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Grazing pressure by amphipods on microalgae in Nanakita river estuary (Gamo lagoon), Japan

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ABSTRACT: Grazing pressure effects exerted by four species of amphipods on epiphytic microalgae were determined in Nanakita river estuary (Gamo lagoon) Japan, considering microalgal strength of adhesion to surfaces with regard to their susceptibility to grazing. Grazing effects were examined for three groups of diatoms, including naturally strongly-attached cells, moderately-attached cells and fairly-attached cells. Diatom species with filamentous forms or low adhesive strength were susceptible to grazing, while those with tighter adhesion were less affected by grazing pressure. Seasonal trends of both amphipods and microalgae found on the macroalgae *Gracilaria vermiculophylla* showed high densities of amphipods and low densities of microalgae during warmer months (June to September) and vice versa in colder months (December to March). This immerse relationship between densities of amphipods and diatoms suggests a casual relationship and shows that effects of grazing pressure by amhpipods on epiphytic diatom communities seem to be strong in Gamo lagoon. A manipulated experiment (feeding pressure experiment) revealed that *Melosira* sp. and *Nitzschia* sp. were mostly selected by tube-dwelling species (*Corophium uenoi* and *Grandidierella japonica*), whilst *Gyrosigma* sp. and *Melosira* sp. selected by free-living species (*Eogammarus possjeticus* and *Melita setiflagella*).

Key Words: Grazing pressure, amphipods, diatoms, algae, and Gamo lagoon

Introduction

In aquatic environments, epiphytes have been found to contribute to the primary productivity of the ecosystem and also supply food for grazers (Zimmermann et al., 1979). Their studies revealed the capacity of amphipods to reduce periphyton biomass.

Reduction of epiphytes on macroalgae has been observed in Gamo lagoon especially during summer. Considering the important position microalgae are likely to occupy in the aquatic food chain, prey choice among estuarine omnivores feeding on epiphytic unicellular algae are very necessary. In Gamo lagoon, grazing pressure exerted by amphipods on microalgae was investigated. Grazing effects were examined for three groups of diatoms, including naturally strongly-, moderately-, and fairly-attached cells. In order to examine the grazing effects exerted by amphipods on microalgae, seasonal trends of both amphipods and microalgae were determined. For a detailed relationship between amphipods and microalgae, feeding pressure experiments were also carried out in Gamo lagoon to determine particular diatoms selected by species of amphipods.

Materials and Methods

Field investigations and experiments were carried out at Nanakita river estuary called Gamo lagoon. On a monthly basis, samples of the macroalga *Gracilaria vermiculophylla* (Ohmi) Papenfuss were collected and examined from two stations, St. 1 and St. 2, between January 1999 to December 1999 using a 0.25 m^2 quadrat placed randomly at algal sites at both stations. In the laboratory, attached materials were scraped off from thalli of macroalgae. Identification and cell counts of diatoms were performed on fixed samples under a light microscope.

Feeding pressure experiment conducted in August 2000, was set up and sampled after two weeks. Four species of amphipods (*Corophium uenoi, Eogammarus possjeticus, Melita setiflagella* and *Grandidierella japonica*) collected from Gamo lagoon were used for the experiment. Fifty adult animals of each amphipod species were inoculated in separate tubes, inserted with brush substrates as substitutes of algae. Three sealed transparent acrylic tubes with different amphipod species were put together in a PVC (polyvinyl chloride) cage and suspended in lagoon water by nylon strings. Control tubes (tubes without amphipods) were also set randomly together with inoculated tubes.

Microalgae found on brush substrates were fixed in 2.5 % glutaraldehyde solution for identification, cell counts and species composition. Cluster analysis (single linkage method) was used to illustrate the similarities in diatom selection by the four species of amphipods.

