

EFFECT OF 30 YEARS OF RISK MANAGEMENT USING SAND NOURISHMENT

Simone Signe Dons Weiling, Kystdirektoratet (Danish Coastal Authority), sisdw@kyst.dk
 Sofie Agger, Kystdirektoratet (Danish Coastal Authority), soagg@kyst.dk
 Nikolai Heath Sørensen, Kystdirektoratet (Danish Coastal Authority), nihes@kyst.dk
 Per Sørensen, Kystdirektoratet (Danish Coastal Authority), ps@kyst.dk

INTRODUCTION

Along the west coast of Jutland, Denmark, from Lodbjerg in the north to Nymindegab in the south, is a 110 kilometre-long stretch of naturally retreating coastline. The coast is characterised by a gently sloping profile of sandy material with alongshore bar systems. The inner coastal plain often contains a few smaller coastal bars, and one larger breaking bar separating the inner and outer coastal plain. A sediment volume of over 4 million m³ is transported away from the area annually (Figure 1).

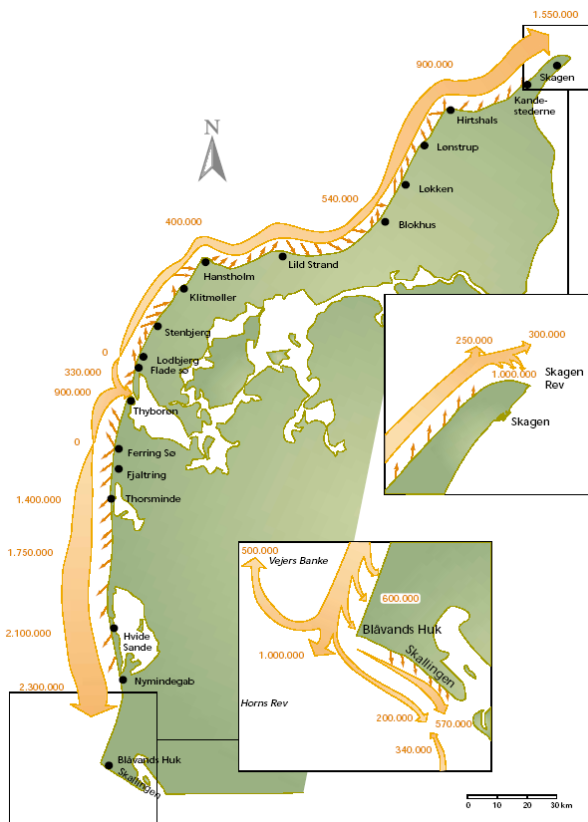


Figure 1. Longshore sediment transport along the Danish west coast. The dominant direction along the Lodbjerg-Nymindegab stretch is southbound.

The entire coastal profile is subject to erosion from wave action, and during storms, the low-laying hinterland - which is protected by sand dikes and shallow, narrow dunes - is highly exposed to inundation. Historically, storm waves have occasionally broken through the dunes. This has resulted in significant inundation and put houses, infrastructure, and agricultural lands at risk of destruction and economic losses.

In November of 1981, a large storm off the west coast of Jutland resulted in such a dune breakthrough, with acute erosion of up to 30 meters measured in some areas. The effects of the storm led to an intensification of sand nourishments as a coastal protection strategy, as groins, which had previously been the primary strategy, had proven to be insufficient in preventing dune retreat.

An agreement was made between the Danish Coastal Authority, the Transport Ministry, Ringkøbing County, and the five coastal municipalities, to implement sand nourishments along the shoreline to reduce erosion, inundation, and injuries. The first agreement was implemented in 1983, and has been renewed every fifth year since (Kystdirektoratet, 2020) (Figure 2).

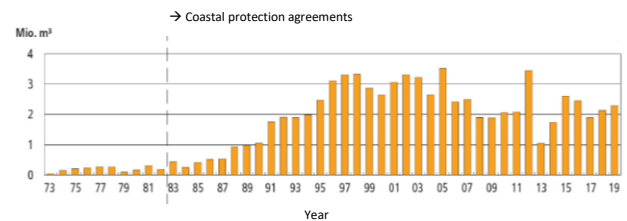


Figure 2. Sand nourishments from Lodbjerg to Nymindegab, before and after the first agreement was signed in 1983 and sand nourishments became the main method of protection against coastal erosion (Kystdirektoratet 2020).

The volume, locations, and targets of the nourishments are adjusted between agreements, based on need and budget. However, the main goal remains the same: to maintain the natural coastal profile of the Danish west coast and reduce the transgressive phase of the coast, as well as maintain a certain height and width of the dunes to protect the hinterland against high water levels.

Safety targets have been established in which the stretch of coast from Lodbjerg to Nymindegab is protected to withstand a 100-year storm event. Due to its geographic isolation, the target for the area around Thyborøn in the north is resistance against a 1000-year storm event (Kystdirektoratet 2013). The minimum for dune width is 40 meters. These safety targets are maintained primarily by way of sand nourishments, which are placed both nearshore and on the beach (Kystdirektoratet 2013).

