



# IZEUT Identification of Belgian maritime Zones affected by EUTrophication

Implementation of the OSPAR Common Procedure  
to combat eutrophication

Promoter : Christiane Lancelot<sup>1</sup>

Véronique Rousseau<sup>1</sup>, Elsa Breton<sup>1</sup>, Bart De Wachter<sup>2</sup>, Adnène Beji<sup>1</sup>,  
Mieke Deconinck<sup>2</sup>, Jurgen Huijgh<sup>2</sup>, Tiene Bolsens<sup>2</sup>, Dirk Leroy<sup>2</sup> and Christiane Lancelot<sup>1</sup>

Universiteit Antwerpen

<sup>1</sup>Université Libre de Bruxelles, Ecologie des Systèmes Aquatiques (ESA),

<sup>2</sup>Environmental Consultancy and Assistance N.V. (ECOLAS)

## Context

As Contracting Parties of the OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, Belgian authorities adopted the Common Strategy to combat eutrophication in the OSPAR maritime area. The long-term objective for 2010 is to achieve and maintain a healthy marine environment where eutrophication does not occur. In this scope Belgian authorities agreed to classify their maritime areas as 'problem' areas, 'potential problem' areas and 'non-problem' areas with respect to eutrophication using as a tool the Common Procedure for the identification of the eutrophication status of the maritime area edited by OSPAR (OSPAR 97/15/1-annex 24). As scientific support to fulfil this obligation, the project IZEUT aims to develop and applicate internationally-recognised eutrophication criteria for the identification of 'problem', 'potential problem' and 'non-problem' areas in the Belgian coastal waters. When established, the criteria will offer an harmonised set of quantitative assessment parameters for providing international agreement on priority areas concerning eutrophication.

## Scientific approach for eutrophication assessment criteria

### *Guiding principles*

The development of appropriate assessment criteria is fundamental in the Common Procedure as these will be used for identification of the current eutrophication status of marine coastal waters but also for assessment of the effectiveness of future implemented measures for nutrient reduction. Important principles such as application of the precautionary principle and that environmental damage should, as a priority, be rectified at source are guiding the current OSPAR strategy for the implementation of the Common Procedure. The current situation of OSPAR recommendations in this matter is the arbitrary nutrient over-enrichment threshold defined as 150 % of the background (historical or geographical) value the latter to be identified for each OSPAR maritime areas or well-defined eco-regions.

While including the above OSPAR recommendations, IZEUT adopted a different strategy based on a combination of scientific analysis and socio-economic methods in order to cope with the complexity of coastal ecosystems submitted to natural and human-induced pressure and the actual environmental and societal stakes. More specifically the strategy chosen to develop the criteria is based on a first assessment of the undesirable symptoms of eutrophication in Belgian coastal waters based on scientific literature and surveys conducted among the fishermen and tourists communities. This multi-criteria analysis would allow to define ecological quality criteria which in turn can be related to nutrient enrichment and allow identification of nutrient thresholds.

### *Current knowledge on eutrophication-related problems in the Belgian coastal waters*

The Belgian Coastal Zone (BCZ) is part of the nutrient-enriched eastern Southern Bight of the North Sea invaded every spring by undesirable algal blooms reaching biomass higher than 30 mg Chl a m<sup>-3</sup>. BCZ is a highly dynamic system with waters resulting of the mixing between the in-flowing Atlantic waters and freshwater inputs from the IJzer, Scheldt and

Rhine rivers. As suggested by model simulations (K. Ruddick, unpublished), the geographical extent of the river plumes varies mainly as function of wind, with tidal effects giving smaller scale modulations. The wind is in turn related to the North Atlantic Oscillation (NAO) index (Rogers, 1997). Nutrient enrichment of BCZ is therefore a complex process resulting from the combined effects of anthropogenic and meteorological forcings. The overall nutrient enrichment of BCZ reflects the cumulative inputs from atmospheric and direct sources, Scheldt, IJzer and Rhine rivers, local benthic remineralization and the inflowing Atlantic waters themselves enriched by nutrient loads of rivers Seine and Somme. The relative importance of each of these different nutrient sources in BCZ is not known and varies locally. A preliminary budget of atmospheric, nutrient-enriched inflowing Atlantic and riverine fluxes of inorganic nutrient ( $\text{NO}_3$ ,  $\text{NH}_4$ ,  $\text{PO}_4$ ,  $\text{Si}(\text{OH})_4$ ) has been established for 1992 at the scale of BCZ. This budget evidences the major responsibility of inflowing Atlantic waters to the nutrient inputs in the area. It also shows a significant exportation of  $\text{NO}_3$ ,  $\text{NH}_4$  and  $\text{PO}_4$  towards adjacent northern areas. These trans-frontier flows of nutrients argue for the development of eutrophication assessment criteria on a regional level, i.e. the eastern Southern Bight of the North Sea, in co-operation with bordering countries.

