After seven years of restoration measures, monitoring, and evaluation, the Living Coast project allows us to conclude that:

It is possible to regain good ecological status in enclosed bays!

To obtain a clear effect from the measures, the water exchange must be limited, otherwise, the effect will rapidly diminish due to mixing with nutrient-rich water from the Baltic Sea.

The internal phosphorus supply from the sediments must be addressed, but for the effects to last, current leakage from land must also be reduced.

Restoration work is difficult

- Effective restoration requires clear targets, expertise, financing, and patience.
- Appointing a “catchment officer” who is given the mandate to make decisions and financial resources provides strength in implementing the measures.
- The site-specific perspective is important, but site-specific knowledge is also needed to identify nutrient sources and cost-effective measures.

A higher pace of restoration requires:

- Clear incentives to reduce nutrient leakage
- More frequent inspections and better opportunities to get advice
- The possibility to receive support financing for new investments
- Clear targets and positive examples

If the land-based measures used for the Living Coast project were to be implemented on a larger scale, such as in the Northern and Southern Baltic Sea’s Water Districts or along the coast, phosphorus leakage to the Baltic Sea could decrease by about 200 tonnes per year, depending on the measure. The estimated cost is about SEK 30 billion.

If all oxygen-free sediments in the coastal zone between Norrtälje and Åhus were treated the same way as in Björnöfjärden, about 550 tonnes of phosphorus could be stored in sediments that would otherwise leak to the water. The estimated cost is about SEK 3 billion.

It is not enough to address the phosphorus that leaks from the sediment. The external load of nutrients from land must also decrease, otherwise “new” nutrients will accumulate in sediment and contribute to eutrophication.

The countries within HELCOM have agreed to the joint Baltic Sea Action Plan (BSAP) and committed to reducing nutrient inputs to the sea. Implementing measures used in the Living Coast project on a larger scale correspond to more than Sweden’s commitments under the BSAP.

Living Coast on a larger scale – more than Sweden’s commitment under the Baltic Sea Action Plan

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Living Coast’s Conclusions and Recommendations

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Living Coast on a Larger Scale – More than Sweden’s Commitment Under the Baltic Sea Action Plan

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The figures show the sources of phosphorus in Björnöfjärden in the water at the begining of the project in 2011 and after the measures were implemented. The lowest amount, 7%, was after 25 years. The rest is indicated by the respective water sample source.

**Agriculture**, 38 kg per year
By liming the fields, installing filter tanks, and doing winter drainage. Phosphorus reduction is achieved by liming the fields through reduced phosphorus emissions from fields has decreased by 80%.

**Forests and open land**, 24 kg per year
By liming the fields, installing filter tanks, and doing winter drainage. Phosphorus reduction is achieved by liming the fields through reduced phosphorus emissions from fields has decreased by 80%.

**Horse keeping**, 17 kg per year
Nutrient leakage from horse manure has been reduced by 80%.

**Agriculture**, 38 kg per year
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**Farms**
With poor wastewater treatment systems. Nutrients also come from natural sources (phosphorous and nitrogen) that enter the bay from the catchment area from human activities in the catchment area and in the bay itself. The supply of phosphorus to the various sources ranged from 3 to 600 kg per year. All measures were important, but the greatest reduction in phosphorus resulted from treating the sediments with aluminium, followed by improving private wastewater treatment systems. Aluminum binds with phosphorous, moving it from the water to the sediments. The diagram shows how effective the measures were in reducing the phosphorus supply to the various sources. The size of the pie chart illustrates differences in annual supply from each source.

**ONE YEAR TO PREPARE**
Before the project began, we studied the bay for one year to obtain a clear picture of the initial situation and to establish a baseline against which to measure the effectiveness of the measures. At the same time, we monitored a nearby bay with similar eutrophication problems but where no measures were implemented. Using a “comparison bay”, made it possible to distinguish restoration effects from other variations between different years.

**ALL MEASURES ARE IMPORTANT**
Directly after the aluminium treatment, the phosphorus concentration in the water decreased. After just a few months, the concentration decreased by 40% compared to the start of the project. This reduction has improved the underwater environment in many ways. First, the iron, which is released on land and is oxidized to iron and releases oxygen, which in turn prevents vegetation from living in the water. This allows algae to release more phosphorus into the water, which in turn is an important food for fish and birds.

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**Before**

**After**

**Reduced nutrient export**
The measures have reduced the nutrient export of phosphorous from land and wastewater in the bay, thereby improving the underwater environment and reducing the risk of hypoxia.

**Reduced nutrient leakage**
Measure has reduced the nitrogen export of phosphorous from land and wastewater in the bay, thereby improving the underwater environment and reducing the risk of hypoxia.

**Better oxygen conditions**
Nutrient reduction from various sources allows more oxygen to enter the bay’s hypoxic zone and improves survival conditions for fish.

**Seabeds are recolonized**
Improved water quality is favorable for plants and animals that live in these environments.

**Facts about Björnöfjärden**
Björnöfjärden’s surface area is 1.5 km2 and the catchment area (the land area that supplies the bay with water from e.g. precipitation) is 30 km2. The bay is about 8 km long and 1 km wide. The depth of around 40 m on the inner side is about 2 m on the outside. The climate is warm and influenced by the Baltic Sea, which is warm and influenced by the Gulf of Bothnia. Darming of the bay is almost complete. The water clarity is between 0.5 and 1.0 m.

**Before**

**After**

**Bathing waters**
Bathing waters are open areas, which can be entered by people. Other bathing waters are open areas that can be entered by people. The bathing water quality is related to the bathing water quality of the respective bathing water area.

**Nutrient exports**
Nutrients are exported to the bay and the archipelago. The nutrient exports are from fields and wastewater treatment systems.

**Phosphorus from sediment**
Nutrients are exported to the bay and the archipelago. The nutrient exports are from fields and wastewater treatment systems.

**Marine animals**
Marine animals are responsible for nutrient export from fields and wastewater treatment systems.

**Internal load reduced**
After the aluminium treatment, more phosphorous stays in the sediments and reduces the risk of hypoxia. Nutrient reduction from various sources allows more oxygen to enter the bay’s hypoxic zone and improves survival conditions for fish.

**Internal load increased**
After the aluminium treatment, more phosphorous stays in the sediments and reduces the risk of hypoxia. Nutrient reduction from various sources allows more oxygen to enter the bay’s hypoxic zone and improves survival conditions for fish.

**Visual disc that reduce the Eutrophication**
Reduced nutrient export and reduced nutrient leakage have reduced the eutrophication of the bay. The measures have reduced the nutrient export of phosphorous from land and wastewater in the bay, thereby improving the underwater environment and reducing the risk of hypoxia.