic design;*
- *improvement of administrative-organizational and instrumental limiting conditions.*

The multi-track approach, which will be followed in this way, gives a higher return than the sum of the parts and as such forms the nucleus of integral water management (figure 13).

Accelerated reduction of pollution
- prevention
- about 50 percent emission reduction of pollutants in 1995 relative to 1985 and an ongoing reduction after 1995
- more than 50 percent reduction of organic micro-pollutants
- adaptation of standards

Hydraulic design
- design shores and banks for multiple purposes
- conservation, restoration and development of the ecological main structure
- restoration of specific types of environment

Guided use
- dehydration reduction
- sustained use

Organization and instrumentarium
- integration of water management tasks
- harmonization and integration of legal instrumentarium
- adaptation of financial instrumentarium

International
- agreements with Rhine riparian states, North Sea states
- reduction of calamity risk on the North Sea and the cross-border rivers
- continue international research into rise of sea level

3.3 Basis

A broad social basis is necessary for the realization of the advocated policy.
The behaviour of the water consumer partly determines the future quality of the water systems. This demands from the consumer an economical use of tap water and groundwater, purchase of products which are environment-friendly and responsible disposal of harmful waste products, in households as well as in businesses. A change in water consumer behaviour can be stimulated by information and education.
Social organizations can obtain financial support for projects aimed at this kind of change in behaviour.

INTERMEZZO

Ecological recovery of the sea: a total approach

The effect of different policy alternatives has been calculated in the policy analysis. The effect is made visible per alternative in relation to the situation in the year 1988.
This is shown by means of the «Amoeba» for the sea (figure 7).
So-called effect-amoebae are illustrated for three relevant alternative policies. Improvements are shown in blue (towards the circle) while deteriorations are in red (away from the circle).
The conclusions are:
1. The current policy (alternative 2) does not produce any improvement, it stops decline;
2. the exclusive reduction of substances, even to 90 percent (alternative 4) has a relatively limited effect. Nevertheless an ongoing reduction is a necessary condition for recovery;
3. reduction of substances to 50 percent and of some substances to 90 or 99 percent (PCBs, TBT, PAHs and oil) in combination with hydraulic design measures is, at this moment, the best policy alternative (2a+).
It should finally be noted that restoration of the sea-ecosystem is possible, but sometimes occurs very slowly (several decades). This is particularly the case with sea mammals, which mostly only have one young per year.
A multi-track approach yields more than the sum of the parts:
with a single track policy, if the chemical blockade on recovery is removed then deficiencies arise in the physical condition of the environment. Lack of resting-places or overfishing are examples of obstacles to recovery. The opposite is also true. One blockade is replaced by another.

Figure 14 Policy alternative 2

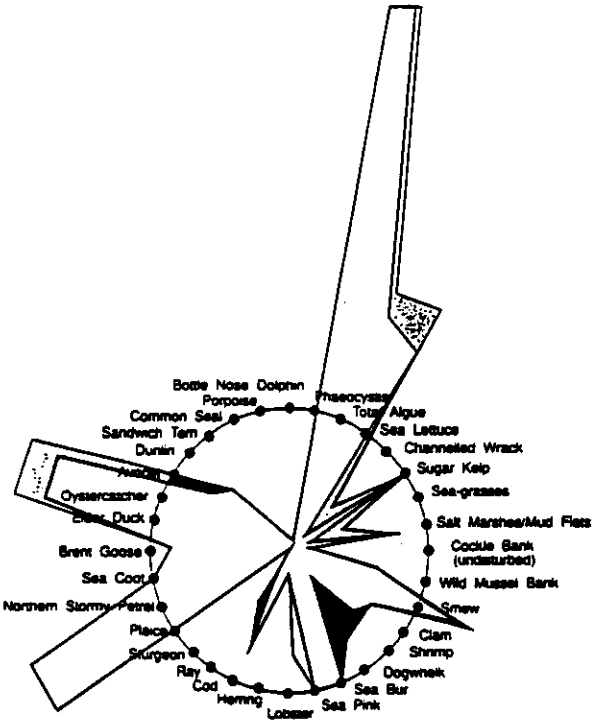


Figure 15 Policy alternative 4

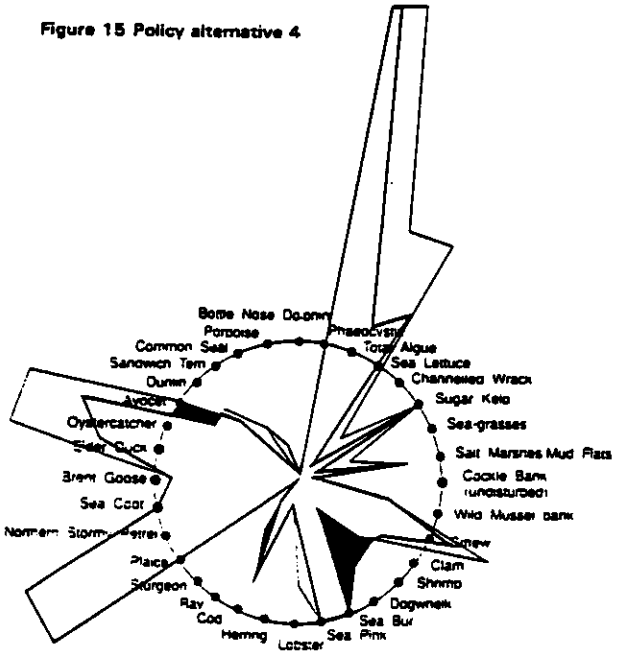
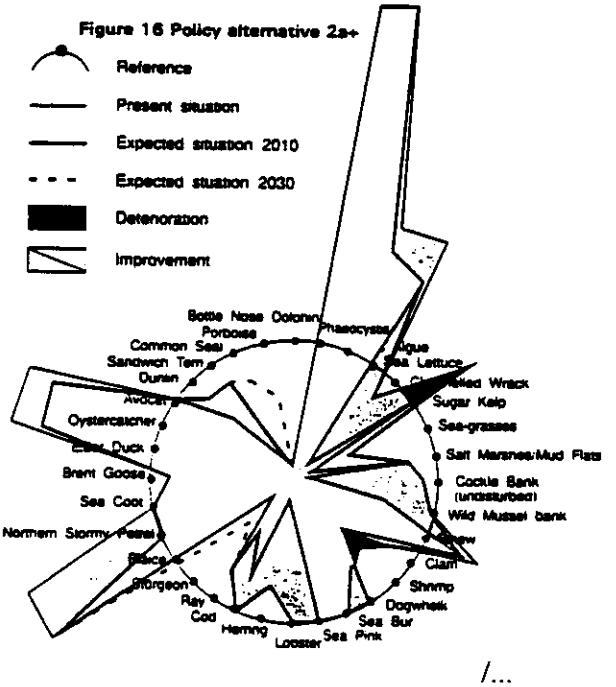


Figure 16 Policy alternative 2a+



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A Quantitative Method for Description & Assessment of Ecosystems: the AMOEBA-approach

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The absence of quantitative and verifiable ecological objectives for Dutch waters impedes the management of those waters. Which activities are admissible and which are not? This article describes the AMOEBA-approach, a conceptual model for the development of quantitative and verifiable ecological objectives. "AMOEBA" is the Dutch acronym for "a general method of ecosystem description and assessment". This model is based on the concept of sustainable development.

I INTRODUCTION

The absence of verifiable ecological objectives

The main objective underlying the Dutch management of the North Sea and inland waters can be loosely defined as:

The maintenance and the attainment of a water quality level to preserve the ecological values in relation to desired uses of the watersystem.

These objectives are however difficult to quantify and to verify, and pose a problem when a water authority wishes to assess a proposal for a new marina, an application for an effluent discharge permit or a sand extraction licence. What is acceptable and what is not? Where should the line be drawn? The reader can imagine the problems with which water authorities are confronted. The major question which arose during the preparation of the third National Policy Document on Water Management (further: Water Management Plan) was: how can abstract ecological objectives be made quantitative and verifiable? The need to answer this question gave rise to the development of AMOEBA-approach.

II. THE AMOEBA-APPROACH

Fundamental ecological values

Before attempting to explore the issue, we need to define the key concept of the objective described above: "ecological values". We have defined this term as "the desired state of the biotic component of the water system. "This desired state is to be determined by government". The object of study is therefore the biological component of the watersystem. The physical and chemical components are considered here as means by which to reach the ecological objectives. The landscape aspect is not taken into consideration (fig.1).

Returning to the main issue, the question arises as to which are the "ecological or natural values" to be preserved as stated in the main objective for the Dutch coastal waters? Are they seals, algae, bacteria or herring gulls? At which numbers should they be preserved? Neither the species nor the desired numbers are stated explicitly. Yet choosing species A can lead to a totally different policy from choosing species B or C (fig. 2).

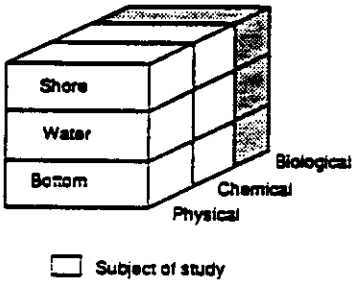

Figure 1: The object of the study is the biological component of the watersystem

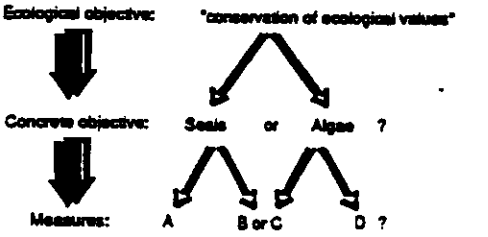

Figure 2: What must be preserved: algae or seals? This makes a big difference.

In order to establish precisely what we mean by these ecological values, we must examine what the most fundamental values are that man attributes to plant- and animal life. Nature herself does not provide an answer to this question. She accepts and reacts to whatever happens, she operates mechanistically. Only man can judge what is good or bad.

We believe that there are three categories of valuable characteristics, whose sustainability are desirable:

1. Production and yield
   These are valuable for functional reasons. This category is a prerequisite for man's existence, e.g. fisheries.

These values are closely associated with species-abundance, the production of oxygen and the self-purifying capacity.

2. Species diversity
   This is valuable for ethical and aesthetic considerations. It involves concepts such as the preservation of species, rarity and completeness.
3. Self-regulation
   Self-regulation has ethical, aesthetic/recreational and economic considerations, which are closely related to concepts such as naturalness, stability, intactness, authenticity and visual integrity. Moreover, self-regulating ecosystems have low management costs.

A guaranteed sustainable ecosystem: the reference system

It now becomes important to determine which ecosystems and kinds of uses and measures provide guarantees for sustainable production, diversity and self-regulation. It has become clear that unrestricted discharges of contaminants threaten sustainable production and diversity. Opinions vary as to the extent to which the present-day use of coastal waters safeguards sustainability. Our knowledge of how water systems work and of their countless complex physical, chemical and biological interactions is insufficient to make any fullproof comments on this issue. Indeed, it is doubtful whether man will ever understand this nexus of interactions sufficiently to be certain that a particular use guarantees sustainability.

