BONUS BALTICAPP policy brief no. 1

Our policy briefs are summaries of scientific knowledge produced in BONUS BALTICAPP, connected to current management and policy actions concerning the Baltic Sea. The briefs engage in and respond to important issues that support long-term sustainability of ecosystem goods and services of the Baltic Sea.

Exploring plausible Baltic Sea futures

– 'food for thought' for the design of marine policies

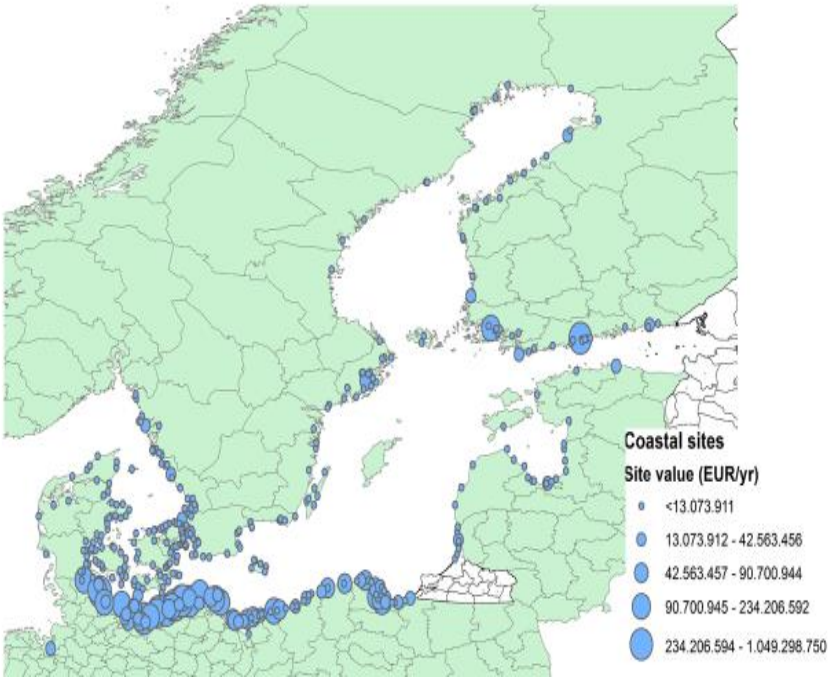
Baltic Sea countries can reach the goal of a healthy sea. However, changing climate and the forthcoming socioeconomic developments will set the challenge. Technological progress and urbanization are plausible trends that would make it easier to reach the goal of good environmental status (GES) while increased demand for animal products would be a hindrance.

Wellbeing for all

Our wellbeing is dependent on marine environments in several ways. Landscape, recreation and historical sites are part of everyday life for many people. The sea is part of our identity. We learn and get new ideas from sea experiences. Especially coastal areas around cities are important hotspot areas of recreation due to high numbers of visitors. The most typical activity is walking along the beach. Over 70% of the population in the Baltic Sea area uses the marine environment for recreation, meaning over 80 million recreation visits annually.

Baltic Sea as a human-environment system

The Baltic Sea is a vulnerable ecosystem that is significantly influenced by human activities and the climate system. Changes in anthropogenic and natural drivers alter the level of pressures such as nutrient loading and fishing effort, and affect the functioning and structure of the marine ecosystem.



Estimates of the recreational value of Baltic Sea coastal sites based on numbers of recreational trips, travelling costs and a spatially explicit random utility model

Causal chain of interactions between the human and natural systems essential for the contribution of the Baltic Sea marine environment to our wellbeing

As a result, the flow of marine ecosystem services and sea-based wellbeing may either increase or decrease in the future.

Mitigation effort to protect the Baltic Sea depends on global drivers

Global warming may reinforce oxygen depletion in the sea, intensify internal nutrient cycling and increase riverborne nutrient loads. These developments will make it more difficult to control eutrophication and to reach the mutually agreed environmental goals (HELCOM Baltic Sea Action Plan, BSAP). In addition, changes in the global and regional socioeconomic drivers such as population size, urbanization, education and life styles have substantial impacts on the mitigation challenge. Some of these drivers, such as technological progress, tend to reduce the challenges to mitigate nutrient loading, while some others, such as increased demand for food and fodder from the region, increase the challenge.

