

Topics for Master- and Bachelor-Theses 2024

Leibniz-Institute for Baltic Sea Research (IOW), Coastal & Marine Management Group

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In case you are interested in topics, please send us your CV, your potential starting date and indicate the topics. Afterwards, we will meet (in IOW, room 400, or via ZOOM) and discuss the suitability of the topics based on your interest, educational background, future perspectives as well as the requirements of your university and your language capabilities (German/English).

Ecosystem Service provision of changing coastal seas

Ecosystem services are the benefits people obtain from ecosystems. Individual and expert group based assessment methods, as well as different Ecosystem Service concepts (potential/demand) will be applied using a wide range of data (monitoring, maps, literature, expert knowledge)

- **Heavy storms** (Schernewski) - Analysis how recent extreme storms affected the coastline and the provision of Ecosystem Services of coastal areas. A comparative study using an Ecosystem Service assessment approach.
- **Wind farms** (Schernewski) – Analysis how selected wind farms affect Ecosystem Service provision in the coastal sea. Additionally, complementary activities within wind farm areas, such as aquaculture, nature protection, boat tourism will be assessed.
- **Re-powering of wind farms or conversion?** (Schernewski) – Several wind farms are old and can either re-powered or face a conversion (different use). Possible uses after a wind farm deconstruction will be compiled and assessed with an Ecosystem Service assessment approach.
- **Floating solar power plants** (Schernewski) – The construction of large floating solar power plants in lagoons and coastal waters are under discussion. How could it look like and what are the consequences for coastal areas. A comparative study using Ecosystem Service assessments.
- **Bathing water quality** (Schernewski) – How important is a good water quality for coastal development, especially tourism? How do new human pathogens (e.g. vibriosis) or an increased awareness of infection risks affect the Ecosystem Service provision of southern Baltic Bathing waters, taking into account possible future changes due to climate change
- **Recovery of macrophytes** (Schernewski) – What are the consequences of the wide-spread re-settlement of macrophytes along the southern Baltic waters. A comparative study using an Ecosystem Service assessment approach.
- **Invasive species** (Schernewski) – The round headed goby (benthic fish) invaded southern Baltic waters and caused a destruction of ecosystems. What are the consequences of the destruction and modification of benthic ecosystems for the provision of benthic ecosystem services?

- **Blue algae blooms** (Schernewski) – Models indicate that climate change might cause an increased amount, coverage and duration of potentially toxic blue algae blooms. What are the consequences for the provision of marine and coastal ecosystem services?

Ecological water quality and its management

- **Climate Change: What can we learn from hot years?** (Schernewski) – Recent very hot years provide an idea how average years may look like in 30 years. What can we learn from it and how will our coastal ecosystems change? The work includes a comparative assessment between recent extremely warm years compared to average years. The work focusses on the Oder Lagoon, a large ecosystem with outstanding economically and ecologically importance. Basis are monitoring data of the last 40 years and long-term data provided by an 3D ecosystem model.
- **Artificial reefs - a suitable nature conservation measure?** (Schernewski) The example of the reef in Nienhagen: The Baltic Sea is a geologically young sea with strong salinity gradients and, therefore, only a limited species diversity. Especially the very limited availability of hard substrate is a problem and restricts the growth and spreading of many species. A problem that partly results from stone fisheries (removal of stones) during the last centuries. Objectives/tasks: Assessment to what extent the reef habitat differs from the habitats in the surrounding sea and critical evaluation whether the reef enhances biodiversity, can serve as stepping stone for the spreading and re-settlement of species and is of benefit for the Baltic Sea ecosystem. Discussion whether artificial reefs can serve a cost-effective nature conservation measure on a larger spatial scale.
- **Anti-eutrophication measures – macro-algae** (Schernewski) – Eutrophication is still a major problem in German coastal waters. The reduction of external nitrogen and phosphorus loads is often insufficient. Therefore, internal measures are under discussion. One of them is the establishment of macro-algae farms with the aim to provide habitats and remove nutrient with the harvest. Aim is an assessment whether this is ecologically reasonable and cost-effective in the Baltic Sea or its coastal waters. An analysis based on case studies, existing literature and long-term monitoring data.
- **Anti-eutrophication measures – phosphorus precipitation** (Schernewski) – Eutrophication is still a major problem in German coastal waters. The reduction of external nitrogen and phosphorus loads is often insufficient. Therefore, internal measures are under discussion. One of them is the reduction of phosphorus concentrations in the water body using a precipitation with different chemical compounds. Aim is an assessment whether this is ecologically reasonable and cost-effective in selected Baltic coastal waters. An analysis based on case studies, existing literature and long-term monitoring data.
- **Eutrophication in coastal water - silicate** (Schernewski) – Analysis of the role of silicate as limiting element for primary production and algae growths (eutrophication) in the Oder Lagoon, the changes in silicate loads and concentrations during the last decades, as

well as the consequences for the ecosystem and eutrophication management. An analysis based on long-term monitoring data.