A system which has not, or has only slightly been influenced by human activities may provide clues to define parameters and processes essential for sustainability. Such a system has the conditions for the evolution and survival of organisms, including man, living in and around it for millennia. By definition, such a system guarantees sustainable production, diversity and self-regulation. The very existence of man and the species of plants and animals which we know today are proof of this.

But where does this lead us? To what extent can natural systems be used as the basis for policy if such systems hardly exist any longer? Man has, after all, left an indelible imprint on his environment. Some degree of deviation from the natural system is inevitable, given the trends in human population size and the impact of modern technology.

The assumption is made that the ecosystem which is not, or hardly not manipulated, offers the best guarantee for preservation of these fundamental values: the REFERENCE system. The closer one comes to the point of reference, the larger the guarantee for ecological sustainability, and vice versa. Society chooses her objectives somewhere between zero and the point of reference. This is, in essence, a weighing up between the direct costs of measures and the loss of guarantees for sustainability on the long term (fig. 3). The search for a concrete ecological objective can therefore be reduced to the question: "what is the maximum acceptable distance to the point of reference?"

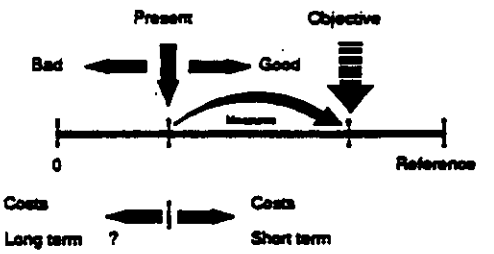

Figure 3: Society chooses the ecological objective, somewhere along the axis between zero and the reference point

The introduction of a reference system provides a standard by means of which an assessment can be made of the ecological condition of a system. The ecological objective, however, needs not necessarily to coincide with the reference system. Once a government decides on the maximum acceptable distance from the reference point, a verifiable ecological objective is established.

Species as target variables

How can a quantitative comparison between the reference system and the present-day ecosystem be made? A comparison of the entire system appears impractical. Firstly because the reference system is known only in part, and secondly because the number of organisms and processes in the system is countless.
This explains why we have confined ourselves to a number of plant and animal species. This limitation is to some extent justified by the fact that the species are expressions of numerous underlying processes. The plant and animal species which we have selected are target variables. They can be expressed in terms of:

- numbers
- distribution
- health

Together the target variables constitute the ecological objective.
The conceptual model described here has been named the AMOEBA-approach.

The choice of target variables

The following considerations contributed to the choice of target variables:

1. Quantitative data on the species must be available.
2. The species must be susceptible to human influence. It is pointless to select ecological objectives without knowing how to achieve them. Each target variable must be linked to at least one steering variable.
3. The species must be accessible to easy and accurate measurement.
4. It should have some indicative value for the condition of the system.
5. The species should, ideally, have some political and social appeal.

The importance of this consideration must not be underestimated. We believe it to be more effective and more appropriate to select species which society and the authorities know and understand, rather than developing a scientific model such as the Shannon-Wiener index, which nobody can understand. It should be said, though, that using the one variable does not necessarily exclude the other. Nevertheless, target variables are in essence policy instruments rather than scientific instruments.

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6. The target variables as a whole have to be a cross-section of the entire ecosystem if they are to provide a reasonably representative picture of the ecological condition:
- species from all types of water-subsystems
- species from the benthos, water column, water surface and shores
- species from high and low parts of the food web
- plants and animals
- present-day and former species
- sessile, migratory and non-migratory species

The target variables do not necessarily need to belong to one food chain.

For several reasons processes have not yet been selected as target variables. This does not mean they can be dismissed as unimportant, but merely species are more suitable as target variables. Processes are of greater importance in identifying steering variables, i.e. measures (fig. 4).

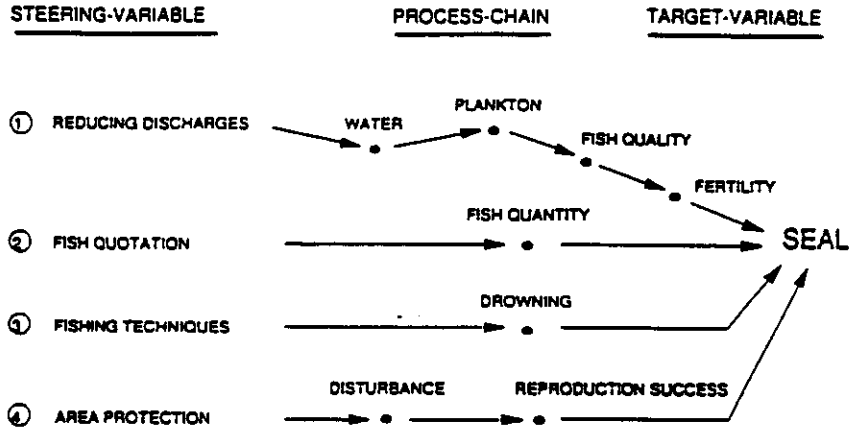

Figure 4: The relationship between one target variable and four steering variables. The process chains indicate the main physical, chemical and biological relationships.

Describing the reference system

Selecting the reference system is a crucial step in the formulation of ecological objectives. To obtain a reliable picture of the uninfluenced system, it makes sense to go back as far in time as possible. However, insufficient knowledge of the system at a particular time makes this impossible. For the North Sea and its neighbouring waters, for example, the condition as it was around the year 1930 has been selected. This is a pragmatic compromise between, on the one hand, the available knowledge and, on the other hand, a relatively low level of human interference. However, in several cases a correction was necessary for human influences.

Three sources are used to determine the reference system:
- old inventories
- comparative research involving other systems
- ecological theory.

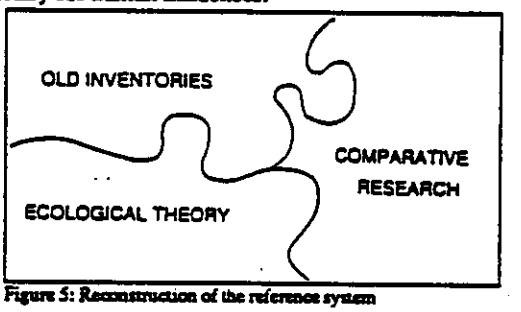

Figure 5: Reconstruction of the reference system

Where the first two sources are insufficient, ecological theory can be used to reconstruct the reference system (Baerselman & Vera, 1989). In other words, the reference system can to some extent be artificial. The reference system is reconstructed step by step using individual components in much the same way as archaeologists reconstruct the past.

A number of complications are liable to beset the formulation of reference systems: some ecosystems are subject to rapid succession (e.g. marshes) or extreme fluctuations (e.g. algal populations). The task of determining an unambiguous reference for systems with high rates of succession is not an easy one. Marshes, for example, may represent a stage in a process of desiccation, which requires several decades in which to become complete. In this example the reference selected is not static, but develops through time. This solution is also applied in other disciplines. Medicine, for example, uses reference values which vary according to a person's age.

Species which show wide fluctuations in natural conditions, such as algae, seals or migrant brent geese need to be given special attention. This can be done in three ways:
1. by taking the average over a number of years, thereby decreasing annual fluctuations (e.g. brent geese).
2. by using a range as a reference value (e.g. 4,000 to 8,000 seals).
3. by taking the numbers present at a specific time of the year (e.g. algae during the spring peak).

In most cases we applied all three methods.

III RESULTS

The AMOEBA-approach in practice

In the Water Management Plan the AMOEBA-approach is applied to the North Sea and major rivers (Rhine & Meuse). Reference numbers and actual numbers are given for 60 selected target variables, mostly species. Since water authorities and policy makers require a clear and simple presentation, a "radar diagram" has been used. This technique is also used to present company data in schematic form. The target variables are arranged in systematic order in the form of a circle. The distance from the edge of the circle to the centre represents the numbers in the reference situation for each species, for example, 2000-3000 breeding pairs of cormorants or 16,000 hectares of sea

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grass (=100%). The actual numbers are superimposed on this circle, for example 500 breeding pairs of cormorants and 3000 hectares of sea grass. For visualization purposes, all points are connected by a line, which produces the two amoeba-like figures. These figures, the "amoeba's" for the sea and the major rivers, present a relatively simple picture of the actual situation of these ecosystems (fig. 6).

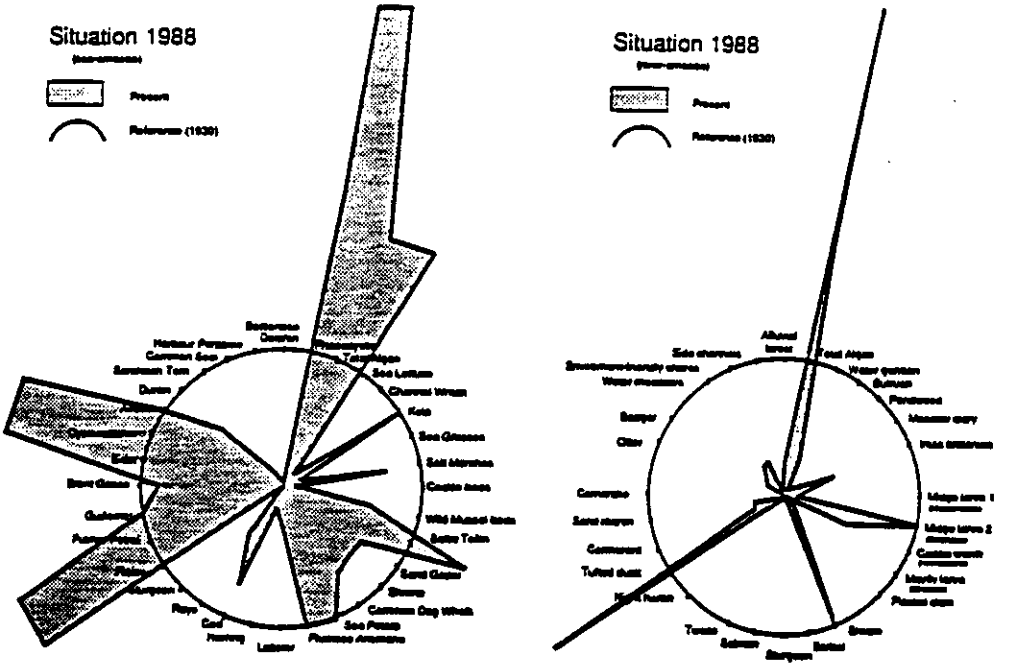
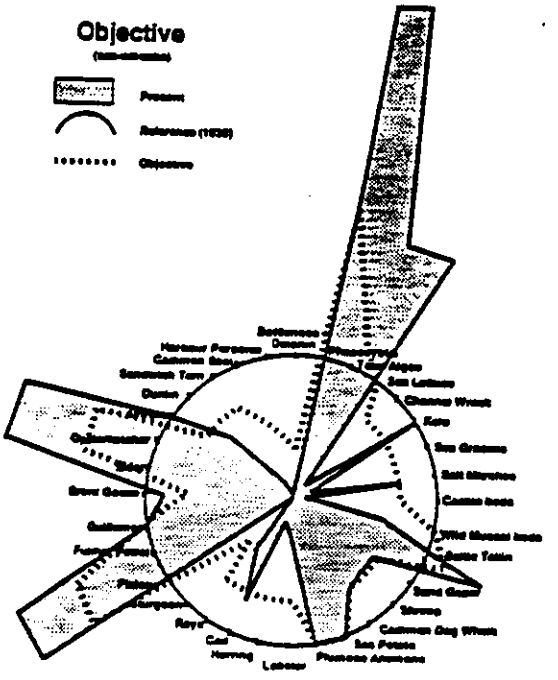


Figure 6: The selected target variables, showing the present ecological situation in the sea (A) and the major rivers (B).

