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Effects of current exposure on habitat preference of mobile 0-group epibenthos for intertidal seagrass beds (*Zostera noltii*) in the northern Wadden Sea

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Abstract

In the northern Wadden Sea, the extent of intertidal seagrass beds, their plant biomass and shoot density highly depends on local current regimes. This study deals with the role of intertidal *Zostera noltii* beds as nursery for mobile epibenthic macrofauna and the impact of seagrass bed characteristics on their abundance and distribution patterns. According to their exposure to the main tidal gullies, sampling sites were separated into exposed, semi-exposed and sheltered. Dominant species of crustaceans and demersal fish were studied in respect of their abundances within seagrass beds and adjacent unvegetated areas. Quantitative sampling was performed at day and night high tide using a portable drop trap. In general, species composition varied little between seagrass beds and bare sand. However, the presence of vegetation had a quantitative effect increasing individual numbers of common epifaunal species. Abundances of 0-group shore crabs (*Carcinus maenas*), common gobies (*Pomatoschistus microps*) and brown shrimps (*Crangon crangon*) were highest within sheltered seagrass beds. With decreasing plant density habitat preference of epibenthos changed on species level. By regulating the habitat complexity the currents regime is profoundly influencing the nursery function of intertidal seagrass beds in the Wadden Sea.

Keywords: mobile epibenthos; intertidal seagrass beds; hydrodynamic exposure; *Zostera noltii*; Wadden Sea; North Sea

1. Introduction

Seagrass beds are known worldwide as important nurseries for juvenile fish and crustaceans (Conolly, 1994; Pihl et al., 1994; Edgar and Shaw, 1995; Heck et al., 1995). Subtidal seagrass habitats often reveal a higher biodiversity and density of individuals compared to adjacent substrate without vegetation (Orth et al., 1984; Pihl Baden and Pihl, 1984; Edgar et al., 1984; Murphy and Fonseca, 1995). Most investigations of plant–animal interactions within seagrass beds have been carried out in subtidal systems, whereas on intertidal seagrass beds of temperate zones only limited information is available. Differences between both systems are however to be expected. Several studies of subtidal ecosystems dealing with the impact of vegetation on epifaunal abundance point out that complex habitats increases biodiversity and individual numbers of epibenthic crustaceans and fish (Isaksson and Pihl, 1992; Boström and Bonsdorff, 1997; Mattila et al., 1999) in context with nursery function (Perkins-Visser et al., 1996; Scott et al., 2000; Beck et al., 2001) and preferred structure for post larval settlement (Pile et al., 1996; Boström and Bonsdorff, 2000; Moksnes, 2002).

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Diversity and abundance is supposed to be correlated with seagrass density and sediment composition (Virnstein et al., 1983; Pihl, 1986). Due to the "wasting disease" in the 1930s caused by an infection by the slime mould *Labyrhintula zosterae*, extended subtidal seagrass stocks were entirely lost in the Wadden Sea (Den Hartog and Polderman, 1975). Today, seagrass beds in the Wadden Sea are limited to the intertidal zone and are dominated by *Zostera noltii* (Hornem) growing in the upper part of the tidal flats close to the high tide line. Although *Z. noltii* is a perennial plant, intertidal seagrass beds in the northern Wadden Sea are characterized by leaf loss due to grazing of brent geese (*Branta bernicla*) (Nacken and Reise, 2000; Ganter, 2000), ice drift and frost during winter. This seasonality of the above ground parts of intertidal beds is an important difference to the subtidal eelgrass beds (*Zostera marina*) of the temperate zones representing rather constant, complex habitats throughout the year.

The faunal community of Wadden Sea tidal flats is not known to be closely associated with seagrass occurrence. No special seagrass fauna has yet been described for the intertidal areas of the North Sea (Den Hartog, 1983). Previous studies showed that intertidal seagrass beds are important complex habitats, which provide shelter from predators (Reise, 1985;) and increase food availability for endo- and epibenthic organisms by acting as a sink for organic matter (Asmus and Asmus, 2000).

