

THE NORTH SEA – WHERE TO GO IN THE FUTURE?

An overview of the North Sea Days on Texel at 13 and 14 October.

The 'North Sea Days' are organized annually to promote the exchange of knowledge and opinions between scientists, policy-makers and stake-holders using the North Sea for their own professional purposes. The symposium, hosted by NIOZ and Alterra Texel, was co-sponsored by the Netherlands Organisation for Scientific Research (NWO).

The part of the North Sea that belongs to our country - the Dutch Continental Shelf (DCS) - is even larger than the dry part of our country, and we carry out many activities in the area: intensive shipping, gas, oil and sand exploitation, recreation, fisheries, pipe-lines, etc. In the near future, we would also like to establish wind-mill parks and marine protected areas. Can all these wishes be united?

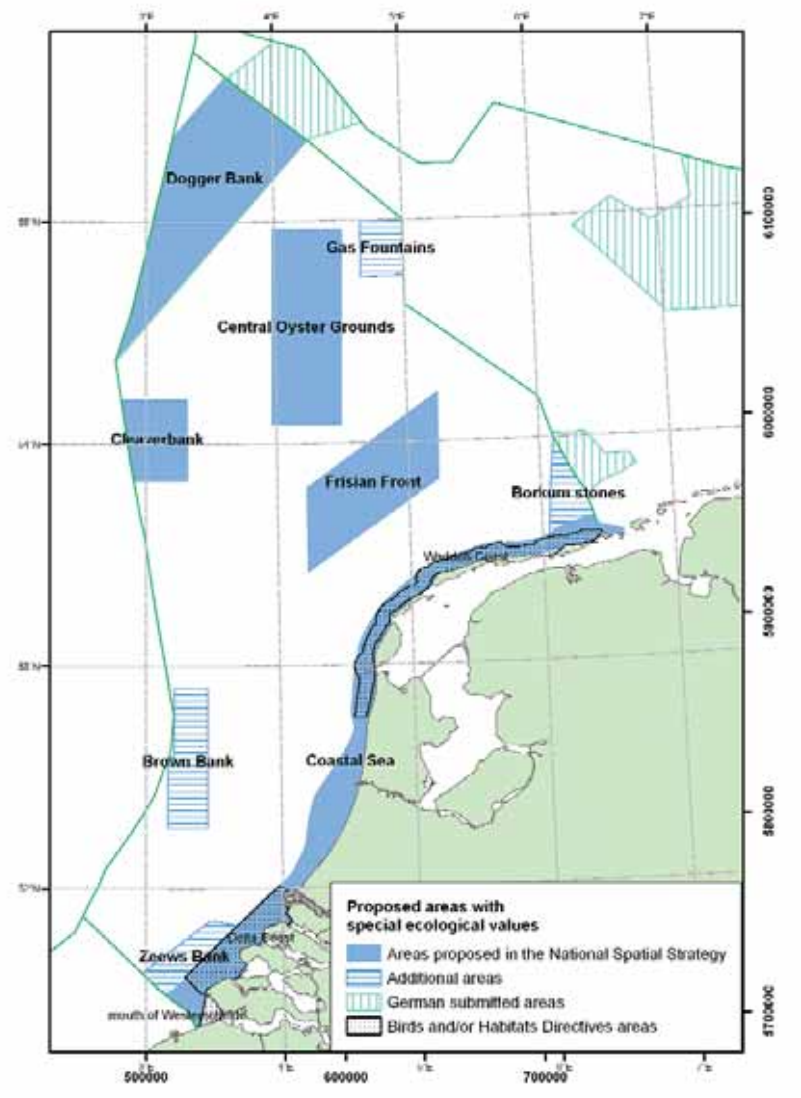
About 150 people gathered to exchange their views on the latest scientific results, political visions, and professional wishes. The subjects that came up for discussion were divided into five sessions, of which the high-lights are presented here.

Policy developments:

The leading policy frameworks for the coming decade are the Integrated Management Plan 2015 of the Ministry of Transport, Public Works and Water Management, the Water Directive, the Bird and Habitat Directive, and the European Marine Strategy. The unifying central focus is a healthy marine environment where at the same time a number of sustainable and profitable economic activities can be carried out. Within the framework of "Natura 2000", our country is obliged to stop a further habitat destruction and decrease of species biodiversity by 2010. With regard to human activities, an installed capacity of 6000 Megawatt of wind energy is envisaged on the DCS for the year 2020. In general, there will be less space for the present methods of fishery.