They show how human use of the water systems has, unintentionally, changed the ecological situation over the past 60-90 years.



Towards an ecological objective.

The next question to be addressed is, which ecosystem does offer acceptable guarantees for sustainable development? In short, what is the ecological objective, expressed in terms of the maximum acceptable distance from the reference?

In the Netherlands, "a sustainable development will be considered to have been achieved when the numbers of the organisms in the sea and river "amoeba's" -the target variables- approach those of the reference situation. It is not necessary to return to the reference situation completely. For marine and brackish waters, the aim is to reach 75%-200% of the reference levels. For freshwater areas, the corresponding percentages are 50% and 200%". Fig. 7 shows this ecological objective in greater detail for the sea.

Impact-amoeba's

To achieve this objective, a strategy has been drawn up. Conceptual and mathematical models were developed to assess changes of all species in the "amoeba" as a result of changing steering variables like water quality, fishcatches, restoration of biotopes etc. The impact of 6 policy alternatives (packages of measures)

Figure 7: The ecological objective for the North Sea, the target-amoeba.

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were calculated (Ministry of Transport and Public Works, 1990). The impact of each alternative was illustrated by "impact-amoeba's". Two notable "impact-amoeba's" for the sea are shown in fig. 8.

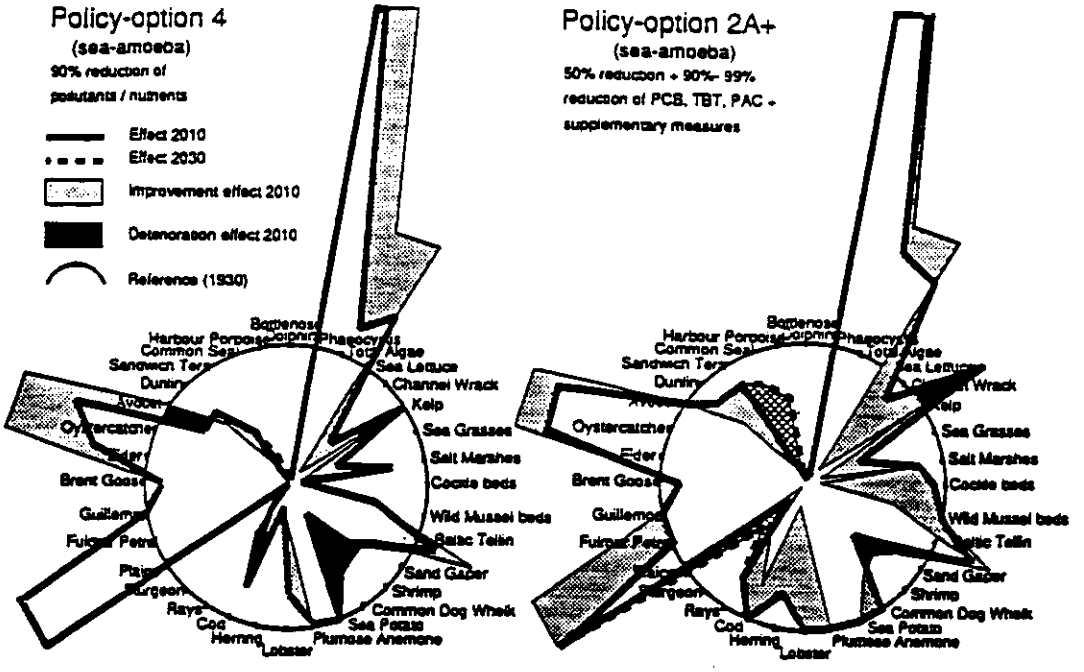

Figure 8: Expected ecological impacts of two policy alternatives: the "impact-amoeba's". Supplementary measures are a large range of physical and biological measures, such as a decrease in the intensity of fishing, prevention of human activities which disturb mammal and bird life, restoration of biotopes, restoration of the natural transition between fresh and salt water, reduction in turbidity, reintroduction of species.

"Ecological Dow Jones Index"

Due to the large number of policy alternatives, the need arose for a simple method by which the impact-amoeba's could be compared. This was achieved by adding together all of the distances (32) to the circle. We called the figure obtained the "ecological Dow Jones index". The smaller the total distance from the reference situation, the better the policy alternative. No distinction has been made between the values for the various species. If these figures are arranged on a scale from 3200 (32 x 100% distance) to 0 (32 x 0% distance), we obtain a result shown in Fig. 9.

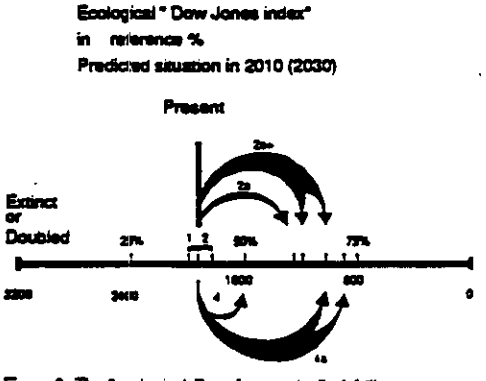

Figure 9: The "ecological Dow Jones index" of 6 "impact-amoeba's".

A new policy strategy

Based on the AMOEBA-approach the Water Management Plan (1989) concludes:

1. The Dutch watersystems are incomplete and unbalanced in composition. With continuation of the present use the ecological decline will proceed and there are no guarantees for sustainable development (alt.1).
2. The present-day policy of a 50% reduction of the discharges of contaminants -Rhine and North Sea Action Programmes- do not produce any improvement, they merely stop further decline (alternative 2).
3. The exclusive reduction of contaminants, even by 90% (alternative 4), has a relatively limited effect. Nevertheless an ongoing reduction is a necessary condition for recovery
4. Reduction of contaminants of 50% and of PCB's, PAH's, TBT and oil of 90-99%, in combination with supplementary measures is, at this moment, the best policy alternative (alternative 2a+).

These conclusions lead to a new policy and management strategy for the North Sea: the multi-track approach.

No overnight solutions

Selecting target variables, specifying the reference numbers and choosing ecological objectives are not "one-off" activities. It may take some time before general scientific agreement is reached on the reference situation. The determination of the ecological objectives will proceed, in the first few years in particular, on a trial and error basis. This is not to say at random, but testing each possibility systematically on the basis of the following criteria:

- Which objectives are both practically and economically feasible?
- Which offer reasonable guarantees for sustainable use and sustainable ecosystems?

- Which measures give high returns at low costs?
- What kind of time-scales are involved?

This is a learning process, in which provisional ecological objectives become more definite as time passes. Adjustments to ecological policy are introduced as a result of new knowledge, changed social requirements or unforeseen developments in the system itself. These are the factors behind the continuous "dialogue with the water system". A similar trial and error approach is employed in the making of economic policy. The OECD publish their economic predictions on the basis of the latest figures and perceptions. These predictions are adjusted annually, and form the basis of financial and social-economic policy. We advocate an ecological policy that is based on a similar systematic approach (ten Brink, 1989).

IV EVALUATION

Referring to the question mentioned in the introduction we now wish to evaluate the AMOEBA-approach.

1. With the AMOEBA-approach it is possible to represent quantitative objectives of nature conservation, fisheries, recreation and the functioning of the systems themselves - and to assess the extent to which the objectives have been achieved. In this way these interests are made tangible as in traditional "hard" sectors such as industry, agriculture, shipping and mining, thus making more integrated and balanced decision-making possible.
2. The AMOEBA-approach is simple and easily visualized. We expect it to make the problems of ecological decline more accessible for water authorities and the public alike. Therefore it can function as a vehicle of communication between policymakers and scientists. A better understanding of the ecological objectives, the problem areas and the measures which have to be taken will increase the collective will to act.
3. The AMOEBA-approach may add substantially to the concept of sustainable development (Brundtland, 1988) and wise use (Ramsar Convention, 1971). The model highlights changes which happen so gradually over a period of up to 60 years as to be almost imperceptible. It also highlights the overall effects of numerous interventions occurring simultaneously. In this way it provides us with an overall picture of the strain which man is placing on the biota. The "gaps" in the "amoeba's" are a measure of the extent to which man is depleting his natural environment.
4. The discussion of man's impact on the environment acquires more tangible form and concentrates on the risk that ecosystems may deviate even further from the ecological objectives. The AMOEBA-approach can be a helpful instrument to environmental impact assessments.
5. Once they have been selected, the target variables give direction to monitoring programmes and to research into dose-effect relationships, aut-ecology and reference systems. The research on bio-indicators can concentrate on the indicative value of the species selected. In this way the amoeba can act as a thermometer for the entire water system.
6. Common criteria such as rarity, diversity, authenticity, intactness and stability are difficult to define and quantify in practice. Using the AMOEBA-approach, they are related to the reference system and are therefore easier to define and quantify.
7. The AMOEBA-approach appears to be of reasonable universal application. In principle, it can be used on all scales and for every system.
8. Different choices of target variables are possible within the limits imposed by the above mentioned six criteria. Undoubtedly this leads to a different "amoeba". The ultimate aim, however is not a particular amoeba-shape, but merely the changes which occur during time and the measures to be taken. We do not expect these differences will lead to measures which differ in principle. Moreover, choices have to be made for formulating objectives, as have been done in e.g. the world of economy and the medical world.
9. The AMOEBA-approach can easily lead to oversimplification of the real situation. One solution to this is to add more target variables. We used for example 40 extra target variables for the North Sea assessment. Furthermore, it is advisable to supplement biological target variables with chemical and physical ones.
   However, many countries will not posses the financial and technical means to research and monitor so many species. Does this mean that the AMOEBA-approach will only be an instrument for rich countries? No! The amoeba can be supplemented during time with new species. One might start with species which are most critical and easy to monitor. Some information is better than none at all.
   In this way a framework of managing aquatic ecosystems can be constructed gradually.

It is of the highest importance that the natural resources of the planet are preserved. This is particularly true for developing countries with a rapid growing economy and population. The AMOEBA-approach can serve as a valuable instrument for policymakers to manage natural resources for these countries.