Many species of mobile epibenthos use the tidal flats as nursery areas (Zijlstra, 1972; Reise, 1985). From April to November juvenile crustaceans and demersal fishes occur in high densities until low temperatures force them to move into deeper water layers. Thus intertidal seagrass beds may contribute to this nursery function of the tidal flats.

The appearance of *Zostera noltii* meadows on the tidal flats depends on their exposure to tidal currents. The extent of the meadows, sediment composition as well as plant biomass are controlled by current velocities (Schanz and Asmus, 2003). Changes in terms of species composition and abundance can be expected due to this abiotic factor.

The aim of this investigation is to show (1) whether seagrass beds support the nursery function of the intertidal zone for mobile epibenthos by increasing the abundances of 0-group individuals, and (2) to which degree the preference of mobile epifauna for the seagrass habitat may change under different hydrodynamic conditions.

2. Material and methods

2.1. Study sites

Investigations were carried out at the east coast of the island of Sylt in the western part of the Sylt-Rømø Bight (Fig. 1). This bight, a shallow tidal basin in the North Sea (54°50′–55°10′ N, 8°20′–8°40′ E), is a semi-enclosed system. The lagoonal character was established by building of causeways connecting the island of Sylt (in 1927) and the island of Rømø (in 1947) with the mainland. The bight encloses an area of 404 km^2 of which 1/3 are tidal flats. About 12% of the intertidal area is covered by seagrass beds (Asmus and Asmus, 2000). The tides are semi-diurnal with a mean tidal range of about 2 m. Salinity varies seasonally between 28 and 32. Mean annual water temperature is 9 °C with a seasonal variation from 19 °C in summer and 0 °C in winter. During the investigation period westerly winds with a mean velocity of 4–5 m s^{-1} were predominant. Total water exchange of the Sylt-Rømø Bight with the open North Sea takes place through one single tidal inlet of 2 km width between the islands. The maximum velocity of the tidal currents within the tidal inlet is about 1.3 m s^{-1}. From the inlet to the inner bight, the gully ramifies and current velocities are abated. At the tidal flats maximum current velocities are 0.3–0.4 m s^{-1} decreasing to <0.1 m s^{-1} at very sheltered areas.

Along the current regime of the same gully, three areas were chosen with different exposure to the tidal

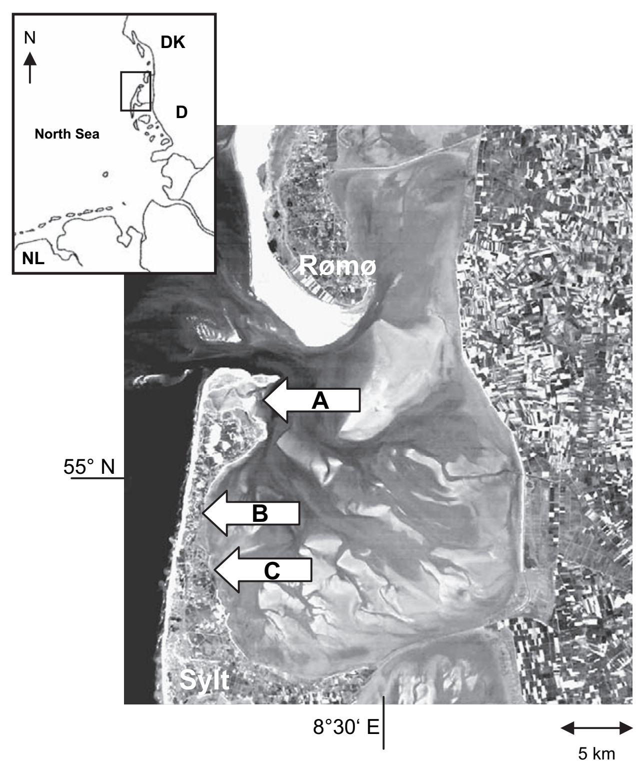

Fig. 1. Arial photograph showing the Sylt-Rømø Bight and sampling locations for mobile epibenthos in intertidal areas on the east coast of the island Sylt, Germany. According to different maximum current velocities measured, sampling sites are classified as (A) exposed, (B) semi-exposed and (C) sheltered. White lines marking the causeways from the mainland to the island closing the Bight except for one single inlet.