A number of Marine Protected Areas on the DCS are proposed for the near future by the ministry of Agriculture, Nature and Food Quality, following a commitment of The Netherlands within the European Union.

Policy measurements are only useful when the changes occurring after their



installation are adequately monitored to increase our knowledge about the basic functioning and reactions to changes in human impact of the North Sea ecosystem. At the same time not all changes are caused by human impact, as illustrated by the regime shifts in the years 1978/1979 and 1988/1989. Also, the general public should be much better informed. Therefore, NIOZ, Alterra and EcoMare have jointly developed the website “Zeeinzicht” (See the Sea; www.zeeinzicht.nl). This web-site is co-sponsored by the Netherlands Oil Company (NAM) and British Petroleum.

New ecological developments

The answer to the question: “What is an ecologically healthy system?” is mainly determined by the –often unspoken- philosophy that people have in their minds. Three possible answers are:

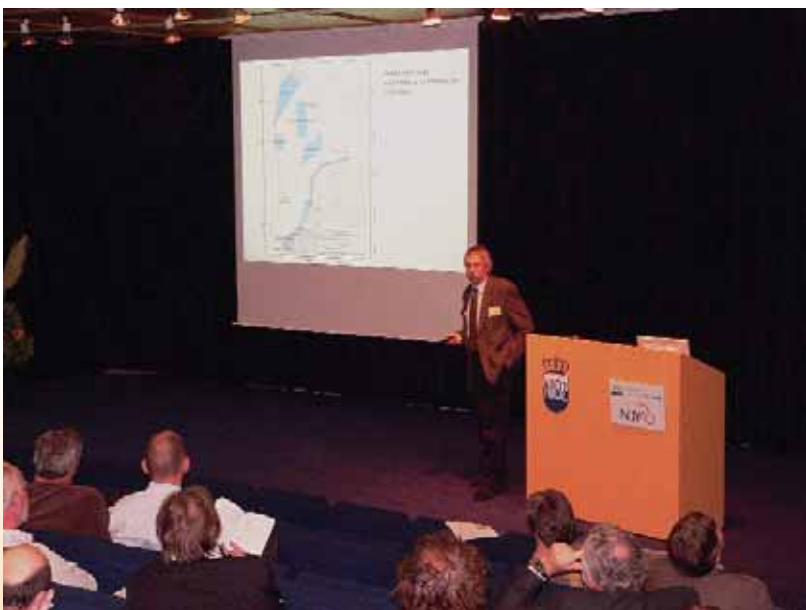
- A system that is running perfectly; like an expensive Swiss watch.
- The romantic view of the prehistoric nature without any influence of man
- The exploitation version in which nature is being optimized for maximum profit.

Therefore, more α - and γ -scientists should be involved in research on the cultural backgrounds of the expectations of people with regard to the phenomenon “nature”.

What happens in the North Sea depends largely on the Gulf Stream in the Atlantic Ocean. However, since the North Sea is much richer in nutrients than the open ocean, populations of algae grow faster and incorporate relatively high amounts of carbon dioxide in their cell material. This mechanism is called the biological CO₂ pump. Due to this CO₂ trapping mechanism, shallow coastal seas are much more important on a global scale than expected on the basis of their small surface area.

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A second and relatively unknown part of the carbon dioxide problem, is the anticipated acidification of the sea. As a paradox, higher levels of dissolved carbon dioxide and bicarbonate (HCO_3^-) will concur with lower levels of carbonate (CO_3^{2-}). Precipitated calcium carbonate (CaCO_3) forms the calcareous skeletons of shellfish, snails, sea-stars, corals, fish and even some families of algae. This acidification is by no means a theoretical problem, but it is expected to be already measurable in the coming decades and is likely to inhibit the growth of calcareous organisms.