Acknowledgements
We thank the following persons who helped work out the AMOEBA-approach: J.F. Bakker, H.J.M. Baptist, D. Boddeke, A.L.M. van Broekhoven, J. Cossen, K. Essink, J.A.M. van Hamelrijk, J.W. van 't Hullenaar, D.J. de Jong, V.N. de Jonge, R.J. Leewis, E. Marteijn, J. Marquenie, G. van Urk, A. bij de Vaate. Moreover we thank the experts of the Dutch institutes RIVO, NIOZ, RIN, DIHO, WL and universities who gave information and advice.

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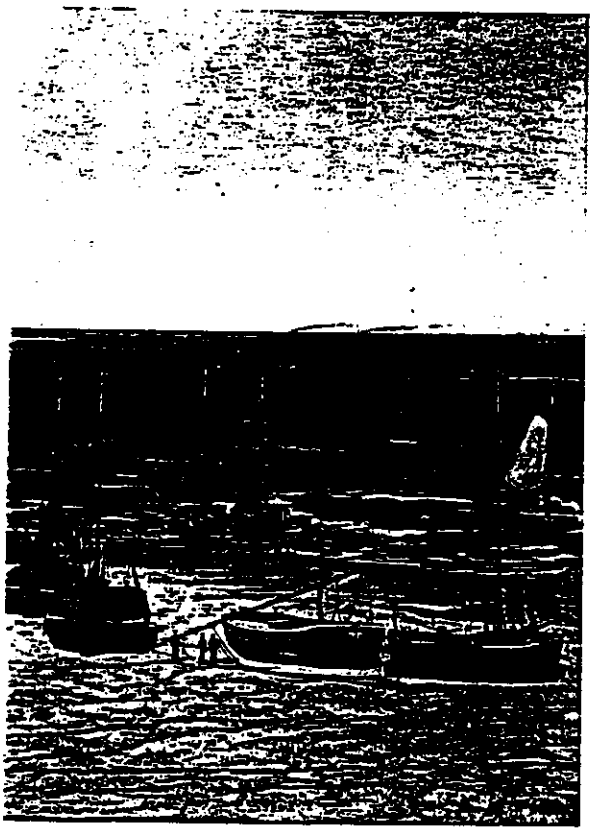
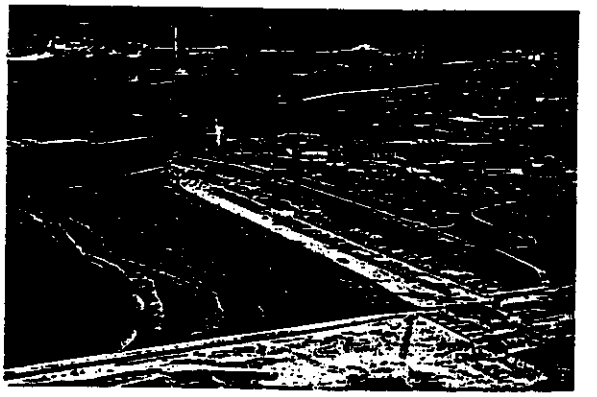
No policy without figures

Since times immemorial, the Dutch have been linked to the sea. Both in the past and today, the prosperity of the Netherlands has depended to a large extent on transport, shipping, fishing and tourism. At the same time, the sea has always been regarded as an enemy, lying in wait to flood the country. It did so again in 1953, when 1835 people drowned in the south west of the Netherlands. This dualism can also be observed in our attitude to the sea; we treated it both as a resource and as a garbage bin. Due to awakening public awareness since the mid-eighties, interest in the sea has revived. Not that the reason is anything to cheer about - apparently, the ecology of marine life was far more seriously disrupted than everyone had imagined.

Parts of the North Sea and most of its estuaries are polluted. Fish have become sick, seals are infertile. Mussels suddenly prove to be a dangerous delicacy when their flesh is contaminated by toxic algae. This algal poisoning, officially referred to as Dinophysis acuminata, is more frequently encountered today. Even in the sixties, eider ducks and terns were dying in massive numbers in the Wadden Sea-poisoned by pesticides. Also, the disappearance or strong reduction in numbers of sea grass, the oyster, the sturgeon, the



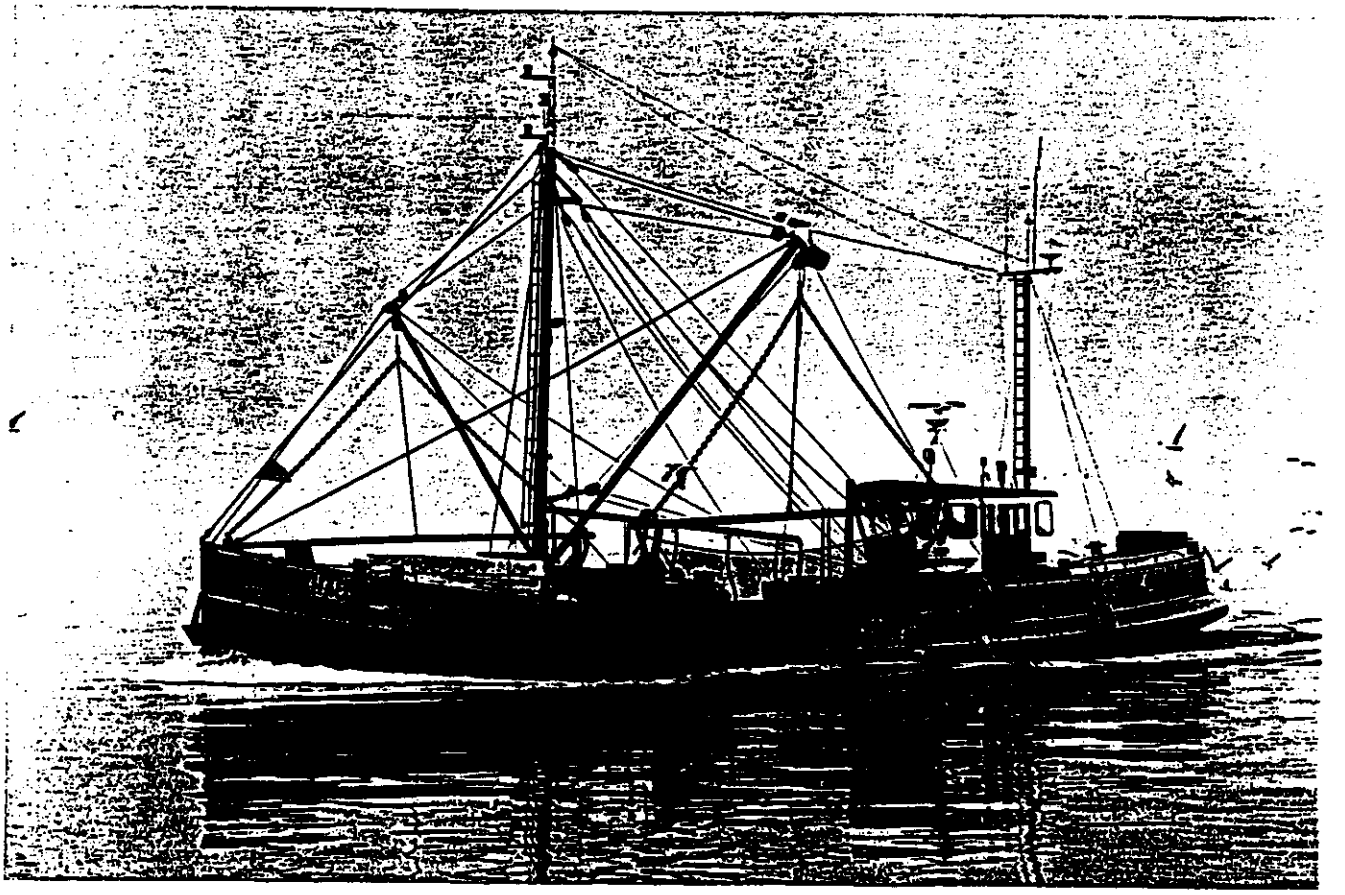


salmon, the harbour porpoise and the bottle-nosed dolphin each represent an alarming signal in their own right.

Every day, rivers disgorge their chemical waste and excess nutrients into the sea. On the sea, beyond the horizon, we find the ships, drilling rigs and oil platforms. A lot of waste is thrown overboard, whether it be domestic garbage, oily drilling grit from the artificial islands or cargo remains from tankers. Fishing boats ply the sea from north to south and from east to west, looking for a lucrative catch. The tickler chains of their trawling nets plough up the North Sea bed. In some places, even seven times a year. Land reclamation and a rise in sea level threaten intertidal mud flats, salt marshes and sand banks. The Treaty of Ramsar has a collective name for this wild country: wetland. Nowadays, some wetland is cut off from the salt water by dykes, which also stop the refreshing effect of the tides. Inlets, such as those of Veere and Den Briel, became brackish lakes. The Lauwers Sea and Wieringen were dammed up and turned into polders. This reclaimed land is now used for purposes such as grazing, recreation or military exercises. A great pity for the North Sea, because these shallow coastal areas are her breeding grounds. You could think of them as the 'golden edge'.

Clearly, something must be done. But repeatedly, policy makers come across questions such as: 'how severely disrupted is the ecology of the North Sea and of the estuaries', 'how did the sea really look' and 'what corrective measures would be most effective'?. These are questions to which society wants an answer, before public funding pumps hundreds of millions of guilders into a large scale cleaning operation of the sea. As yet, none of these questions have been answered by the natural science experts.

Although it is difficult to express the sea in terms of figures and formulas, practical necessity demands it. Policy aims such as: "the maintenance, development and, if necessary, restoration of natural assets..", are much too vague. "No policy without figures", as the former Water Management Minister, Mrs. Smit-Kroes, once said. And without policy, there can be no large scale cleaning operation. The story of the 'amoeba' expresses the attempts made to clarify, discuss and assess the status of natural values in the North Sea and the adjacent estuaries. One of the cornerstones of this method is the use of historical data.



7. **Biodiversidad marina y costera**

- A nivel de la Comisión Permanente del Pacífico Sur (CPPS) se han incorporado a los planes de trabajo, conceptos relativos al manejo integrado de zonas costeras y marinas. También se están evaluando posibles areas de acción en materia de actividades de acuicultura, areas protegidas marinas, entre otros temas.

- Asimismo, la CPPS se encuentra considerando posibles mecanismos de coordinación interinstitucional con los órganos pertinentes del Convenio sobre la Diversidad [illegible] (SBSTTA, la Secretaría Ejecutiva y los Grupos de Trabajo Ad-hoc).

SOUTH AFRICA

Unfortunately South Africa is not yet in a position to make a meaningful contribution with regard to the above mentioned requests.

South Africa is currently in the process of developing a strategy for the implementation of the Convention on Biological Diversity (CBD). As soon as this process is under way and the appropriate and responsible organisations have been identified, we would submit the information you requested (Target date, 31 August 1996).

