



## **Decline, recovery, and site persistence of intertidal seagrass beds in the Northern Wadden Sea since the 1930s**

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Seagrasses fulfil several vital ecological functions and are therefore of high importance for coastal ecosystems. They are furthermore regarded as an indicator for ecosystem health. However, as seagrasses are very sensitive towards a variety of environmental parameters, particularly to human induced eutrophication, they are declining worldwide. In contrast to this global crisis of seagrass ecosystems, intertidal seagrass beds in the Northfrisian Wadden Sea (coastal North Sea) have recovered recently and may constitute the largest intertidal seagrass area in Europe.

Aerial photographs taken from the Northfrisian Wadden Sea in the periods 1935 – 1937, 1958 – 1959 and 2005 were used to map long-term variability in extent and spatial distribution of intertidal seagrass beds. Photographs were visually analyzed, and seagrass beds were recorded and quantified with a geographical information system (GIS). This set of long-term records was completed by aerial mapping data until 2011.

Today, seagrass beds cover more than 15 % of the tidal flat area of the Northfrisian Wadden Sea, which is rather similar to the extent they had in the 1930s. However, the seagrass development in the last 80 years is characterized by an intermittent loss of bed area of about 34 % in the late 1950s and even 60 % in the 1970s – 1990s. This is followed by a recovery and a strong increase in seagrass bed area since the mid-1990s. It is assumed that the intermittent loss was primarily caused by direct and indirect effects of eutrophication but also by increasing hydrodynamics and associated sediment instability, which are also adverse for seagrasses. The recovery is consequently the result of the decrease of these adverse effects.

Despite the variability in seagrass extent, beds show a remarkable persistence at preferred sites and over several decades. Core areas for seagrass were identified in the shelter of high sands and barrier islands where the beds are protected from the prevailing westerly North Sea swell.

Our long-term observations suggests that intertidal seagrass beds in the Northfrisian Wadden Sea have maintained their general distribution pattern over many decades, and that the present environmental conditions for intertidal seagrass are here not worse than in the 1930s.