An ecosystem approach towards beach spatial planning

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The Belgian/Flemish coastal zone hosts a complex of space- and resource-use activities with a myriad of pressures impairing environmental conditions both on the coastline and on coastal waters (Willekens & Maes, 2008; De Smet *et al.*, 2010). Specifically at the beach zone, predictions on sea-level rise, storms and flood risk for the North Sea have led to action plans and future coastal defence projects for strengthening the Belgian/Flemish coastline (Roode *et al.*, 2008). As management of beaches is clearly a multi-faceted and complex endeavour, where the interests of several stakeholders need to be combined, coastal managers need to be engaged with ecologists (and vice versa), and beach management needs ecological dimensions. Hence, solid and meaningful biological and ecological information is needed and clear and user-friendly management tools are essential to guide integrative and ecosystem-based strategies to sustainably manage ongoing space-use activities at the Belgian/Flemish coast. Since 1990, enough research data was gathered to (1) establish a scientifically sound and spatially-based biological valuation of the Belgian/Flemish coastal zone (Vanden Eede *et al.*, in prep., 2013), using the marine biological valuation method (Derous *et al.*, 2007b), and to (2) develop an ecological model to predict the ecosystem response of beach nourishment scenarios at different trophic levels. Both management tools would potentially assist local decision-makers and allow for the integration of "nature" at an early stage of policy implementation.

The biological valuation of the Belgian/Flemish coastal zone allowed for the observation of significant trends and patterns in its intrinsic biological value. Detailed analysis of areas under coastal flood risk indicates that the use of biological valuation maps to assist management decisions at low jurisdictional levels is positively promising, for example through the Provincial Spatial Implementation Plans (PRUPs) (Maes & Bogaert, 2008). Still, for an integrative approach, these maps should be considered along with other criteria defined within a solid decision-support system. Further research on the applications of biological valuation to coastal areas is still necessary to enhance the robustness of the tool and consequently strengthen its effectiveness within spatial planning strategies.

For the next years, Belgian/Flemish beaches face a multitude of beach nourishments. If implemented without good ecological practice (Speybroeck *et al.*, 2006) and in combination with other recreational and management activities, beach nourishment potentially threatens habitats which are valuable to several beach-dependent organisms (Speybroeck, 2007). Grain size and slope determine the biodiversity of the beach ecosystem and since both these technical aspects are severely changed during nourishment, it is indispensable to optimize them as much as possible in order to minimise the effects on sandy beach biota. All ecological model simulations indicate that the used nourishment sediment grain size is the dominant factor in determining the effect on the ecosystem, with deterioration of the beach ecosystem after nourishment with too coarse sediment (e.g. >> than 300µm). For the first time, a gradient for median grain size of nourishment sediment could be established: 200-300µm. Although the effect of nourishment slope was less strong compared to the sediment, it also affects species zonation patterns. Furthermore, it is advised to evaluate the beach ecosystem "health" by a combination of different variables (biodiversity,

macrobenthos biomass) since focusing on one variable can be deceptive as opportunistic species can become very abundant on a beach impacted by nourishment.

References

De Smet L. and A. Volckaert. 2010. Inventory of the socio-economic activities affecting the Belgian marine waters and the related developments within the European Marine Strategy Framework Directive 2008/56/EC: Final report.

Derous S., E. Verfaillie, V. Van Lancker, W. Courtens, E.W.M. Stienen, K. Hostens, I. Moulaert, H. Hilewaert, J. Mees, K. Deneudt, P. Deckers, D. Cuvelier, M. Vincx and S. Degraer. 2007a. A biological valuation map for the Belgian part of the North Sea: BWZee. Final report SPSD II, Belgian Science Policy, Brussels, Belgium: 99 (+ Annexes).

Derous S., T. Agardy, H. Hillewaert, K. Hostens, G. Jamieson, L. Lieberknecht, J. Mees, I. Moulaert, S. Olenin, D. Paelinckx, M. Rabaut, E. Rachor, J. Roff, E.W.M. Stienen, J.T. Van der Wal, V. Van Lancker., E. Verfaillie, M. Vincx, J.M. Weslawski and S. Degraer. 2007b. A concept for biological valuation in the marine environment. Oceanologia 49 (1):99-128.

Maes F. and D. Bogaert. 2008. Who rules the coast? Policy Processes in Belgian MPAs and Beach Spatial Planning. Maklu.

Roode N., G. Baarse, J. Ash and R. Salado. 2008. Coastal flood risk and trends for the future in the North Sea region: results and recommendations of Project Safecoast: Synthesis report. The Hague: 136.

Speybroeck J., S. Degraer and M. Vincx. 2006. Beach nourishment: an ecologically sound coastal defence alternative? A review. Aquatic Conservation: Marine and FreshwaterEcosystems 16:419-435.

Speybroeck J. 2007. Ecology of macrobenthos as a baseline for an ecological adjustment of beach nourishment. Thesis submitted in partial fulfillment of the requirements for the degree of Doctor in Sciences: Biology, Universiteit Gent.

Willekens M. and F. Maes. 2008. Case Study: The Belgian coast. Report under the IMCORE Project.