UNITED KINGDOM

The UK's Biodiversity Steering Group, comprising representatives of all major sectors, including industry, NGOs and research institutions, has recently considered coastal and marine biodiversity. Their report published in September 1995 gave advice to the UK Government and the attached extracts may be useful information for your study. The UK Government will respond to the report's conclusions shortly.

You will see from the attached extract (at Annex A) from the report that the UK has the most diverse coastline in Europe, containing rich assemblages of plant and animal species and many habitats of international importance. The report identified three main threats to this biodiversity, pressures from built development, recreation and tourism, rising sea levels and pollution and contamination.

The report concludes that it is in the oceans where some of the issues of sustainable use of biodiversity come into sharpest focus. The North Sea Quality Status Report shows that the UK sector was generally healthy with levels of contaminants falling. This work is being updated and extended to all the seas around the UK in fulfilment of an obligation Under the new OSPAR Convention. There are, however, three key issues which the Steering Group identified as needing to be addressed if we are to ensure the continued protection and improvement of marine biodiversity. These are maintaining and improving current controls on man-made inputs to the sea, the continuing pressure on many fish stocks and the extent to which certain fishing practices lead to casualties among non-target species and affect habitats.

The report's analysis of habitat action plans and statements (at Annex B) brought out

general issues and actions applying to coastal and marine habitats. These included the identification of the need for protection and management of important UK habitats and the need for all statutory bodies responsible for planning, development, land management or conservation to take account of Government policies on sustainable development and conserving biodiversity.

Concern about pollution has been heightened recently because of the Sea Empress disaster off the coast of Wales, and the Government will need to take account of this in its response to the report's conclusions.

A significant step forward in the UK has been the identification of possible marine/coastal Special Areas of Conservation which may be designated under the EU Habitats Directive. These areas are often in places which historically have sustained a high level of human activity (for example ports and areas used for fishing and recreation). The discussions surrounding these designations are identifying practical issues of potential conflict between conservation and development and pointing the way to sustainable solutions.

The Coastal Forum was launched in England in December 1994 and provides for an exchange of views on coastal zone issues in England by a wide range of interested bodies. It publishes a newsletter which reports its activities to a wider audience. Proposals for establishing Coastal Forums for Northern Ireland, Scotland and Wales are currently under consideration.

In November 1995 Policy Guidelines for the Coast was published. This draws together existing guidance and policy statements in a concise digest and highlights common themes. Work is currently underway to prepare a guide which seeks to highlight best practice in coastal management. This document, "Coastal Zone Management - Towards Best Practice", will complement but not overlap with existing guidance.

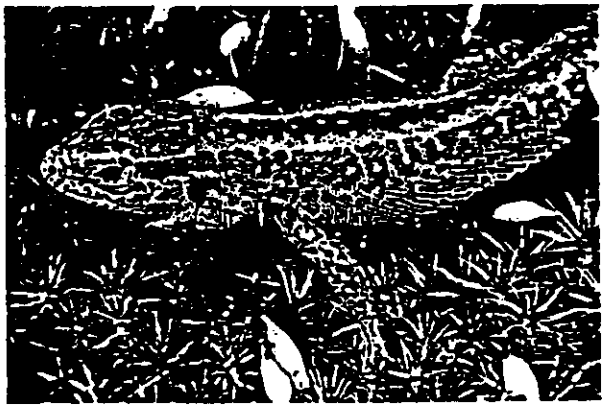
Other UK initiatives include those taken by statutory agencies : for example, English Nature's "Estuaries Initiative, Scottish Natural Heritage's "Firths Initiative" and the ongoing publication of a series of comprehensive coastal directories by the Joint Nature Conservation Committee.

The UK is also carrying out a programme to identify the components of coastal and marine biodiversity around its shores and of monitoring those components using various techniques. A summary of this action for the coastal margin and the marine environment is attached (at C).

3.1 We are fortunate in the United Kingdom that relatively large amounts of data are collected on biodiversity. But much of this is not readily available in a form that assists decisions on the management of species populations or the direction of land-use change. We need to improve the collection, organisation and co-ordination of biological information and data. The opportunity to do this now arises with the need to establish a monitoring programme to measure progress in achieving national and local biodiversity targets. There is also the requirement to monitor progress on the implementation of Directives and Conventions.

3.2 The European dimension is increasingly important with the establishment of the European Environment Agency and its Nature Conservation Topic Centre. The programmes of these organisations are currently being developed. Emphasis is already being placed on the collection and storage of standardised biological data.

3.3 The need to identify important components of biodiversity and for data collection and monitoring under the Biodiversity Convention provides a framework into which requirements from a number of EC Directives and other Conventions fit. The box explains the requirements of Article 7 of the Convention. Table 2 shows the commitment to collect data and information relevant to biodiversity under various EC Directives and the Biodiversity Convention itself. Table 3 shows the current status of monitoring and surveillance for the main groups of species on the long list.



P Edgar

Sand Lizard

ARTICLE 7 OF THE CONVENTION

The starting point for an examination of current practices and future needs is the text of the Convention on Biological Diversity. Article 7 states that each contracting party shall, as far as possible and as appropriate, for the purposes of in situ conservation, ex situ conservation, and the sustainable use of components of biological diversity undertake the following :-

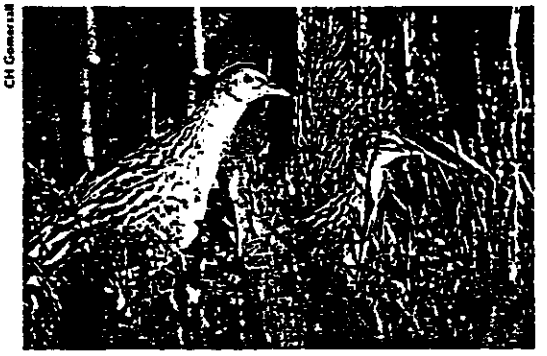
- identify the components of biological diversity important for conservation and sustainable use;
- monitor through sampling and other techniques the components of biological diversity paying particular attention to those requiring urgent conservation measures and those offering the greatest potential for sustainable use;
- identify processes and categories of activities which have, or are likely to have, a significant adverse impact on the conservation and sustainable use of biological diversity and monitor their effects through sampling and other techniques;
- maintain and organise by any mechanism, data derived from identification and monitoring activities relevant to the above measures.

In the identification of biological diversity regard should be given to:-

- ecosystems and habitats:-
  - containing high diversity, large numbers of endemic or threatened species, or wilderness;
  - required by migratory species;
  - of social, economic, cultural or scientific importance;
  - that are representative, unique or associated with key evolutionary or other biological processes;
- species and communities that are:-
  - threatened;
  - wild relatives of domesticated or cultivated species;
  - of medicinal, agricultural or other economic value;
  - of social, scientific or cultural importance;
  - important for research into the conservation and sustainable use of biodiversity, such as indicator species;
- described genomes and genes of social, scientific or economic importance.

Table 2: THE INTERRELATIONSHIP BETWEEN THE REQUIREMENTS TO COLLECT DATA AND INFORMATION RELEVANT TO BIODIVERSITY UNDER VARIOUS EC DIRECTIVES AND INTERNATIONAL CONVENTIONS

Requirement for data and information	EC Birds Directive	EC Habitats Directive	Ramsar Convention	Bonn Convention	Bern Convention	Agricultural Regulations	Water Directives	Forestry Regulations	Fishing Regulations	Biodiversity Convention
Requirement to gather information on:	Wild birds	Habitats and species	Wetlands and species	Migratory species	Threatened habitats	Agricultural practices	Pollution levels	Forestry practices	Yield and population of fish	All components of biodiversity
Maintain and organise data	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Requirement to monitor	Bird population levels	Habitats and species	Wetland and species	Migratory species	Threatened habitats	Various	Water quality	Air pollution effects on forests	Various	All components of biodiversity
Collect information on designated sites for conservation of biological diversity	SPAs	SACs	Wetland sites						Yes	
Data on sustainable use of biodiversity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Data to quantify threats to biodiversity	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes



Corncrake

Bittern

Capercaillie

Stone Curlew

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Table 3: CURRENT MONITORING OF SPECIES ON THE BIODIVERSITY 'LONG LIST'

Group	No. species currently on list	No. species currently with 'biodiversity' action plans	Vagrant species	No. species mainly in wider countryside	No. species mainly on SSSI or reserves	No. species found both in wider countryside and SSSI/reserves	No. species lacking adequate status assessment[1]	No. species with some form of assessment programme in place[2]	No. species which action plans exist or are being considered[3]
Algae (exc. stoneworts)	18	0	0	11	3	4	13	5	0
Fungi	21	4	0	unknown	unknown	unknown	unknown	unknown	6
Lichens	81	7	0	19	37	18	26	44	6
Liverworts	32	5	0	10	11	10	1	30	0
Mosses	79	6	0	27	24	26	20	52	6
Stoneworts	13	1	0	1	7	2	4	9	0
Vascular plants	230	28*	0	70	88	71	9	185	35
Ants	5	3	0	0	1	2	1	4	0*
Bees	19	1	0	5	4	9	0	18	1
Beetles	72	12	0	7	19	42	19	50	3
Butterflies	25	6	0	1	3	21	0	0	25
Caddis Flies	2	0	0	0	0	2	2	0	0
Crickets/Grasshoppers	7	1	0	0	1	5	2	2	3
Dragonflies	7	1	0	0	0	6	2	5	0
Two-winged flies	54	3	0	2	22	28	32	22	0
Mayfly	1	0	0	1	0	0	1	0	0
Millipedes	7	0	0	0	1	6	2	5	0
Molluscs	45	11	0	9	7	29	28	15	2
Moths	122	3	0	27	39	53	11	103	8
Other invertebrates	40	4	0	17	6	16	23	13	4
Spiders	44	0	0	1	24	17	0	42	2
Stonefly	1	0	0	1	0	0	1	0	0
True Bugs	5	0	0	0	2	3	4	0	1
Wasps	7	0	0	2	3	1	1	5	1
Amphibians	7	2	0	5	2	0	0	5	2
Birds	200	9	3	103	16	77	15	140	43
Fish	25	4	0	10	0	11	1	16	6
Mammals	66	9	17	44	2	2	17	24	7
Reptiles	10	1	3	5	1	1	0	5	5
TOTAL	1,245	116*	23	378	323	454	235	799	166

* The 6 Euphrasia species are covered by one action plan

[1] species poorly known and without current systematic assessment schemes

[2] species for which there are assessment programmes in place

[3] species subject to species action plans, or which are soon to begin. Detailed monitoring assessments are included as part of the plan

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3.4 *Biodiversity:The UK Action Plan* explained that the Biodiversity Steering Group would include in its remit overseeing the working group already established following the May 1993 seminar on biodiversity organised by JNCC and DOE. The work of the group would be designed:-

- to improve the accessibility and co-ordination of existing biological datasets;
- to provide common standards for future recording; and
- to examine the feasibility in due course of a single UK Biota database.


