EVALUATION OF THE SEA-FLOOR INTEGRITY IN LITHUANIAN BALTIC SEA WATERS

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Nowadays coastal and maritime activities are becoming more intensive and variable. Traditional marine activities as fisheries, shipping, coastal recreation are supplemented by new economic developments such as aquaculture, offshore oil extraction, alternative energy production, electricity connection lines, gas pipelines and LPG terminals and lots of other developments in marine space. Offshore wind energy development is becoming a challenge of the first importance. However, traditional activities are still keeping their place and also expand pretty rapidly. Furthermore, pressure at the coast for tourism and recreation space is growing, along with the demand for both residential property and holiday homes. Also natural values are of the great concern and it is considered to expand the marine area of protected and NATURA 2000 territories. All these activities impact the marine ecosystem and on the other hand they are being impacted by the quality of marine environment. For example fisheries and recreation are directly dependent on the marine state and unsustainable use of marine resources could negatively impact not only the marine environment, but also the human activities at the sea.

Seeking to ensure the implementation of long-term sustainable development targets and objectives at the marine areas in 2008 The Parliament of European Union approved The Marine Strategy Framework Directive (2008/56/EC) (MSFD) which states the most important milestones for marine environment protection. This directive foresees that implementing economic activities in the marine area its characteristic, natural processes, protected habitats and sensitive species have to be taken into account. First step for implementing this MSF directive is to analyse the characteristics of the marine environment and the pressure of the existing activities, evaluate the common state of the marine environment.

In the MSF directive there are listed eleven Qualitative descriptors for determining Good Environmental Status. Seeking to avoid negative subsequence of physical changes of the environment two special descriptors have to be analysed: hydrographical conditions and sea-floor integrity. It is important to answer two questions: whether irreversible changes of hydrographical conditions could have negative impact on marine ecosystem? and is the sea-floor integrity retained enough to ensure that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely affected?

This presentation will focus on evaluation of sea-floor integrity identifying current state of the bottom, its characteristics, current and planned economic activities in the Lithuanian Baltic Sea aquatory. Criteria for the evaluation of this MSFD descriptor will be discussed.

There is no single opinion in European Union (Borja A., *et al.* 2011) or in the Baltic Sea region what criterion should be used for evaluation of the rate of changes of physical environment and what quantitative value have to be used for assessment of those criteria. This is mostly because of very different physical environment in different geographical latitudes. Even the Baltic Sea itself is different when talking about sea-floor physical conditions. For example, in the bottom of Gulf of Finland crystal rocks formed millions of years ago can be found, and in Lithuanian aquatory marine bottom is covered with glacial and postglacial sediments aged by only few thousand years.

Physical characteristics of the sea-floor can be changed because of the impact of human activities: relief, composition of bottom deposit. Depending on the rate of the impact and particular sea-floor area characteristics these changes can have or not to have negative impact on biotopes and on general condition of the ecosystem. For the evaluation of the state it is important to monitor human impacted bottom areas and its proportion with not impacted bottom.

So firstly the physical damage of the sea-floor done by human activities has to be evaluated taking into account characteristics of bottom sediments (substrate). This criteria is very important in the areas of intensive trawling, damping and sediment extraction places; in all are areas where physical changes of the sea-floor can have a direct impact onto bottom biotopes.

Physical environment of the sea-floor also could be described by relief and sediments. These features together with hydrologic conditions determine the structure of biotopes. 4 types of substrates could be defined: 1) soft substrate – fine sand and mud (size of particles < 2mm), 2) gravel substrate – gravel and pebbles (size of particles from 2mm up to 256mm), 3) hard substrate – boulder, main rocks (particles size >256mm), 4) biogenic substrate - shelly ground (Ricea J., *et al.* 2012). In the Lithuanian Baltic Sea aquatory first three types of substrate are common: soft substrate – sand, silt and mud; gravel substrate – gravel, pebbles and different sand and hard substrate – boulders, moraine and clay. Soft substrate type is being formed by modern sediment and other substrate types – mostly by earlier geological periods and earlier Baltic Sea development stages. Because of changed sedimentation conditions and deposit material sources lythological composition of sea-floor deposits and limits of distribution of different sediments type could be changed. In the Lithuanian Baltic Sea bottom already there are areas of damped deposits. This shows that sea-floor is already affected by human activities. In Lithuanian aquatory activities that mostly affect changes of physical characteristic of the sea-floor are damping of dredged material of Klaipeda sea port, sand extraction for beach nourishment, and trawling by bottom trawls. There was no research of the trawling impact on the Lithuanian Baltic sea-floor conducted, so only areas where this activity is going on can be defined.

It is foreseen that in the future more intensive use of marine areas will have more impact on the sea-floor. There are plans to built an electricity cable from Sweden to Lithuania, reconstruction of Sventoji Sea port already begun, plans to build a new deepwater port and to develop the offshore wind energy are considered. So identification of sea-floor areas impacted by human activities is one of the objectives of evaluation of good marine environment status. For the evaluation of the Good Environmental Status identification of changes of areas of lythological types of deposit could be used.

Evaluation of changes of hydrodynamic conditions is also very important for Lithuanian aquatory. Klaipeda state sea port is situated in the Klaipeda straight which connects Curonian lagoon with Baltic Sea. Deepening of the port impacts the hydrological conditions and water exchange between freshwater Curonian lagoon and saline Baltic Sea.

Development of the port impacts changes of hydrological conditions and sediment transport, and also coastal dynamics. More and more saline water comes into the freshwater Curonian lagoon because of the deepening of Klaipeda state sea port. Increasing the depth, reconstructing and building new hydrotechnical equipment the distribution of water outgoing from Klaipeda straight is changing. Changed hydrological conditions can affect all ecological situations.

Developing the port new breakwaters are build, entrance channel is deepened. This affects the dynamic of waves and currents, sediment transport and state of coast. Tendencies of coastal dynamic were changed by reconstruction of port breakwaters and deepening of port entrance channel. Before the reconstruction of the port breakwaters beaches situated close to the port entrance was stable, and recently they are eroded. Opposite tendencies are on the coast of Curonian Spit – after the reconstruction of breakwaters accumulation of the sediments started and the beach widened. No threshold values are set for the hydrological parameters. Collection and analysis of data are necessary, highlighting tendencies of extreme occasions. Coastal conditions could be assessed by monitoring changes of coastline position and sand volume on the beach.

Identification of activities impacting the sea-floor integrity, defining sea bottom areas which are already under the pressure of on-going human activities will serve as a basis for preparation of the programme of environmental measures which could help to achieve or maintain good environmental status in the marine environment.

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