Planning marine space for mussel farming with focus on use of scientific knowledge – Estonian Case Study

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Summary
The GAP2 Project's Baltic Sea Case Study is actively contributing into development of the actual Maritime Spatial Plan (MSP) for the Pärnu County's sea area in Pärnu Bay (Gulf of Riga, Baltic Sea). Allocation of marine space for feed-mussel farming with aim to clean the water and to produce the high quality mussel biomass for feed production in line with the EU Blue Growth aspirations is an emerging issue for the Pärnu Bay MSP process. By counteracting eutrophication the feed-mussel farming is contributing to a process of "closing the nutrient loop". However, mussel farms compete for space with e.g. coastal fishery, recreation and tourism in the Pärnu Bay. Due to low salinity of Pärnu Bay waters and because of voracious filter feeding ability the zebra mussel (*Dreissena polymorpha*) was chosen as the potential candidate for feed-mussel farming.

Introduction
The first Pilot Maritime Spatial Plan (MSP) for the Pärnu Bay (Gulf of Riga, Baltic Sea) has been developed by the Baltic Sea Regional Programme 2007-2013 BaltSeaPlan Project. Based on the BaltSeaPlan outcome the possible solutions to the problem of integration of fisheries management into the process of MSP are suggested and issue is exemplified the by analysis of the place based management of the herring fishery in the Pärnu Bay (Kopti *et al.,* 2011). The BaltSeaPlan outcome is also used to evaluate the role of the MSP in promoting sustainable economic development including tourism and recreation in the Pärnu Bay sea area (Martin *et al.,* 2013). According to order 441 (11 October 2012) of the Government of Estonia the development of the actual MSP for the Pärnu County's sea area is originated. The MSP related issue of allocating marine space for the potential developments of the feed-mussel farming in the Pärnu Bay is lively discussed now. Discussions are supported by the latest scientific research. Relationships between grazing rates of an invasive bivalve *D. polymorpha* and ambient environmental factors in a turbid eutrophic Pärnu Bay waters are recently studied and published by Oganjan and Lauringson (2014). This paper is focusing on spatial distribution of *D. Polymorpha* in the Pärnu Buy and on the potential solutions related to the actual allocation of marine space for potential feed-mussel farming.

Materials and methods
Extensive fieldwork was carried out in 2011-2012 with aim to acquire necessary scientific knowledge on *D. Polymorpha* in Pärnu Bay. In total 140 concrete blocks were deployed by a diver on the sea bottom along transects covering different environmental conditions at the depths between 0.5 and 5 m. 3 replicates of samples were collected from the blocks using non-standard frames with dimensions of 7x7 cm and 10x10 cm with aim to explore *D. polymorpha* attachment and growth. In laboratory samples were sorted, all of the invertebrates and macrophytes found in the samples were counted and determined to the lowest possible taxonomic level. Based on theoretical assumptions a set of environmental variables was chosen for analyses. The impact of different environmental factors on the spatial distribution of mussels was explored using the Boosted Regression Tree technique (BRT).

Results and discussion

The BRT modelling explains more than 90% of *D. polymorpha* spatial distribution pattern related to variability of environmental factors concerned. Results are suggesting the most significant relation to slope and depth of the bottom. Abundance of mussels grew with increasing inclination of substratum. However, the depth being a proximal variable, expresses effects of several direct variables or their combinations.

The possible marine space allocation for potential mussel farming is building on a principle of spatial efficiency and co-use of marine space. Rather good overlap of marine areas characterized by high standardized abundance of *D. Polymorpha* and of marine areas used by seasonal coastal spring spawning herring trap-net fisheries are suggesting the option of combined use of these marine areas (Figure). Similarly to feed-mussel farming fishery counteract eutrophication, by removing considerable amounts of nutrients through fish landings - the content of N and P in the Baltic Sea herring is 2.4% and 0.43% of the wet biomass (Hjerne and Hansson, 2002).

The planned wind park sea area could also be co-used for the future feed-mussel farm installations. However, the technical suitability of this option still needs to be studied in further details.

If necessary, there is sufficient suitable sea area to be used even for large scale feed-mussel farming in the Pärnu Bay.

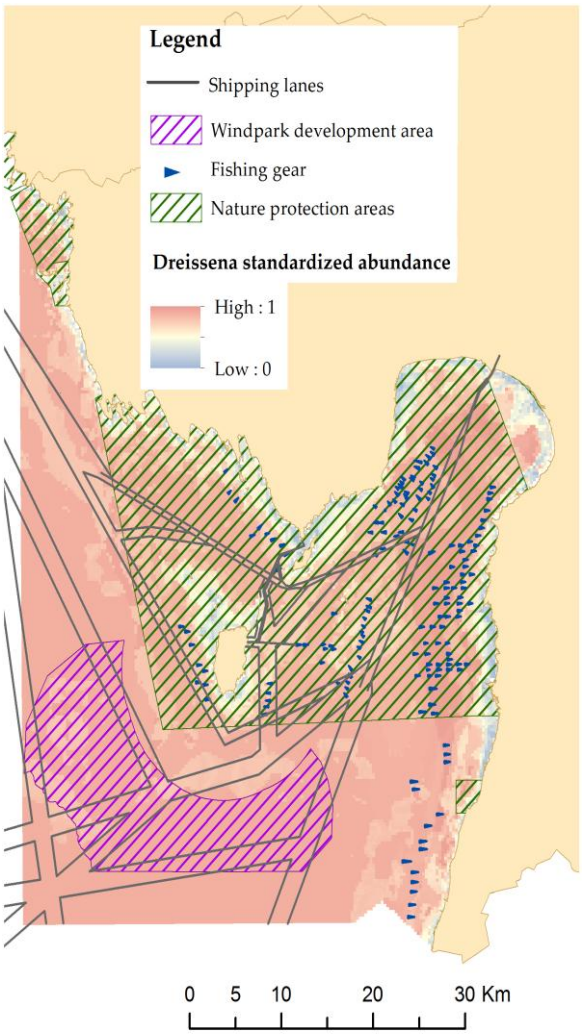

Figure. Spatial distribution of *Dreissena* standardized abundance against the background of shipping lines, planned wind park development area, fishing gear positions, and nature protection areas.

References

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