P Wakely

Killarney Fern

3.5 In the time available, it has not been possible to validate Table 3 fully. However, the Table does indicate that important groups of species are not covered by the more rigorous forms of surveillance and monitoring included in the last two columns. The proposed Focus Groups we describe in Chapter 6 should be asked as a priority to give consideration to this issue. In doing so, attention needs to be given to the high costs of formal monitoring systems and the lengthy periods before the results can feed into action. There will be the need to prioritise and to consider cost effective approaches including sampling, the identification of groups of indicator species in category one (ie lacking adequate status assessment) which figure significantly on the middle list (see Annex F), and then the possibility of filling major gaps in the long list.

3.6 The concept of biodiversity, and of national action plans within the framework of the international Convention, has given a focus to a large amount of statutory and voluntary work which has long been continuing and growing. As well as Article 7 of the Convention and the European dimension explained earlier, important aspects are Britain's own Wildlife and Countryside Act, with its schedules of protected species, the EU's Birds and Habitats Directives and many international Conventions -particularly Ramsar, Bonn and Bern. The statutory nature conservation agencies set up under the Environment Protection Act 1990 and the Natural Heritage (Scotland) Act 1991 have a specific duty to protect and enhance nature conservation and are operating major programmes. *Biodiversity:The UK Action Plan*, itself, established broad objectives, set out in the "59 steps", some of which are being carried forward by the work of the Steering Group.

3.7 Data and information are essential if broad aims, specific objectives and precise targets are to be achieved. We need to know where we start from, and what is changing, in order to understand what is causing the change, whether we need or can prevent the change, and to evaluate any remedial action we might take. Programmes, such as the EC Directives and the UK Action Plan, increasingly embody requirements for structured monitoring in which:-

- a baseline is established;
- there is regular and systematic recording to detect change or progress towards specific targets; and
- the reasons for change, particularly undesirable change, are then studied in order to inform action.

Questions of data availability and resources will often make it necessary to compromise, eg by undertaking monitoring of progress towards targets on a less than ideal basis, for example by recording the occurrence of a species in ten kilometre or smaller squares rather than more complete population details.

3.8 In addition, there is a need for broader surveillance which will allow important new trends to be identified, studied and, where appropriate, action taken through operational programmes. An example is the decline of many farmland birds which, while still having large populations, have reduced in numbers by as much as 50% over the last decade.

3.9 The quality, ease of access and relevance of the information available may greatly influence the quality of decision taken. The UK has a large volume of data (estimated at over 60 million species records), but there are important gaps. A growing focus on habitats has exposed a shortage of aggregate data and information on habitats in the UK and EU. A first priority is to improve the accessibility and co-ordination of what we already possess. We recommend mobilising this data applying the principles of information management. Examples of this approach are the IUCN advice on global biodiversity assessment, and the work of the Co-ordinating Commission for Biological Recording (CCBR). The statutory conservation agencies, through the JNCC, and the Biological Records Centre of ITE are the two main focuses of this work, and are already moving in the recommended direction. The local dimension is also crucial.


R Key

Sandbowl Snail

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RECENT DECLINES IN COMMON FARMLAND BIRD SPECIES IN THE UK

The British Trust for Ornithology's Common Birds Census (CBC) has measured population fluctuations among common species since the early 1960s. It provides an example of how broadly based surveillance can identify important new trends. Fieldwork is carried out by skilled volunteers and covers farmland and woodland habitats using a census method which identifies territorial birds. The CBC provides an estimate of annual change in the size of UK populations of common bird species. In 1994 censuses of the bird populations of 87 farmland plots and 113 plots of other habitats were used to estimate changes.

The declines among farmland birds have been striking as is shown in the table. The declines appear to be driven by the loss of spring-sown cereals and crop rotations, the intensification of grassland management, and the increased use of chemical pesticides; further work is required for a better understanding of these factors and their effects upon birds.

Species	% decline in numbers in 25 years; 1969-1994. Source BTO CBC 'farmland Index'
tree sparrow	-89
grey partridge	-82
corn bunting	-80a
turtle dove	-77
bullfinch	-76
spotted flycatcher	-73
song thrush	-73
lapwing	-62
reed bunting	-61
skylark	-58
linnet	-52

a Note that corn bunting is now so rare that it is found on too few CBC farmland plots to construct a 'farmland' index. Instead CBC plots from all habitats have been used to calculate the decline.

The need for improved information on population trends is reflected in the recent introduction of the Breeding Bird Survey which is jointly supported by BTO, JNCC and RSPB. It is a volunteer-based survey which sets out to increase the coverage of regions, habitats and species over existing schemes, including the CBC, using a formal sampling strategy. Survey methods are simple and efficient, and volunteers record details of both the birds they encounter and the habitats they live in. The new survey provides tremendous potential to identify population declines at a UK or finer level, to provide pointers as to likely causes and either suggest remedial action or identify the need for targeted research.

3.10 The information needed to support the different kinds of decision required by the UK Action Plan is derived from many different data sources held by many different organisations. Examples of areas where information support is required include:-

- selecting species and habitats for action plans;
- establishing targets for them;
- deciding where to direct effort to achieve the targets;
- assessing the effectiveness of action plans; and
- deciding what to do at specific locations.

3.11 Information management requires taking a systems approach. The same data will be needed by many people, and much of the information will be re-used many times. The ideal is to record, check and store once and access many times for many purposes.

3.12 The steps needed to make our existing information sources more usable and to provide for integrated expansion are:-

- identifying priority datasets for our purposes and indexing the sources;
- establishing standards to ensure that the system works technically, that the information is managed consistently, and that the information is relevant to the needs of customers whether policy makers or those directly concerned with operations;

capturing accurate data, validating it, storing it securely and keeping a careful record of changes made (in producing managed datasets with such features as version control and "life histories" of the entities recorded);

generating aggregate information from the original data and ensuring its validity, security and version control;

- avoiding duplication of effort and errors in copying data so that, ideally, each dataset is managed to agreed standards by a single known individual or organisation and made available to others who have a legitimate use for it.

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providing access on appropriate terms in order to avoid duplication and ensure consistency;
establishing an appropriate charging regime (which could include an absence of charges on a mutual "knock for knock basis" by co-operating organisations);
making appropriate arrangements for copyright and other aspects of Intellectual Property Rights (IPR);
conforming to the Environmental Information Regulations.

3.13 At the technical level, the approach recommended below - a disseminated system with potential for electronic networking - is well within the state of the art and does not require massive centralised facilities using experimental designs and equipment.

3.14 At the operational level - service to customers - the risk is of creating something which works but is not useful. Our approach is based on serving policy objectives, including in particular monitoring the progress towards the targets set out in this report and our obligations under UK statute, EC Directives and International Conventions. We start from the use already being made of biological data, and the plans and intentions of many relevant organisations for incremental development. The preferred approach is to establish a basic model of the relevant features (a data model), and to fill in sections of the model as operations require.


P Wakely

Early Gentian

3.15 Because of the efforts of dedicated amateurs and, increasingly, statutory organisations, the UK has an exceptionally rich resource of biological data and information. But there are important gaps which it will be slow and expensive to fill, and a significant period is needed before new sets of records can demonstrate changes over time. An important need is to assess the accuracy, reliability and relevance of existing datasets which often reflect individual enthusiasms or past organisational priorities.

3.16 We have therefore tried to address what is practicable in the short term with constrained resources. A key concept is to squeeze every possible ounce of meaning and value from the present bank of data, and from established programmes for recording at planned intervals (time series monitoring).

We therefore have in mind the approach outlined above of working within a framework which is filled in as required. We are setting out on what should be a long term continuous process to monitor UK biodiversity for the purpose of maintaining, and if possible increasing, that biodiversity.

3.17 Two major elements in this process are analysed below:-
the feasibility of a UK Biodiversity Database (UKBD) based upon a staged approach; and
giving primary focus to national and local targets, and giving careful consideration to the best use of existing systems. Monitoring a large number of species is potentially expensive and inevitably slow to bear fruit if new systems have to be developed.

3.18 The UKBD is recommended as the mechanism which will achieve:-

"the accessibility and co-ordination of existing biological data, and provide common standards for future recording" (Biodiversity: The UK Action Plan - paragraph 10.40).

3.19 Any UKBD should involve a network of co-operating organisations who have each agreed to operate to agreed standards, and accept responsibility for maintaining and providing access to the sets of data which they have collected.

3.20 Most problems are concerned with the human, organisational and financial aspects of the system. Not the least of these will be the development of a culture in which individuals and organisations accept the benefits of the maximum degree of data exchange. The concept of custodianship of datasets is critical to the success of a co-operative system and will need careful development under clear Government guidance. However, we start from a dangerous decline in the resourcing of this work at both local and national levels. The local records centre network is not uniformally resourced, and at present centres are closing or barely ticking over. Many of the major national voluntary and statutory organisations are experiencing reduced funding and, in the case of the public sector, are subject to a general freeze on running costs and cuts in those costs in some organisations.

3.21 The heart of a UKBD will be data on habitats, species, protected areas and the status of these entities under international conventions, EC Directives and domestic legislation. The key organisations concerned with this area

are the statutory nature conservation agencies and their Joint Committee together with ITE, and in particular the Biological Records Centre, which is part-funded by the JNCC. Organisations such as the British Trust for Ornithology, Butterfly Conservation and other specialist non-Governmental organisations focus on particular species. The Wildlife Trusts and local records centres focus on local and regional needs. The UK is fortunate in still possessing a significant number of individuals who contribute vital data as a result of their enthusiasm for nature.

3.22 The marine area is seen as increasingly important to conservation. The Southampton Oceanography Centre, MAFF, SOAEFD, the Aberdeen and Plymouth Marine Laboratories, ITE and the Marine Conservation Society all hold important data sets, while the JNCC's Marine Nature Conservation Review and Coastal Directories Project are currently improving the baseline data and classification system. NERC's British Oceanographic Data Centre, working on behalf of the EU, have put together a directory of marine environmental data held by UK agencies. This complements a PC based directory, produced by the same group, of some 462 marine environmental datasets held by UK laboratories and readily accessible to both policy makers and scientists.

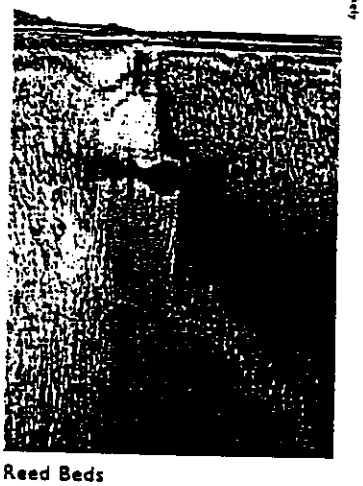
3.23 Beyond this core area, important datasets are held by various Government departments and statutory organisations. Prominent amongst these are MAFF, particularly through ADAS, and the National Rivers Authority - soon to be part of the Environment Agency.

3.24 As the circle widens, work on biodiversity interfaces with the work carried out particularly by NERC on major processes such as climatic change and atmospheric and marine systems. However, it would be impracticable to try to start by embracing this wider territory. Development of the UKBD should focus on the heartland described above. The wider field should be taken into account, but probably on the basis of specific data transfer provision rather than full compliance with UKBD standards.