Without ongoing coastal management in the form of sand nourishments, the shoreline would have an annual retreat of up to 8 m in the region north of Thorsminde, and between 1-4 m along the remainder of the stretch (Figure 3).

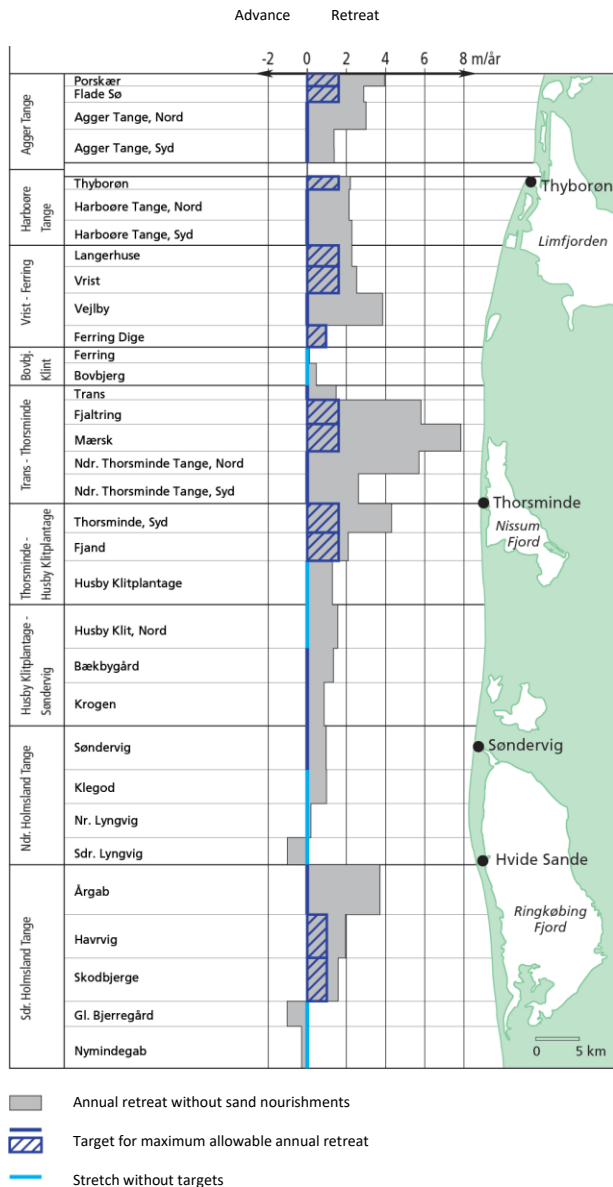


Figure 3. Targets for maximum coastal retreat along the Lodbjerg-Nyminddegab coastline (Kystdirektoratet 2020).

OBJECTIVES

The purpose of this study is to analyze the evolution the active coastal profile over time and in relation to the sand nourishments that have taken place along the Danish west coast from Lodbjerg to Nyminddegab. The aim is to form a basis for assessing the long-term effect of the sand nourishments, as well as assess the needs for future nourishment efforts. There will be a special focus on the long-term effect of shoreface nourishments to assess whether the current distribution of 60/40 between shoreface and beach nourishment, respectively, can be shifted to a higher percentage of shoreface nourishment. If this is possible, the costs of the nourishments can be reduced significantly.

A further aim is to reevaluate the sediment size and sand

percentage of the sand nourishment volumes relative to the geology of the coastal area.

METHODOLOGY

The evolution of the active coastal profile over time, and the effect of the historical and ongoing sand nourishments, will be analyzed using a long-term archive of over 50 years of coastal profile transect and sand nourishment data.

The Danish Coastal Authority measures cross-shore profiles along the west coast in order to observe and analyze coastal evolution. Measurements in the northern end, near Thyborøn, date back to 1874, and the remainder of the stretch has been measured since 1957. Since the 1990s, the transect measurements have been conducted annually. The transects, which are placed perpendicular to the coast, are measured every 600 to 1000 m along the 110-kilometer stretch, and offer high resolution insights from which annual erosion and accretion can be calculated, and the evolution of the active coastal profile can be examined.

For every sand nourishment, load volume and coordinates have been recorded.

The analysis is ongoing and will be finalized in the spring of 2024.

Acknowledgement:

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REFERENCES

Kystdirektoratet (2013). Vestkysten 2013, Statusrapport. Transportministeriet. https://kyst.dk/media/79877/vestkysten_2013_statusrapportlodbjerg-nyminddegab-1.pdf

Kystdirektoratet (2020). Vestkysten 2020, Statusrapport. Miljø- og Fødevareministeriet. https://kyst.dk/media/103443/vestkysten-2020_statusrapport.pdf