SSP1, Sustainability	SSP5, Fossil-fueled development
• Population in the region and globally peaks and starts to decline after 2050 • Rapid urbanization • Gradual move towards less resource intensive lifestyles	• Global population peaks in 2050, population in the Baltic Sea region increases steadily • Rapid urbanization • Resource and energy intensive lifestyles prevail
• Increased plant based diet • High N efficiency, high share of local & organic products • Reduced agricultural land cover & livestock	• Increased meat and dairy products in diet • Globalised, export oriented sector, intensification • Increased livestocks => expansion of agricultural land cover
• Tertiary treatment becomes the standard • Separation of rainwater and sanitation • Advanced on-the-site treatment common in rural areas	• New investments made to serve growing urban areas • focus on human health rather than environmental quality • Some upgrading due to technology spill-overs
• Sustainable fisheries with high quality products • Circular economy in aquaculture • Small-scale, low impact fishes promoted • Avoidance of habitat damaging gear and bycatch	• Large-scale fishing focusing on maximising profits • Habitat destructive gear and bycatch allowed • Industrial scale development of freshwater and marine aquaculture with no nutrient focus

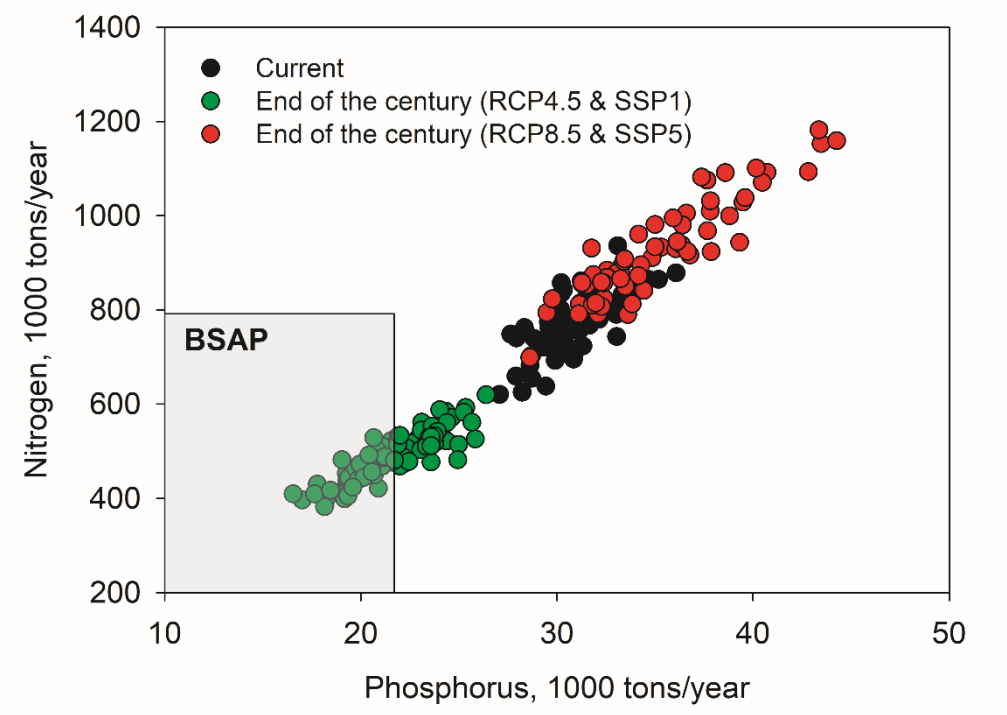
Extension of two extreme global futures to the Baltic Sea region. The global futures translate to developments in the regional drivers of agricultural nutrient loading, wastewater treatment and the fisheries

Long-term projections of nutrient loads, prepared for different combinations of regionally extended global socioeconomic futures (SSPs) and regionally downscaled climate futures (RCPs) portray gradually deviating pathways and a wide variety of final outcomes by the end of the current century.