3.25 Local centres for data lie at the centre of an effective system. In particular, local data and information are needed to produce Local Biodiversity Action Plans. Local and regional centres both serve the locality and provide information needed for the national picture - the UKBD.

3.26 We gave consideration to funding a fairly uniform network of local records centres on the model which operates successfully in most of the country. However, on reflection we decided to recommend that in each area - to be defined locally - a consortium should be developed by the leading organisations involved. A more centralised approach would be very costly; would displace existing local resourcing, and would risk reducing local commitment and the relevance of the centres. There is, however, a need for an organisation, or group of organisations, to drive forward work at the local level.

3.27 Where local records centres exist they should be the centre of the network. In other cases the local wildlife trust might be the focus. In all cases the wholehearted co-operation of local authorities is essential, because of the support many of them give to local records centres, and the data they generate or collect, and the use they make of biodiversity data for planning and other purposes. The statutory nature conservation agencies are already providing resources to some centres, but continued local Government funding is critical.



Reed Beds

P Wakely

The National Level

3.28 At the national level we see a network of organisations which co-operate voluntarily. The key concept will be "custodianship". Organisations owning relevant datasets will agree to maintain and develop these sets and to conform with the agreed standards and protocols of the network. There would need to be a focus for the network. If this is to work effectively, it should be provided by one organisation. This should be the JNCC with advisory machinery representing other major players. This is because of JNCC's expertise, its large number of datasets and planned developments, and its long standing involvement with the Biological Records Centre. A small full time headquarters will be required to mastermind the project, to develop standards and to plan and monitor the progress of the UKBD.

The Master Directory

3.29 A crucial early stage in developing the UKBD is the creation of a regularly updated directory of datasets and other key information. An important option is to develop this simple text directory into a more technical meta database giving full details of the technical characteristics of the entries. This role should include:-

- assessing the quality of data;
- encouraging improvements, and
- resisting both duplication and redundancy.

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3.30 An important contribution can be made at both national and local levels by maximising the use of the Recorder software system for recording species and their geographical locations. The system, developed by the statutory nature conservation agencies and the Wildlife Trusts, can be used by individual volunteers or local centres and allows data from appropriately designed surveys to be available in an electronic form which is easy to collate nationally. The package includes aids to standardisation such as a species dictionary. The value of the system to individuals and small organisations would be increased if it could be loaded with appropriate national information, such as species of conservation concern or action plans, and could therefore provide both feedback and context for local work.

Sma' Glen

RECORDER

Recorder is a computer application aimed at people and organisations collecting or collating site based observations of terrestrial and freshwater species. The Recorder project is managed by the Joint Nature Conservation Committee, and the Countryside Council for Wales, the Department of the Environment (Northern Ireland), English Nature, Scottish Natural Heritage and the Wildlife Trusts.
This sample printout illustrates four features of Recorder which would help a locally based organisation meet Biodiversity Action Plan information needs. The printout is from a copy of Recorder used to collate dragonfly data for North East England.

RECORDER — **Demonstration** — **Friday 15 October 1993**

Cordulegaster boltonii (Donovan, 1807) — **Odonata Cordulegasteridae**

Golden-ringed dragonfly
'Large, black and yellow hawker dragonfly. Breeds in acidic streams and, sometimes, lakes and ponds on heaths and moorland, but a very strong flier which can occur far from breeding areas. Common in the west of Britain, especially in south-west England, Wales, Cumbria and north-west Scotland, also more locally in the Midlands and much of the Pennines. Rather scarce in the east and absent from the south-east except for isolated heathland colonies.

Status	Region[2]
Local	Northern England
Common	Wales
Common	Scotland
Local	Great Britain

Site[3]	Grid ref	Date	Source of record
Close House	NZ1265	10 July 1981	Ball, Dr S G[4]
Coister Cleugh	NY99	13 July 1973	Long, Dr A G
Shull	NZ0833	02 July 1955	Anon (1955)
Shull	NZ0833	07 June 1947	Anon (1947)
Newton Hall-Pity Me	NZ2745	1961	Heslop-Harrison, J

[1] **Nationally supplied information on species.**
Recorder contains a dictionary of 36,000 terrestrial and freshwater species typically providing information on status, biology and distribution.

[2] **Nationally supplied status and facilities to add local species status.**
National status information provided as part of Recorder can be compared with assessments of local status made by the user. This comparison is one of the steps recommended during Local Biodiversity Action Plan construction.

[3] **Facilities to add site based species records.**
With appropriate data, the package allows the comparison of status of species across suites of sites. This is an important operation when identifying and planning action for locally important species. Around 350 copies of Recorder are in use and capturing a significant proportion of locally generated species data. Users are spread across local records centres, county wildlife trusts, the statutory conservation agencies, the National Trust, several National Parks, individuals and a variety of natural history societies.

[4] **Support for national data collection.**
The application helps users produce highly checked data on the location of species in a consistent electronic format. This has already made the collation of national data sets more efficient for some species groups, and is used by some national species recording schemes.

3.31 The Countryside Information System, developed for DOE by ITE to display the results of the Countryside Surveys, is a valuable tool in presenting data which can be set out on a grid of one kilometre squares. Data may include, for example, ecological characteristics, land use, species distributions, altitude, soils, administrative areas and designations. This facility allows broad patterns of these data to be displayed and compared at a national level. The system is designed to provide easy, flexible access to data and a particular feature is the ability to extract information for any configuration of one kilometre squares. CIS provides a standard format for the exchange and dissemination of information, and it contains a catalogue of available datasets.

3.32 Standards are once more the key here. Custodians of information have a range of tools to assist access to their most used datasets eg: CIS, UKDMAP and in the near future the facilities of the emerging Internet. Datasets need to be documented if they are to be used and interpreted easily. With appropriate standards a dataset could be captured in Recorder, collated nationally and subsets published in CIS or UKDMAP. So long as data are geographically referenced (by use of the national grid, latitude and longitude or other information which can be turned into co-ordinates), it can be presented and analysed by the CIS (or a Geographical Information System (GIS)). Particular attention needs to be paid to the requirement of people or organisations with limited competent skills through "user friendly" programs and "front ends" which assist the ordinary user.

High Brown Fritillary

COUNTRYSIDE INFORMATION SYSTEM

The Countryside Information System (CIS) was commissioned by the Department of Environment to provide policy advisers, planners and researchers with an easy and flexible means of accessing a wide range of information on the environment. The CIS can help meet biodiversity commitments in two principal ways:-

- by helping the exchange and linking of information about patterns of biodiversity and environmental impacts.

The CIS is currently being used by a wide range of users ranging from Government departments and local authorities to universities and wildlife non-governmental organisations. In addition to land cover and vegetation data from the Countryside Survey 1990, new information is currently being made available on the system including Ordnance Survey topography and geographical reference data, designated areas and the distribution of farm types in England and Wales. Additional information on birds, flowering plants, invertebrates, soils and climate are expected to be available in 1996.

- by providing a tool for publishing the results of national surveys and monitoring exercises and by promoting the use of common standards of data analysis and presentation.

The CIS is a Windows-based software package which can store, analyse and present maps, tables and graphs for any data that can be summarised for one kilometre squares on the National Grid of Great Britain. It now includes a catalogue which provides detailed information on the system's available data and suppliers.

Standards:

3.33 Standards lie at the heart of a UKBD. They fall into three areas:-

- biodiversity standards.
- information standards;
- technology standards;

3.34 **Biodiversity standards** relate to the content of the databases - species dictionaries, habitat classifications, standardised scales for assessing the status of species and habitats, criteria for identifying species under threat, etc.

3.35 **Information standards** relate to such matters as definitions of the types of information needed, the structuring of these types for effective management in a database and version control.

3.36 **Technology standards** relate to the workings of the information technology. For example, communication between modern databases can be achieved by specifying that they all use, or at least can be accessed through, Structured Query Language (SQL). Similarly, there need to be standards for communications on the network. It is likely that these would involve the use of the Internet.

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3.37 Work to develop standards is in hand in both the voluntary and statutory sectors. We have begun the major task of mapping this activity and encouraging filling gaps. If appropriate standards are conformed to, data can be recorded, stored and transmitted in a variety of ways extending from paper and post through the exchange of computer prints or floppy disks and electronic networks. The degree of electronic sophistication depends on costs and benefits.

3.38 An important aspect of the Environmental Information Regulations 1992, (implementing EC Directive 90/313/EEC on the freedom of access to information on the environment), is that public sector holders of relevant data have both an obligation to provide access (with reasonable charges) and to ensure that the data is accurate.


Starfruit

3.39 We consider that the objective should be to provide the most open possible access compatible with these policies and with the need to provide an incentive to data custodians to perform their fairly onerous duties. In some cases, custodians will themselves have strong interests in obtaining data from others and one could think of a "knock for knock" approach. In other cases, perhaps the more commercially orientated public bodies and the private sector, the key datasets are almost by-products of their main activities and they need relatively little reciprocity from other custodians.

3.40 Data providers have had to live with this situation for some time. In the environmental field, ITE, for example, have different rules of access and charging for those who co-operate in exchanges of data, bona-fide researchers and those seeking to use data for commercial purposes. Collaborators or researchers may often be charged only handling costs of data. Access can be controlled through various procedural and electronic devices which, at a cost, provide "gateways" ensuring that rules for access and charging are applied.

3.41 The importance of intellectual property in the biodiversity area has recently been emphasised by the Co-ordinating Committee for Biological Recording (CCBR) and others when analysing the Environmental Information Regulations. A crude summary is that recorders of data and organisations collating datasets acquire Intellectual Property Rights which may pass to their estate. These issues have not yet been tested in the courts and various practical steps are being taken to gain clearance for the use of data, but it is necessary to recognise that this is laborious, time consuming and not without risk of expensive legal judgements.

3.42 We consider that a UK Biodiversity Database (UKBD) would be an important tool for carrying forward the Biodiversity Action Plan and other commitments under UK and EC legislation and international conventions. At relatively little cost, it would add considerable value to the high volume of existing and planned data.

3.43 The UKBD would be a cost effective way to set standards, improve access and encourage greater use of the existing and planned sources of data and information.

3.44 The UKBD is best thought of as a network of collaborating organisations conforming to an agreed overall design and IT, information management and conservation standards. The work programme could be developed through stages which each involved a product of value in its own right.

3.45 An effective network would require a small management centre, essentially concerned with negotiating standards and participation, which should be based on the JNCC. Contributing organisations would become "custodians". This would involve an undertaking to maintain specified datasets to UKBD standards and to make them available on agreed terms of access and payment.

3.46 The local level is crucial both as a provider of data and a user of that data. It is particularly important to encourage a healthy local sector against a background of decreasing resources and closing local record centres.

3.47 Both national and local custodians may need a financial incentive to participate in the UKBD network. While many custodians in national organisations concerned with biodiversity would expect to benefit, others might find themselves in a one-sided relationship in which they provided more than they used.