Eutrophication phenomenon in the eastern Southern Bight of the North Sea is related to *Phaeocystis* colony blooms. The success of this non-siliceous phytoplankton results of both its ability to use the excess nitrate in P-regenerated conditions (Rousseau, 2000) and its "resistance" to grazing (Gasparini *et al.*, 2000). It has also been shown that most of organic matter derived from ungrazed colonies is remineralized in the water column by intense bacterial activity (Rousseau *et al.*, 2000). Although this could create locally some transient oxygen depletion, no serious oxygen problems have been reported in Belgian coastal waters in particular and more generally in the eastern part of the Southern Bight of the North Sea, due to the prevailing hydrodynamical conditions that oxygenate the coastal waters. Most adverse impact of *Phaeocystis* colony blooms has been reported as deposits of foam on the beaches or as clogging fishing nets.

#### *Perception of the eutrophication phenomenon and socio-economic assessment of Phaeocystis-related damages*

Reports of *Phaeocystis*-related damages were up to now mostly anecdotal. The qualitative perception of *Phaeocystis* blooms and their related-damages was for the first time assessed by conducting surveys amongst the coastal civilian and fishing communities. The coastal civilian community, composed of a majority of tourists, are weakly familiar with the eutrophication phenomenon. Foaming is considered as a minor nuisance compared to other forms of environmental disturbance such as oil pollution, garbage or dead jelly fishes on the beaches, bad weather conditions. The socio-economic impact of foam-related events was assessed by estimating the resulting economic losses for the tourism industry. On the basis of the survey results and considering the recurrent presence of foam on the beaches, the negative economic effects of foam was estimated to  $3.85\text{-}5 \cdot 10^6$  euros.

The impact of eutrophication on fishing activities was assessed by surveying fishermen working in Belgian coastal waters. The main reported fished species in the period February - June, are flatfish (sole, plaice, limon sole), shrimp and roundfish (cod, whiting). Most of the fishing grounds were shown located relatively closed to the coast. Fishermen were familiar with the occurrence of algal blooms but generally did not perceive them as a major nuisance. Some of them acknowledge however that algal blooms impact their fishery activities by clogging of nets and consequently a more frequent net raising during bloom periods.

### *Identification of Belgian maritime zones affected by eutrophication*

Our socio-economic approach of *Phaeocystis*-related damages leads to the conclusion that *Phaeocystis* blooms are not perceived as a nuisance and induce only a very limited economic losses. The identification of eutrophication status of Belgian coastal waters can therefore not be derived from criteria based on undesirable effects. The identification of eutrophication-related 'problem', 'potential problem' and 'non-problem' areas in Belgian coastal waters, was established on the basis of mapping of the winter stock of nutrients which is routinely measured in OSPAR maritime areas.

### **Conclusions**

The delimitation of zones in Belgian coastal waters, as made in IZEUT, is an iterative process that should be reconsidered according to the use made of coastal waters. Development of aquaculture activities in BCZ could well lead to a different zonation due to the impact of *Phaeocystis* blooms on filter feeders. In the same way, a better knowledge on the adverse effects of *Phaeocystis* blooms on ichthyofauna, fish nurseries and benthic animals could well lead to a reassessment of the delimitation of maritime zones. The impact of *Phaeocystis* blooms in adjacent northern areas characterized much higher residence time such as Dutch and German Wadden Sea and the German Bight, still need to be assessed.

Addressing these crucial scientific and societal questions is to our point of view one of the most important challenging research option for developing well-sound ecological criteria in the context of sustainable development.

### **References**

- Gasparini S., M.-H. Daro, E. Antajan, M. Tackx, V. Rousseau, J.-Y. Parent & C. Lancelot (2000) Mesozooplankton grazing during the *Phaeocystis globosa* bloom in the Southern Bight of the North Sea. *J. Sea Res.* 43: 345-356
- Rogers, JC (1997). North Atlantic storm track variability and its association to the North Atlantic Oscillation and climate variability of northern Europe. *J. Climate.* 10:1635-1647.
- Rousseau V., Becquevort S., Parent J.-Y., Gasparini S., Daro M.-H., Tackx M., Lancelot C. (2000) Trophic efficiency of the planktonic food web in a coastal ecosystem dominated by *Phaeocystis* colonies. *J. Sea Res* 43: 357-372
- Rousseau V. (2000) Dynamics of *Phaeocystis* and diatom blooms in the eutrophicated coastal waters of the Southern Bight of the North Sea. PhD thesis. ULB. 205 p.
- OSPAR Strategy to Combat Eutrophication (Reference number: 1998-18)  
[http://www: OSPAR.org](http://www.OSPAR.org)