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MONOGRAPH

A comparison of amphipod assemblages between canopy and understory strata in seaweed and seagrass beds off the coast of Otsuchi Bay, Japan

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ABSTRACT This study compared the amphipod assemblages between the canopy and the understory of Sargassum, kelp and seagrass beds in Otsuchi Bay, Japan. Although the macrophyte biomass was larger in the canopy than in the understory in all the bed types, amphipods were more abundant and diverse in the understory in all cases, in particular, free-living amphipods. Tube-dwelling amphipods dominated both the canopy and the understory throughout the study period, except that algae-boring amphipods dominated the canopy of kelp beds in summer. The higher abundance and diversity of amphipods in the understory (even though there were lower habitat abundances than in the canopy) was probably due to the fact that the understory provided (1) more sheltered habitat for protection from predators and/or water movement, (2) more detrital deposition (a food source for amphipods) and (3) more diverse microhabitats.

KEY WORDS Amphipod assemblage; canopy; seagrass bed; seaweed bed; understory.

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INTRODUCTION

Seaweed and/or seagrass beds provide one of the most productive ecosystems on earth (Costanza et al., 1997). Amphipods are one of the important components of these ecosystems, comprising a large number of species with high abundance and biomass. Furthermore, amphipods play a major role in transferring energy in seaweed and seagrass ecosystems as primary consumers and act as prey for higher consumers (Michel et al., 2015).

Seaweed and seagrass beds, even when dominated by a single macrophytic species, provide heterogeneous environments for amphipods; hence, they can be regarded as a complex of various habitat types, each providing specific microhabitats. Furthermore, these beds can be differentiated into canopy and understory. Canopy and understory provide different biotic and abiotic environments, and as a result, their faunal assemblages also differ (Hirst, 2007); however, most previous studies have focused solely on amphipod assemblages in the canopy of macrophyte beds, and little attention has been paid to the amphipod assemblages occurring in the understory of those beds.

Therefore, this study aimed to characterise differences in assemblage structure and dynamics of amphipods communities between the canopy and understory of seaweed and seagrass beds.

MATERIAL AND METHODS

Sampling was carried out using SCUBA every

1–3 months, from July 2015 to June 2016, at Akahama in Otsuchi Bay, on the Pacific coast of northeastern Japan. The following three types of macrophyte beds that occur on subtidal rocky shores were investigated: *Sargassum yezoense* (sargassum bed), *Saccharina japonica* var. *religiosa* (kelp bed) and *Phyllospadix iwatensis* (seagrass bed). Three quadrats (25 cm × 25 cm) were haphazardly set in each bed. Within each quadrat, seaweeds and seagrasses were cut with scissors at just above their holdfasts or rhizoids, and then were put into a 0.6 mm-mesh net along with associated benthic animals (These samples were defined as canopy samples). Moreover, the material left on the bare rock surface, such as holdfasts, rhizoids, undergrowth vegetation and sediments, were immediately suctioned using an air-lift sampler. The suctioned material and associated benthic animals were gathered in a 0.6 mm-mesh net. (These samples were defined as understory samples). All samples were then sieved through a 1 mm mesh, and then all the amphipods were collected and identified into the lowest possible taxon. All amphipod species were classified into the following four functional groups: tube-dwelling species, algae-boring species, free-living species and commensal species. The dry weight of each macrophyte species was determined. In addition, the abundance, species richness and Shanonn-Wiener diversity index (H') of amphipods were calculated for each quadrat and compared between the canopy and understory strata.

RESULTS AND DISCUSSION

In all beds, macrophyte biomass was much greater in the canopy than in the understory stratum. Alternatively, mean abundance, species richness and H' of amphipods were higher in the understories. In canopies of sargassum and seagrass beds, the assemblages were mostly dominated by tube-dwelling species, such as *Jassa morinoi*, *Ericthonius pugnax* and *Sunamphithoe* spp., throughout the study period. In the canopies of the kelp beds, algae-boring species, *Najna consiliorum* and *Ceinina japonica*, were dominant during summer; however, they decreased in abundance as the kelps died-back during winter. In the understories of all the beds studied, tube-dwelling species were dominant throughout the study period, although free-living species, such as *Quadrimaera pacifica* and *Pontogeneia* spp., were also abundant and sometimes dominated the assemblages. Commensal amphipods were rarely found in either the canopies or understories.

Although habitat abundance (as determined by macrophyte biomass) is lower in the understories than in canopies, the abundance and the diversity of amphipods were higher in the understories. This suggests that amphipod assemblages were strongly affected by the habitat characteristics. The higher amphipod abundances in understories may be due to the more protected environment (from predators) provided by understories and/or that water flows more slowly through the understory than through the canopy. Therefore, understories may provide better shelter for amphipods, especially for free-living species, which are thought to be more sensitive to predation and water-movement than other lifestyles such as tube-dwelling species. Moreover, more detritus, an important food source for amphipods, might be retained in understories, because less water moves through the understory. The higher amphipod diversity in understories was due to the higher abundance of free-living species found there. In addition, the understories provided more diverse microhabitats, in undergrowth vegetation and sediment, which probably promotes a more diverse array of amphipods.

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