3.48 There are intricate questions of charging, rights of access and intellectual property rights which need to be addressed as an early priority.

3.49 We have focused on improving access to existing or planned datasets of importance to biodiversity. We noted, however, that knowledge was limited on important species and habitats, and in particular that programmes of systematic surveillance or formal time series monitoring have limited coverage. Further consideration should be given to this issue, and to any necessary supporting research by the implementation machinery proposed in Chapter 6.

6.20 In Chapter 3, we recommend a three pronged approach to improving the quality and accessibility of data and biological recording. This is:-

making the maximum use of existing data:

developing a nationally based biodiversity information system by stages: and

developing a locally based biodiversity information system through the establishment of local consortium funding.

6.21 The sharing and re-use of data should bring economies to national and local bodies as well as providing improved information to support the biodiversity targets. Moving towards a United Kingdom Biodiversity Database (UKBD) will require a staged approach, establishing a co-operative network with a small management centre and investing in products and standards which would encourage data owning organisations to improve the accessibility of their data. The need to encourage the development of Local Biodiversity Action Plans which will help to deliver both national and local targets is fundamental. The consortium approach, whereby local data centres would receive funds for providing a service to a range of bodies (eg local authorities, country agencies, NRA, wildlife trusts, RSPB regions etc) is considered to be the best way forward, while bearing in mind the need for a mechanism to co-ordinate and bring together local effort which is inevitably fragmented.

6.22 If all the work identified at both national and local levels were to be tackled simultaneously, and quickly, the cost would be very high and there would be a significant management overhead. We have therefore looked at a more realistic approach through the appropriate grouping and phasing of projects.

Raised Bog

6.23 Best endeavours were made to develop indicative costs for the stages within the national and local approaches. Existing programmes will contribute to the process, but new investment and improved co-ordination are needed. The costs summarised below are based on the suite of more detailed projects contained within each stage. The costs include:-

new investment to achieve the stage outputs; and

the costs of programme and project management calculated at marginal costs for organisations which are already involved in relevant activities.

6.24 One option is to continue with the current level of investment. This has a number of risks. At the national level there is a risk that some datasets will be lost, or severely constrained because their value is not understood by their owners or their potential users, and without a co-ordinated strategy, general access and the collation of data will continue to be difficult. This will affect the ability to respond to international and European conservation initiatives, including the Habitats and Birds Directives, as well as the ability to monitor the proposed targets contained in this report. /...


P Wakely

Creeping Marshwort

6.25 At the local level investment in local records centres is declining and centres are closing. There is a significant risk that the development of Local Biodiversity Action Plans will be delayed or that they will be constrained in the longer term. We therefore recommend that appropriate investment be made at both the national and local levels.

6.28 For the national approach we see three stages:-

identifying strategic datasets and setting standards;

- providing incentives to network members to improve accessibility;
- testing the benefits of an electronic network.

6.26 For the local approach there are also three stages:-

- establishing a consortium funding case and setting standards;
- supporting local initiatives and establishing or enhancing local data centres;
- building local systems and networks.

6.27 The first stage will be to identify strategic datasets and to set standards. The aim will be to provide:-

a nationally agreed list of strategic datasets which underpin international, European and national requirements;

standard lists for taxonomy, biotope and land use classifications, and a system for maintaining and distributing them as key information exchange standards;

a maintained catalogue of biodiversity datasets containing information on their content and accessibility;

a programme for publishing key datasets; and

a framework for a data access agreement for adoption by bodies holding strategic national datasets.

The stage will need to be developed over a minimum of three years starting in 1996/7 and could be delivered for £575,000.

6.28 Stage two will be to provide incentives to network members to improve accessibility. This will be through the following products:-

- a series of improvements to the accessibility of datasets in the agreed list which will include cataloguing, documentation, dataset publishing, agreement on access terms and establishing a legal title;
- a data model to assist information exchange; and
- the collection of monitoring and surveillance data within the action plans for transfer to the appropriate national and local datasets.

Begun after the first stage has achieved consensus on the agreed list of strategic datasets, the second stage could be programmed over a minimum of three years and would cost £845,000.

6.29 Stage three will test the benefits of an electronic network. This stage will include:-

- a system for managing the selection of key habitats and species, and providing access to the organisations participating in the delivery of the action plan targets as an example of the long term data approach;
- a networked facility for providing the information exchange needed for each organisation co-ordinating either a habitat or a species action plan. The facility would be a pilot for wider networked access to data and information;
- a report on the best means of establishing an electronic network to make data access and exchange easier for the emerging network of organisations managing national or local biodiversity data; and
- a report looking at the benefits arising from national and local data management, and the added value from electronic networking.

Stage three could be delivered for £700,000 over three years and could beneficially overlap with stage two.


I Robinson

Great Crested Newt

6.30 The estimated costs for the projects contained in each stage are shown in Table 9.

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Table 9: ESTIMATED COSTS FOR DEVELOPING A UK BIODIVERSITY DATABASE

Project	1996/7 (£000)	1997/8 (£000)	1998/9 (£000)	1999+ (£000)
Stage One				
Priority list of national datasets	50			
Establish and maintain standard term lists	75	25	25	
Establish and maintain data catalogue	50	50	50	
Design data exchange arrangements	15	10	10	
Publish datasets to make them accessible	80	60	20	
Management overhead	35	10	10	
TOTAL	305	155	115	
Stage Two				
Support establishing legal title		40	80	80
Support accessibility improvements		100	150	100
Establish and maintain generic data models		25	10	20
Support data banking		45	45	45
Management overhead		35	35	35
TOTAL		245	320	280
Stage Three				
Scoping study for electronic network	60	25		
Pilot of network and dataset access	195	95	95	
Key species and habitat selection system	45	25	25	
Evaluation of benefits			60	
Management overhead	25	25	25	
TOTAL	325	170	205	
GRAND TOTAL	630	570	640	280

6.31 The first stage will be to devise a case for consortium funding and to set local standards. This will involve:-

- defining the services which a local data centre could provide including the cost for providing this service, the benefits to each customer organisation and a model management and funding structure;
- a set of locally and nationally validated data management policies for local data centres;
- guidance on the types of data which will be of most value to Local Biodiversity Action Plans, and the service level required for each customer organisation; and
- the provision of a nationally provided support service for the Recorder Software Package.

This three year stage will cost £520,000.

6.32 The second stage is to support local initiatives and to establish or enhance local data centres. This will involve:-

- a target of 50 local initiatives to establish or enhance local records centres to help meet the long term information needs of Local Biodiversity Action Plans;
- a target of 50 local data centres to adopt standard policies, and ensure that local data contributes to Local Biodiversity Action Plans and is accessible via the data catalogue;
- a number of schemes to improve the value and relevance of voluntary contributions to local biodiversity information which will involve partnerships between statutory and voluntary bodies; and
- facilities to exchange local species information between local areas and nationally.

This stage can be tuned to the pace of Local Biodiversity Action Plan initiatives, and can start as soon as the consortium funding

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case produced in the first stage is agreed. The stage would cost £1.175m and last at the minimum three years.

6.33 The third stage will be to build local systems and networks. This will involve:-

a report documenting the progress in establishing consortium funding for local data centres, a review of the viability of this approach, and an assessment of the value of the service provided;

identifying any new or changed information systems which would improve the service provided by local data centres, and increase the value of local biodiversity data;

the establishment of network links between local data centres and consortium members; and

a new or revised information system to improve local biodiversity data management.

Stage three could cost £725,000 over a minimum of four years, and is best started when a number of local consortium funded data centres have been established in stage two.

6.34 Table 10 shows the estimated cost for these three stages. The costings in the table do not include the costs of running local data centres which need to be sought from local formed consortia.

6.35 The proposed information management strategy will involve the co-ordination of activities across a number of organisations. It will involve the change of working practices, and if consortium funding of local data centres is to succeed, the strategy will require changes to the way local organisations budget and pay for data and information management. At a national level, the strategy will influence the established information policies of a number of national organisations.

Table 10: THE LOCAL APPROACH

Project	1996/7 (£000)	1997/8 (£000)	1998/9 (£000)	1999+ (£000)
Stage One				
Devise consortium funding case	60			
Standards for data centre policies	45	25		
Develop guidance on priority datasets	45	45		
Support for Recorder	65	65	65	
Management overhead	35	35	35	
TOTAL	250	170	100	
Stage Two				
Support establishment of consortium funding		60	145	210
Support establishment of standard policies		25	50	50
Support making high priority data accessible		80	160	160
Development of Recorder		100		
Support for IT investment		30		
Management overhead		35	35	35
TOTAL		330	390	455
Stage Three				
Review viability of consortium funding			60	
Review data centre systems needs			60	30
Support for linking data centres				250
Develop systems identified by the review				255
Management cost			35	35
TOTAL			155	570
GRAND TOTAL	250	500	645	1025

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COASTAL AND MARINE BIODIVERSITY INFORMATION

The United Kingdom is carrying out an active programme to identify the components of coastal and marine biodiversity around its shores and of monitoring these components using various techniques.

Coastal margin

The United Kingdom has, over the past decade, surveyed and mapped the main non-marine biological components of its entire coastal margin using aerial photogrammetry techniques reinforced by detailed ground survey for habitats and field observation for species populations. The products of this work have been essentially twofold. Firstly, a detailed classification of all terrestrial coastal habitats has been developed to assist site evaluation, and, secondly, comprehensive databases on the components of coastal biodiversity have been established. This information is in the process of being disseminated in book form as 17 volumes each of which deals comprehensively with a region of the UK coastline, covering: geology and physical environment, terrestrial coastal habitats, inshore marine and estuarine environments, species, archaeology, protected areas, land use, human activities and coastal management. Four of the 17 volumes have been published to-date, the remainder will be completed by the end of 1997. This material will be made available, in due course, also in electronic form.

The UK is currently investigating the most appropriate methods for monitoring the components of coastal biodiversity, and is investigating various techniques, from satellite imagery to field recording and the use of indicator species. It has developed experience in the modelling of the physical coastal environment and of the difficulty of using such techniques in complex and dynamic environments.

Marine environment

The United Kingdom has, over the past decade, carried out survey of its inshore waters to refine its knowledge of the nature of the components of marine biodiversity, using, on tidal areas, aerial photogrammetry techniques, supported by field survey, and, on subtidal areas, acoustic survey, supported by remote and drop-down video, grab sampling and diving techniques. About 50% of the inshore coastal waters of the UK has been surveyed using one or more of these techniques. The results of this work will be twofold. Firstly, the preparation of a detailed classification, using both vegetation and faunal components, of seabed habitats, and secondly, a major database of the components of marine seabed biodiversity. This is supported by databases on the physical marine environment, on fisheries, and on water quality. The information on inshore marine biodiversity is being published in book form, area by area. Much of the information on marine species is already available in electronic form.

The UK is currently investigating the most appropriate methods of monitoring the components of marine biodiversity, including the use of the techniques referred to above.