Changes in nutrient availability have had large consequences on the composition of the algal spring bloom in the Dutch coastal region (Marsdiep) over the last three decades. Three different periods can be discerned by various nutrient regimes and species of algae: The period before 1977 is characterized by small algae in combination with limitation by nitrogen and silica. The period between 1978 and 1987 represents the decade with the highest eutrofication, resulting in a dominance of large algae. The last period is characterized by a particularly strong decline in phosphate levels, resulting in a bloom of mainly

small flagellates. Important questions are: do these different types of algae have different nutritional values for higher trophic levels, and has the algal bloom intensity also changed? When algae are being grazed by animal plankton, their biomass can become available as food for the highest trophic levels of the food web, such as fish, birds, marine mammals and fishermen. But sometimes algal blooms are finished by viral attacks and their cellular material is degraded again by the bacteria. This is negative for fishermen, but cannot be avoided.

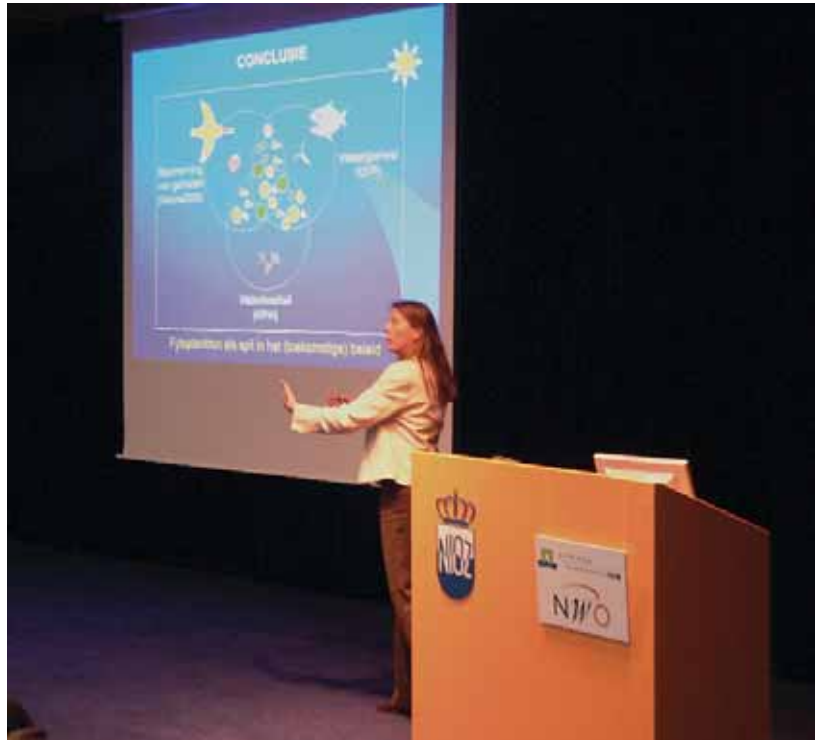
Another group of micro-organisms which is apparently common in the North Sea and the Wadden Sea are the Archaea, of which there are two groups active, the Crenarchaeota and the Euryarchaeota. The Crenarchaeota thrive in winter when light limits algal growth. Like algae, they use carbon dioxide as carbon source for their cell material. Nitrogen serves as energy source through oxidation of ammonia to nitrate (nitrification). In spring and summer, algae oppress the Crenarchaeota, but in summer, the population of the Euryarchaeota rises.

The densities of juvenile plaice and sole are changing in the Dutch coastal zone. The year classes 0 and 1 of plaice have decreased by at least a factor of ten. The average length of 0- and 1-year old sole is increasing and spawning occurs earlier in the year, allowing the 0-group sole to grow longer before winter arrives. The most likely explanations for the different development of plaice and sole are changes in sea-water temperature and in nutrient levels.

In total, there are forty bird species on the DCS, but they do not have the same 'conservation value'. It would be best when policy would focus on species that either reproduce slowly, have a very small population, or for which the DCS is more important than other parts of the North Sea. The health of a bird population can be best estimated from the breeding success in the colony. If you only look at the development of the numbers and the health of adults, effects will only be noticed when it is already too late to react. Because the densities of birds are changing rapidly, the assignment of the exact locations of Marine Protected Areas cannot be a one time affair.

