Estuarine, Coastal and Shelf Science 85 (2009) 666–670

Contents lists available at ScienceDirect

Estuarine, Coastal and Shelf Science

journal homepage: www.elsevier.com/locate/ecss

Short Communication

The colonization of macroalgal wrack by the meiofauna in the Arctic intertidal

Barbara Urban-Malinga [a,*], Dorota Burska [b]

[a] Sea Fisheries Institute, Department of Fisheries Oceanography and Marine Ecology, Kołłątaja 1, 81-332 Gdynia, Poland
[b] Institute of Oceanology, University of Gdańsk, Al. Marszałka Piłsudskiego 46, 81-378 Gdynia, Poland

ARTICLE INFO

Article history:
Received 6 July 2009
Received in revised form
24 September 2009
Accepted 30 September 2009
Available online 8 October 2009

Keywords:
beach
decomposition
macroalgal wrack
litter bags
nematodes
rhabditids
monhysterids
meiobenthos
Arctic

ABSTRACT

A litter bag experiment was performed on a wrack-loaded beach in Hornsund (southern Spitsbergen) to study the decay rate of stranded macroalgae and their colonization by meiofauna. The average monthly loss of macroalgal dry mass was 45 ± 5%. The composition of the wrack-associated fauna was similar to those reported from other world regions. Nematodes composed of bacterivorous rhabditids and monhysterids were the numerically dominant taxon (>99% of the community). High nematode densities averaging 35,000 ind. per litter bag (6,500 ind g^{-1} dwt) indicate their skills for rapid colonization and successful exploitation of the short-lived habitat established on an Arctic beach. We suggest that stranded macroalgae may play a role as a potential hotspot for nematodes and microbial processes in the Arctic coastal ecosystem. It is also suggested that wrack position on the beach profile which resulted in different wrack-age and moisture content may affect the composition and diversity of the wrack-associated meiofauna.

1. Introduction

Wrack-loaded beaches have been identified as biogeochemical hot-spots (Coupland et al., 2007), i.e. zones showing disproportional high biogeochemical activity when compared to the adjacent area (McClain et al., 2003). Coupland et al. (2007) found that a square meter of wrack deposited on the Australian coast supported a three times higher metabolic rate than the equivalent area of living seagrass or macroalgal habitat. Examination of the processes associated with stranded macroalgae and factors controlling them are thus essential to determine the fate of these materials and to assess their importance in the cycling of matter and energy at the sea-land interface.

Beach wrack supports diverse and abundant macrofauna (Griffiths and Stenton-Dozey, 1981; Colombini et al., 2000; Dugan et al., 2003; Jaramillo et al., 2006; Ince et al., 2007; Olabarria et al., 2007; Rodil et al., 2008; Lastra et al., 2008) which usually dominates stranded macroalgae habitat in terms of the biomass, but plays a quantitatively lesser role in wrack breakdown which is more likely to be controlled by micro- and meio-fauna (Koop et al., 1982; Inglis, 1989; Jedrzejczak, 2002; McLachlan and Brown, 2006). Although the role of meiofauna in general, and nematodes in particular, in the decay processes is well known (Findlay and Tenore, 1982; Aller and Aller, 1992; Alkemade et al., 1992a, b; 1993; De Mesel et al., 2004; Moens et al., 2005), the number of detailed studies dedicated to the wrack-associated meiofauna is surprisingly poor (Bouwman et al., 1984; Alkemade and Van Rijswijk, 1993; Alkemade et al., 1994).

Large quantities of macroalgae are deposited along the Arctic coast (Węsławski et al., 1993) but information on the associated fauna, decay and fate of this material and its role for the seasonally ice-covered nearshore ecosystem is lacking. This paper describes the results of a litter bag experiment performed in Hornsund (southern Spitsbergen) to investigate the colonization of freshly deposited macro-detritus by meiofauna with an emphasis on nematodes. The macroalgal deposit was sampled at two locations on the beach profile in order to assess the abundance and composition of the wrack-associated meiofauna. It was hypothesized that wrack-age and moisture content could affect the associated community structure.

2. Materials and methods

2.1. Study site

Hornsund is the southernmost (77°N) fjord of Spitsbergen. It remains frozen until May, but the tidal zone is covered with ice

* Corresponding author.
E-mail address: basiam@mir.gdynia.pl (B. Urban-Malinga).

0272-7714/$ – see front matter © 2009 Elsevier Ltd. All rights reserved.
doi:10.1016/j.ecss.2009.09.033

usually from autumn till late June. Tides are regular, semi-diurnal of an amplitude reaching up to 1.8 m (Siwecki and Swerpel, 1979; Węsławski et al., 1993). The average coastal water temperature in the summer here lay within the range 1–4 °C (Węsławski et al., 1993, Ronowicz, 2005).

A wrack-loaded beach in Rettkvalbogen (R) (77°00′N, 015°30′E), located in the vicinity of the Polish Polar Station was selected for the study (Fig. 1). It is a sheltered location, surrounded by skjerra (coastal rocks). The beach is around 7 m wide. Intertidal sediments are dominated by very coarse/coarse sands and gravels (Urban-Malinga et al., 2009). Macroalgae washed ashore form a thick deposit cover.

