

IMPACT OF BIVALVES ON CARRYING CAPACITY THROUGH NUTRIENT FEEDBACKS

van Broekhoven Wouter^{1,2}, Karin Troost¹, Pauline Kamermans¹ and Aad Smaal^{1,2}

¹ Institute for Marine Resources & Ecosystem Studies (IMARES), PO Box 77; 4400AB; Yerseke, the Netherlands
E-mail: wouter2.vanbroekhoven@wur.nl

² Aquaculture and Fisheries Group, Wageningen University and Research, PO Box 338; 6700AH; Wageningen, the Netherlands

Bivalves are key species in many estuaries around the world, because of their large filter feeding capacity (Dame & Prins, 1998). They are also widely cultured for food. Ecological impacts can be analysed in terms of ecological carrying capacity. This refers to the maximum level of (in this case bivalve) production that an ecosystem can sustain without unacceptable ecological impacts (McKindsey *et al.*, 2006). The “acceptability” of impacts is determined within the political domain, but the role of science is to provide insight.

Bivalve filter feeders can influence the ecosystem in various ways. Besides removing plankton from the water column by filter feeding, they may also function as a feedback mechanism in terms of nutrient recycling, stimulating growth of particular functional groups (Newell, 2004). For example in the Netherlands, in a study by Prins and Smaal (1994) wild mussel beds in the Oosterschelde estuary increased nutrient availability in summer when phytoplankton was nutrient-limited. In a recent study using a modelling approach, Guyondet *et al.* (2010) also found that mussel culture may be able to alter ecosystem structure through changes in nutrient cycling. However, knowledge gaps remain, for example with regard to remineralisation rates of mussel faeces and pseudofaeces. The aim of this PhD research proposal is to improve understanding of the role of bivalves in nutrient cycling.

This subject is highly topical because of a new development in the Dutch mussel industry. The industry is currently undergoing a transition whereby wild seed catch is gradually being replaced by seed collector systems. These comprise seasonally introduced artificial substrate in the water column which is then colonised primarily by mussels. The mussel seed is harvested at the end of the season and entered into the regular culture cycle. The additional mussel load seasonally imposed on the ecosystem presents questions with regard to its effects on carrying capacity by influencing nutrient fluxes and stoichiometry. The seed collector systems in the Oosterschelde estuary and the Dutch Wadden Sea will be used as the model for this study because of their novel ecological significance, and their novel properties in terms of (age) structure and seasonality. Moreover, the peak of their activity is in summer when the impact of nutrient release on primary producers may be greatest (e.g. Prins and Smaal, 1994).

This study will culminate in a nutrient budget for seed mussel collector systems, which can be used in the assessment of carrying capacity impacts. Elements contributing to this budget include investigation of the growth of mussels and other life on the collectors, effects of crowding, and the fate of excretion products of the mussels. One of the main challenges will be the integration of levels of scale, from individuals to the ecosystem.

References

- Dame R.F. and T.C. Prins. 1998. Bivalve carrying capacity in coastal ecosystems. *Aquatic Ecology* 31:409-421.
- Guyondet T., S. Roy, V.G. Koutitonsky, J. Grant and G. Tita. 2010. Integrating multiple spatial scales in the carrying capacity assessment of a coastal ecosystem for bivalve aquaculture. *Journal of Sea Research* 64:341-359.
- McKindsey C.W., H. Thetmeyer, T. Landry and W. Silvert. 2006. Review of recent carrying capacity models for bivalve culture and recommendations for research and management. *Aquaculture* 261:451-462.
- Newell R.I.E. 2004. Ecosystem influences of natural and cultivated populations of suspension-feeding bivalve molluscs: a review. *Journal of Shellfish Research* 23:51-61.