Emerging dangers

One of the Ecological Quality Objectives for the North Sea concerns levels of floating litter as measured by the number and weight of plastic items in stomachs of fulmars (*Fulmarus glacialis*). Over time, the situation for industrial plastic granules has improved slightly, but for garbage the situation is still deteriorating, with a 100% score for the presence of municipal plastics in fulmar stomachs in the Dutch coastal region, which is the most polluted area of the North Sea. Recently, the financial system of the collection of garbage in the major Dutch



harbours has changed to an indirect one, where the cost for waste disposal is already included in the harbour fee.

A second emerging risk is the introduction of non-native species in our waters, which they enter from discharged ballast water of ships or from imports for aquaculture. This problem is regarded as one of the most serious threats after climate change to biodiversity of coastal environments. From 2009 onwards, ballast water has to be treated on new ships according to the Ballast Water Convention that has been adopted by the International Maritime Organization in 2004. In the future, ballast water will have to be treated on board with special installations. NIOZ is currently investigating whether it could act as an international test centre for the certification such new treatment equipment.

The most threatening example of aquaculture imports is the current expansion of the Japanese oyster in the coastal waters of Zeeland and the Wadden Sea. These oysters compete for food with other filter-feeding shellfish, but in contrast to mussels and cockles, oysters do not serve as food for higher trophic levels. This could well endanger the function of the Delta and the Wadden Sea as a crucial refuelling station for many migratory bird species.

Transport of particulate material along the coast

The defence of the Dutch coast and the islands depends entirely on the transport of sand and silt along the coast. Dutch policy has made the following choices for coastal defence:

- Monitor the system and let it have its own natural development as long as this is acceptable from a safety point of view.
- When this is no longer possible, sand from the North Sea will be supplied to the coastal foundation. More research is necessary to decide whether the -20m depth contour is the optimal choice to mark the seaward end of the coastal foundation. A shallower border would save a lot of ship time and thus costs of the trailing hopper suction dredgers.
- Only in exceptional cases, a hard-substrate coastal defence using concrete or basalt, or a tarmac coating is considered, like the dam near the lighthouse in the north-western part of Texel.

Model calculations at Utrecht University show, that the historical 100-150 year cyclicity of the Marsdiep / Noorderhaaks tidal delta will not be interrupted by the consequences of the construction of the 'Afsluitdijk' in 1932.

Large sand particles do not move in suspension, but as 1-15 m high sand dunes on the sea bottom that move at a velocity of meters per year in the direction of the residual current. These observations have direct consequences for constructions at sea. These sand dunes are also observed in the Marsdiep tidal inlet. The Texel ferry (TESO-) project of NIOZ has also shown that most of the suspended particulate matter is transported well below the sea surface. As a consequence, satellite observations underestimate this transport through the Marsdiep tidal inlet by an order of magnitude. These results will be used in a research project on the consequences of building the "Maasvlakte-II" for the transport of sediment along the Dutch coast.

New Gateways for Marine Research

Contacts between research, policy, non-governmental organizations and stakeholders using the North Sea should be intensified and implemented policy measurements should be thoroughly evaluated before new changes are introduced; with the goal to learn from each other and optimize our practices in interaction with high quality survey programmes.

Recently, a number of reports on the organisation of marine research in the Netherlands have appeared. They all conclude that the quality of research is very good to excellent and for our country highly relevant, but they also criticise the fragmentary organization. In reaction, the field has started to reorganize itself.

- The new Delta-institute will be an applied research institute with a primary focus on civil and engineering expertise. Delft Hydraulics, GEO-Delft and parts of the Institute for Coastal and Marine Management-RIKZ and TNO will participate in it.
- Wageningen TNO Marien will supplement the Delta-institute in that it will focus primarily on applied marine ecology, with biology and chemistry as its primary disciplines. Participants are RIVO, Alterra and TNO. This organization has formally started on 1 January 2006.
- The National Programme for Marine and Coastal Research of NWO focuses on sustainable human use and conservation of marine environments. The challenges are most urgent in the intensively used Wadden Sea and the Dutch coastal zone of the North Sea, but they also play a role in the open oceans and Polar Regions.

More information on the North Sea days is given on the web-site www.noordzeedagen.nl (in Dutch)

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