2.2. Wrack-associated community composition

Triplicate samples of rotting macroalgae were sampled at the beginning of July 2005 in order to study the meiofauna community associated with wrack. Macroalgae were sampled from the wrack surface with a core 10 cm in diameter to the depth of approx. 10 cm at two locations: 1, on the upper beach, close to the dune and 2, on the lower beach parallel to the shoreline (Fig. 1). Macroalgae were preserved with 4% formalin solution. In the laboratory the preserved material was washed with filtered tap water first over a 1 mm sieve to remove the larger fragments of algae and subsequently over a 38 μm sieve. Algal fragments were picked by hand, thoroughly washed over the sieve with tap water to clean any organisms, dried at 60 °C for 48 h and weighed. The suspension retained on the 38 μm sieve was split three times in a Motodo sample splitter designed for plankton research. Fauna from two sub-samples was counted and identified to the higher taxon level. The first 200 nematodes were sorted out, mounted on permanent glycerine slides and identified to the lowest possible taxonomic level under the microscope.

One-way ANOSIM (Primer, version 6) was used to test for differences in meiofaunal community structure between sampling sites. It was performed on standardized and square-root transformed higher meiofaunal taxa abundance data. The non-parametric Mann-Whitney U-test was used to check whether there were significant differences in meiofaunal abundances between deposits on the lower and higher beach.

Macroalgae from both sampling locations were identified to the lowest possible taxonomic level under a stereo-microscope.

2.3. Litter bag experiment

Litter bags made of a mesh with a pore diameter of 1 mm measured approximately 12 x 18 cm. *Fucus distichus* thalli that were freshly washed ashore were collected at the study site. In the laboratory, the macroalgae were thoroughly washed with tap water to clean any organisms and oven-dried at 60 °C for 48 h. A total of ten litter bags containing 9 ± 0.5 g dry weight of defaunated macroalgae were placed on the wrack surface on the lower beach (close to the wrack line and high water level) where the most intensive accumulation of fresh algal material was observed (Fig. 1). Litter bags were placed parallel to the shoreline approximately 50 cm apart fixed to the sediment beneath using long metal sticks. Prior to the start of the experiment, the algal material in bags was re-hydrated by submerging bags in the container with ambient sea water. The experiment began on July 12th 2005. Litter bags were collected after one month. One out of the ten bags was washed out and empty. Nine bags were put into separate plastic bags and were transported to the laboratory where the entire content of each bag was thoroughly washed with tap water first over a 1 mm sieve and subsequently over 38 μm sieve. Cleaned algal fragments retained on the sieves were collected, oven-dried at 60 °C for 48 h and weighted. The difference between the initial and final weight served to calculate the dry mass weight loss as a measure of wrack decomposition.

Fauna retained on the sieve was preserved in 4% formalin solution and stained with Rose Bengal to facilitate counting and sorting. All the meiofauna from the sample, except for nematodes, were counted and identified to the lowest taxon level under the

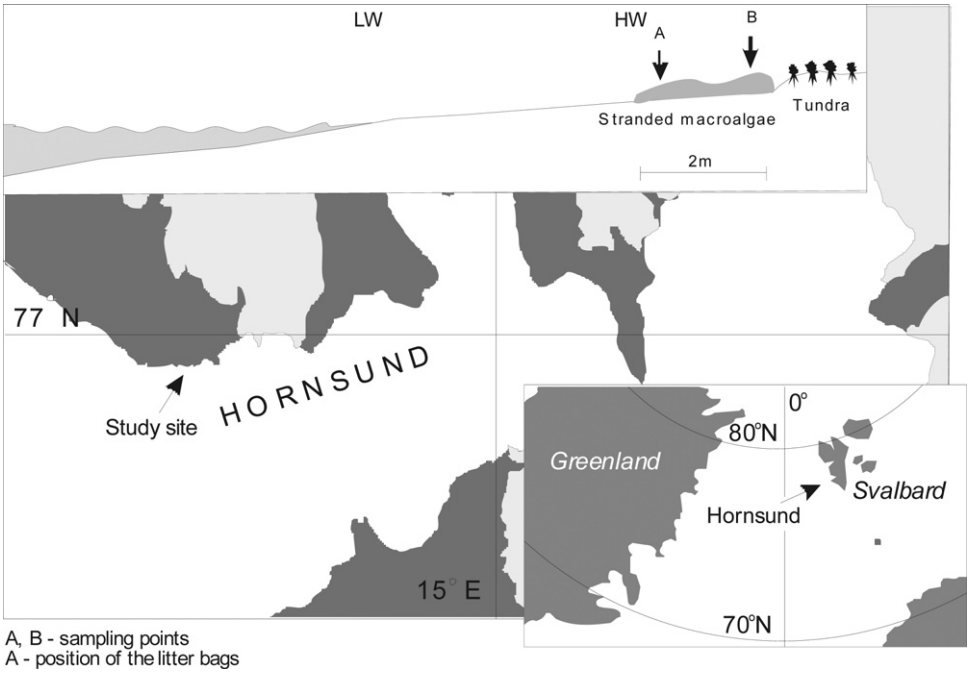

Fig. 1. Map of the investigation area and distribution of study sites on the beach profile (LW – low water, HW – high water).