Under the global sustainability scenario (SSP1), nutrient loading will continue to decrease despite climate change. The BSAP goals for nitrogen will be met, but the phosphorus goal remains more difficult to reach. Reaching the BSAP goal for phosphorus in the perspective of 20-30 years would

require substantial additional mitigation efforts compared to today.

Under the SSP5 global future, on the contrary, both nitrogen and phosphorus loads would increase without substantial additional water protection efforts. Reversing this trend would require substantial additional efforts and water policies. Under the fossil-fueled global future, reaching GES in the Baltic Sea is realistic only through dramatic structural changes in the agricultural sector and adoption of policy instruments directed to steer consumer decisions, or alternatively, a yet unforeseen technological leap in manure handling.



Annual variability in nutrient loads to the Baltic Sea currently (2010-2030) and at the end of the century (2078-2098) for combinations of global sustainability and medium climate change (SSP1 & RCP4.5) and fossil-fueled development and high-end climate outcome (SSP5 & RCP8.5).

Socioeconomic drivers more important than climate change

Fisheries regulation, climate change and nutrient pollution alter the functioning and structure of the Baltic Sea ecosystems and food webs. Overall, nutrient load changes under SSP1 or SSP5 are the main driver of marine ecosystem changes and are more important than projected changes in climate.

Under SSP1, reduced nutrient inputs lead to improved bottom oxygen conditions, reduced number of blue-green algae blooms and improved water quality, which contribute to the maintenance of suitable habitat conditions for many Baltic Sea organisms, irrespective of the assumed climate change. However, projected salinity changes and increased temperature may compromise local efforts to promote species diversity. According to our model simulations, the predator/prey proportion remains balanced, and the Baltic Sea ecosystem will be able to provide highly valuable fish.

Under SSP5, i.e. with high nutrient loads, the impact of a changing climate on the marine ecosystem would be considerable and more important than under low nutrient conditions because it reinforces primary production and oxygen depletion of the deep water. Benthic fauna and bottom-feeding fish will suffer from deteriorated seafloor conditions.

On the other hand, pelagic fish living higher in the water column may benefit from increased primary and zoo-plankton production. Under SSP5, fish catches will focus on smaller and less-valued pelagic fish mostly caught for industrial purposes, e.g. to be processed as animal feed.

People living around the Baltic Sea countries value highly the sustained provision of marine ecosystem services. Opportunities for water recreation: swimming, sailing and fishing are highly prioritized. However, even more important are improvements in ecosystem health and species diversity.

Key concern: food

Reaching the GES of the Baltic Sea will be in the hands of the riparian countries. However, the magnitude of the challenge to control nutrient loads and fisheries will remain conditional on the magnitude of climate change, global socioeconomic drivers (population change, life styles) and regional developments in the core sectors (agriculture, waste water treatment and fisheries).

The agricultural and fisheries sectors operating in the Baltic Sea region provide food mainly for local consumption, but also for global markets. Global warming is expected to impair the conditions for agriculture in many parts of the world that are currently strong in food production. This may improve the relative competitiveness and lead to expansion of fisheries and agricultural sectors in the Baltic Sea region.

The key concern to be addressed by the current and future policy makers is: how to reconcile our needs associated with food production and healthy aquatic environments?

RECOMMENDATIONS

Extending the impacts of megatrends and plausible global developments to the Baltic Sea region help us to identify opportunities and risks that need attention in the design and implementation of environmental policies:

- Make use of emerging opportunities and innovations across sectors. Encourage technology adoption and diffusion to develop new abatement technologies.
- Get prepared for plausible undesired developments in the underlying drivers of marine pollution and extraction, and adjust the policy and mitigation effort accordingly
- Apply iterative and adaptive policy process consisting of periodic assessment and re-evaluation of the mitigation effort needed

Scenarios and integrated modelling may serve policy processes such as implementation of the HELCOM Baltic Sea Action Plan and EU Marine Strategy Framework Directive

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