- **Development of cyanobacteria in the Oder Lagoon** (Schernewski) – Did the ongoing long-term reduction of nutrient loads into the lagoon affect the composition and abundance of cyanobacteria, is there a likelihood that loads reductions are compensated by atmospheric N-fixation and is there any evidence of toxic species and toxin production? An analysis based on case studies, existing literature and long-term monitoring data.
- **Assessment of artificial light pollution during night** (Piehl) – Inventory, classification and mapping of various sources of underwater light pollution in the western Baltic Sea. (*Which are the most important sources?*) Assess the sensitivity of different water bodies to underwater light pollution based on view parameters (e.g. optical properties) in order to derive underwater light pollution maps. Assess the sensitivity of relevant organisms to light pollution to derive sensitivity ranges that can be used as thresholds for classifying impacts on marine habitats. (*Which are the most sensitive water bodies and species?*) Combination of pollution and habitat maps in order to derive habitat vulnerability maps. (*Which are the most impacted areas? - Overlap of most sensitive water bodies and habitats*)
- **Extreme weather events** (Piehl) - Impacts of extreme weather events on water quality in the Baltic Sea are not yet considered and thus the implementation of marine policy (MSFD) need to be critically assessed. Several extreme events occurred in the last decades and will be retrospectively analysed for their influence on current monitoring and assessments strategies of water quality indicators (e.g. oxygen deficiency, algae blooms). What is the influence of extreme events on I) existing monitoring strategies and II) on status assessments and trend analysis?
- **Development of an ecological relevant oxygen indicator** (Piehl) – In order to address the link between biodiversity and oxygen stress, existing oxygen deficit indicators shall be linked more closely to the existing HELCOM benthic biodiversity indicator (BQI). For the western Baltic Sea, the relationships between oxygen deficiency and the BQI should be analysed in depth. Further, if target values for the oxygen deficit indicators can be derived from the good condition according to the BQI and whether these are comparable to the oxygen situation around 1960.
- **Use of satellite data for seagrass detection: a complementary method to existing monitoring?** (von Thenen)

Seagrasses play an important role in coastal waters. At the German Baltic Sea coast, the state agency for environment, nature protection and geology is responsible for monitoring the seagrass meadows. However, the monitoring is not done in a high temporal resolution. Therefore, the study aims to investigate the use of satellite data as a complementary monitoring method. A supervised classification with google earth engine shall be applied to map the seagrass distribution along the German Baltic Sea coast and be compared to the monitoring data from the state agency.

Marine protection and nature-based solutions

- **Coastal protection** (Schumacher) - How can coastal protection deal with climate change, especially sea-level rise. Are sand nourishment and oyster banks environmentally friendly protection approaches and how do they affect sand transport in the shallow North Sea? A comparative study using an Ecosystem Service assessment approach.
- **Designation and Extension of Marine Protected Areas** (Schumacher) – To protect and restore marine habitats and species populations, the EU Biodiversity Strategy sets a target of legally protecting at least 30% of marine area by 2030 (with 10% of marine area under strict protection). Despite an increase in the spatial coverage of MPAs in European seas their effective implementation is lagging behind and many MPAs are still under intensive human uses. Objective of this study is to assess the suitability of the ecosystem services approach for the designation and zoning of marine protected areas in selected case study areas (in the Mediterranean Sea).
- **Effectiveness of technological marine protection and restoration measures** (Schumacher) – Technological solutions gain increasing interest for the protection and restoration of coastal and marine ecosystems (e.g. for reef and seagrass meadow recovery). Different technological restoration measures suitable for the Mediterranean Sea will be compiled and assessed using an Ecosystem Services assessment approach.
- **Effectiveness of hybrid coastal and marine infrastructures (incl. coastal protection, offshore wind energy & low trophic aquaculture)** (Schumacher) – The integration of nature-based solutions into coastal and marine infrastructures, such as coastal protection, wind energy, port, and aquaculture infrastructures) gain increasing interest to support the preservation and restoration of marine biodiversity and ecosystem services. Objective of this study is to evaluate the social-ecological effectiveness of selected hybrid infrastructures by analyse benefits and potential trade-offs for marine biodiversity and ecosystem services.
- **Retrospective analysis of implemented technological nature-based solutions** (Schumacher) – With the aim to restore marine biodiversity and ecosystem health and services, nature-based solutions for coastal and marine infrastructures (incl. coastal protection, offshore wind farms and low trophic aquaculture) gain increasing interest. Through a retrospective analysis of implemented technological nature-based solutions (based on case studies, literature and expert interviews), this study aims to identify strength and weaknesses in the implementation process and provide recommendations for future developments.

Marine litter

- **Meso- and macro-litter monitoring at remote beaches** (Haseler)- In Europe and many countries worldwide the OSPAR 100m beach litter monitoring method is the standard to assess the pollution of beaches with litter items above a size of 25 mm. The rake method is applied to assess the pollution of beaches with litter items between 25 and size of 2-3 mm (meso litter size fraction). Both method shall be applied at several remote beaches (without seasonal cleaning) to identification the state of pollution as well as spatial and temporal gradients. The gathered data should allow the creation of a list of most common items, the identification of indicator items, the assessment of pollution pathways and sources and shall serve as basis for general mitigation measures.
- **Meso- and macro-litter (plastics) monitoring at urban beaches** (Haseler) - In the Baltic Sea region, the rake method is applied to assess the pollution of beaches with litter items between 25 and size of 2-3 mm (meso-litter size fraction). This method shall be applied especially at urban beaches where seasonal macro-litter beach cleaning takes place. This method is complemented by surveys on macro litter. This means the amount and composition of the daily collected litter during cleaning activities will be assessed. Aims are the identification of the state of pollution as well as spatial and temporal gradients. The gathered data should allow the creation of a list of most common items, the identification of indicator items and shall serve as basis for local mitigation measures.
- **Behaviour of floating meso- and macro-litter (plastics) in the sea** (Schernewski) – The emission of litter, especially of plastic items, is still an important problem and relevant in the Baltic Sea, as well. However, there is a discrepancy between the estimated emitted amounts of floating plastic to the sea and the amount finally observed data in the sea and at coasts. A major reason seems to be that floating plastic, once in the sea, is overgrown with micro-organisms and algae that change the buoyancy and cause a sinking and deposition on the sea bottom. Objective is to assess how fast selected floating items are overgrown, change the buoyancy and turn into sinking particles as well as to discuss the consequences for marine litter pollution. The study will be based on field and laboratory experiments.