

# Ecological compensation on open sea and coastal areas of the Baltic Sea

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## **Ecological compensation on open sea and coastal areas of the Baltic Sea**

The need to protect biodiversity is increasing worldwide. Impacts of human activities, especially eutrophication, have strongly and adversely impacted marine environment in the watershed, coastal and open sea areas of the Baltic Sea. The existing marine protected area (MPA) network is a central component in sustaining biodiversity values of the Baltic Sea. However, even though the MPA network protects important marine and coastal habitats and species, further measures are needed to reduce the rapid de-cline of biodiversity. One additional measure to halt biodiversity loss is ecological compensation or offsetting, where ecological damage caused by human activity is compensated by restoring or protecting biodiversity elsewhere.

### *Ecological compensation*

Ecological compensation is a procedure where the adverse effects on biodiversity caused by human activity at given locality are compensated (or offset?) by restoring or otherwise increasing biodiversity elsewhere. The aim is to produce ecological benefits to ecosystems (and/or species) and secure the essential ecosystem functions, and potentially also ecosystem services in situations where human activities cause degradation to natural environments. Ecological compensations should only be used as a final measure to minimize biodiversity loss. According to the mitigation hierarchy avoidance, mitigation and restoration on site should all be applied prior to compensation to minimize the damages. Furthermore, compensations should be measurable, permanent and of similar magnitude as the damages. The impact should be estimated based on ecological criteria, which separates ecological compensations from for example nutrient or carbon compensations.

### *Ecological compensations in the marine environment*

The compensation of marine ecological functions and values can be more complicated than compensating terrestrial values, because marine ecosystems are dynamically and three dimensionally interlinked ecological entities, which are characterized by strong spatio-temporal connectivity. Furthermore, potential compensation measures in the Baltic Sea watershed and coastal areas depend on the local environmental conditions and already existing human use of the marine area. Especially on coastal regions holistic approach in compensation planning is potentially needed. Compensation plans and measures should cover the whole watershed area because reducing the effects of eutrophication on a local level by restricting the inflow of nutrients from the watershed can provide better chances to actually achieve the offsetting goals than if only local coastal or marine measures are taken.

### *Offsetting ecological values in the Baltic Sea*

There exist a very limited number of examples on marine ecological offsetting worldwide. Therefore, developing concrete compensation plan should include specific measures suitable for the Baltic Sea environmental conditions for different habitats occurring in sheltered and open coastal areas, including key habitats for fish and birds.

Reducing nutrient input in the watershed area may enhance the state of marine areas locally and can thus improve successful implementation of other compensation measures in coastal areas of the Baltic Sea. Indeed, for some marine habitats, reducing nutrient input can be precondition for successful restoration. However, if nutrient reductions in the watershed area are planned as a part of the offsetting plan, it should be carefully considered that they are additional measures and actually result in exceeding the goals set by the EU for agricultural emissions and that they also result in relevant ecological effects on the targeted ecosystem values and functions. Changes in land use practices, utilising gypsum to reduce phosphorous losses from soil, developing manure processing methodology and constructing artificial wetlands are some potentially useful offsetting options in the region.

Coastal inlets and bays typically maintain very high biodiversity in the Northern Baltic Sea. Coastal areas are also under high anthropogenic pressure due to the intense use of the coastal areas in maritime transport, aquaculture, tourism and leisure activities. Coastal ecological compensation plan can include measures such as limiting the dispersal and removal of biomass of common reed (*Phragmites australis*), dredging seabed, restoring underwater communities by removal of underwater vegetation or re-introducing previously lost species, enhancing fish reproduction areas or restoring important bird resting and nesting areas.

In shallow, open sea areas the compensation measures are most likely to target underwater meadows, which support high biodiversity. The reconstruction or restoration of seagrass meadows has been studied extensively worldwide during the last decades. Furthermore, first attempts have been made recently in the Swedish west coast during the expansion of the Göteborg harbor to compensate the loss of underwater meadows by planting eelgrass (*Zostera marina*) in suitable habitats. Shallow sandy areas could also be constructed or restored to support the reproduction of Baltic whitefish (*Coregonus lavaretus*).

Offsetting the ecological values of rocky shores could include measures to construct or restore algal or bivalve communities. Many rocky shore species disperse via water currents or with swimming larvae, so providing suitable bottom substrate can result in desired underwater communities. However, artificial reefs can also provide possibilities for indigenous species dispersal, so the advantages and risks should be carefully assessed during the planning process.

#### *Offsetting measures for individual species*

The need for ecological offsetting measures for individual species has often a legislative base, e.g., EU's Habitats Directive requires member states to preserve or obtain the favourable conservation status of assigned species of community importance. However, currently only a limited number of examples exist even from terrestrial environments on offsetting measures aiming at compensating the degradation or loss of individual species. Restoration of degraded habitats or construction of artificial habitats, temporary relocation of individuals or communities and *in lieu* type measures could be considered when planning species specific compensations. It should also be recognized, that offsetting is most likely not an option for extremely rare and endangered species, which is struggling even at its current dispersal range.

#### *Conclusions*

Most of the open sea and coastal ecological offsetting measures can also be utilized in other levels of the mitigation hierarchy when reducing and limiting the effects of human activities. It is thus essential that the chosen measures are planned and used to specifically offset ecological functions and values and the planning, realisation and monitoring of the entire offsetting is well defined and carried out as a part of realizing the mitigation hierarchy.

- ❖ Knowledge on ecological offsetting should be increased across ecosystems through open-minded experimentation
- ❖ Planning offsets should be done rigorously and be based both on sufficient science-based background knowledge and practical expertise
- ❖ Planning and execution of offsetting should be transparent for all stakeholders involved in the process
- ❖ Long-term monitoring should be performed to verify the success of offsetting measures
- ❖ Ecological offsetting should be included within the environmental programs of novel human activities along reducing and mitigating the impacts of economic activities