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Marina planning in regions of dynamic coasts - ecologically safe and economically efficient approaches for the future

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Leisure boating is increasing all over the world, including in the Baltic Sea region. The highest increase is expected on its eastern coast – in countries of the former Soviet Union. Until the beginning of the 1990s, it was not possible to own a leisure boat in the USSR. After gaining independence, access to the sea was no longer restricted but it has taken a long time to get used to the idea that the sea is open for everyone. The economy of the Baltic countries has improved significantly over the last 30 years and the number of people affording leisure boats is rapidly growing. As a result, we need more marinas for safe and tourist-friendly boating. However, most of the old ports and their infrastructures were destroyed by the Soviet regime. Therefore, we needed to start from almost zero.

Developing small marinas is expensive. Many things can go wrong, especially when natural conditions are not thoroughly analyzed. That is why scientific research during the planning process is an important investment. An example is taken from a very small marina that had major problems with siltation. This marina is located on the northern coast of Estonia, in the region where dynamic sandy beaches quickly alternate with stable till shores.

The aim of the work was to find solutions to stop the siltation of the marina, to enlarge the volume of the marina without affecting the nearby sandy shores and to create the preconditions for Natura 2000 habitats while preserving the initial environment as much as possible. We developed a research methodology including: a) analysis of old maps showing historical coastal changes and processes; b) geophysical research accompanied with sediment coring and taking sediment samples for laboratory analysis; c) modeling the effects of shore processes to the marina and vice versa.

After several modeling exercises with different configurations of the marina, we reached satisfying solutions. Due to very fine-grained sand, it is impossible to completely avoid sediment influx into the marina. However, the final configurations need slight dredging only once in 6-8 years. We also found a solution how jetties can contribute to the healthy state of the nearby public sandy beach. The marina is located on the western side of a small peninsula with till shores. Just west from the marina is a natural sandy beach where sands are moving back and forth along the coast depending on storms. We designed the western jetties to look and function like the initial

peninsula and the new marina is like an extension of the peninsula. The extracted sand from the aquatic area should be placed on the sandy beach. The added sand combined with reduced sediment movement would leave the natural beach in a more or less stable state even in the case of global sea level rise. The outer boundaries of the marina jetties look like a natural till shore. It absorbs waves' energy, inhibits sand transportation to the open sea and creates preconditions similar to natural till shore habitats.