Results and Discussion

For all species of amphipods, high and low densities were found in warmer and colder months, respectively (Fig. 1). *Corophium* recorded the highest density followed by *Eogammarus* then *Grandidierella* with *Melita* recording the least at St. 1. Both stations recorded maximal attached materials of 1.5 and 3.5 g $\cdot g^{-1}$ in February with a minimum of 0.2 g $\cdot g^{-1}$ in September and July for St.s 1 and 2, respectively (Fig. 1). After April, there was generally less than 1.0 g $\cdot g^{-1}$ of attached materials for both stations until November. The attached materials started increasing after November

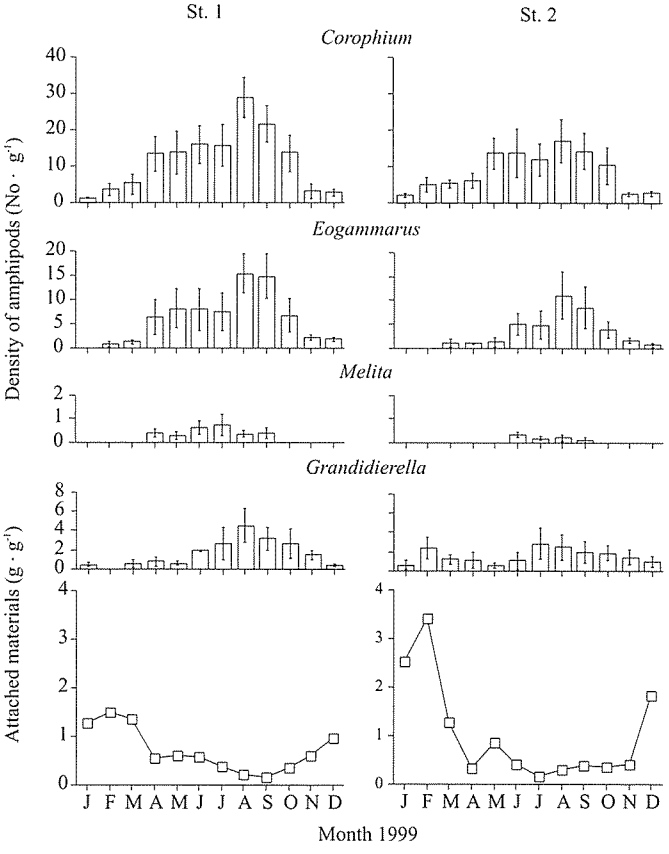

Fig. 1. Monthly changes in amphipod densities and total attached materials (including microalgae and detritus) per algal biomass on*Gracilaria* at Sts. 1 and 2 in Gamo lagoon, Japan. Bars indicate SD, n = 4.

and attained a peak in February.

According to Moore (1975), algae forms a regular and relatively important part of the diet of *Asellus*. He found out that, diatoms always accounted for at least 95% of the algal flora ingested by *Asellus aquaticus* and *Gammarus pulex* living among growths of *Claodophora glomerata*. Hickman and Round (1970) concluded that low standing crop of benthic diatoms in lakes during summer was attributed to increased grazing by invertebrates

The situation in Gamo lagoon was not different from what has been reported. An initial increase in the densities of amphipods during spring resulted in the corresponding decrease of diatoms. High densities of amphipods and low densities of microalgae were found during warmer months whilst high densities of microalgae and low densities of amphipods occurred in colder months. The effect of grazing pressure by amphipods on epiphytic diatom communities seems to be strong in Gamo lagoon. High densities of amphipods with corresponding low densities of epiphytic diatoms in summer suggests that grazing pressure by amphipods was likely the main factor that caused relatively low diatom densities in this season. Kawamura and Hirano (1992) concluded that grazing pressure is one of the primary factors which influence the formation of benthic diatom communities on the substratum.

Results from the feeding pressure experiment showed eight diatom species (*Navicula, Nitzschia, Gyrosigma, Melosira, Synedra, Triblinella, Surirella*, and *Amphora*). An analysis of the similarities between the selection of diatoms shows that there were two primary clusters (Fig. 2). Tubes inoculated with amphipod species forming one group (CL 1) and tubes without amphipods (controlled) forming another group (CL 2). CL 1 was further divided into two subgroups; CL 1-1 for tubes inoculated with *Eogammarus* and *Melita* (free-living species) whilst CL 1-2 for tubes inoculated with *Corophium* and *Grandidierella* (tube-dwelling species). These results also suggest and agree with the fact that amphipods fed on diatoms in Gamo lagoon. It showed that *Melosira* sp. and *Nitzschia* sp. were selected by tube dwelling species including *Corophium uenoi* and *Grandi-*

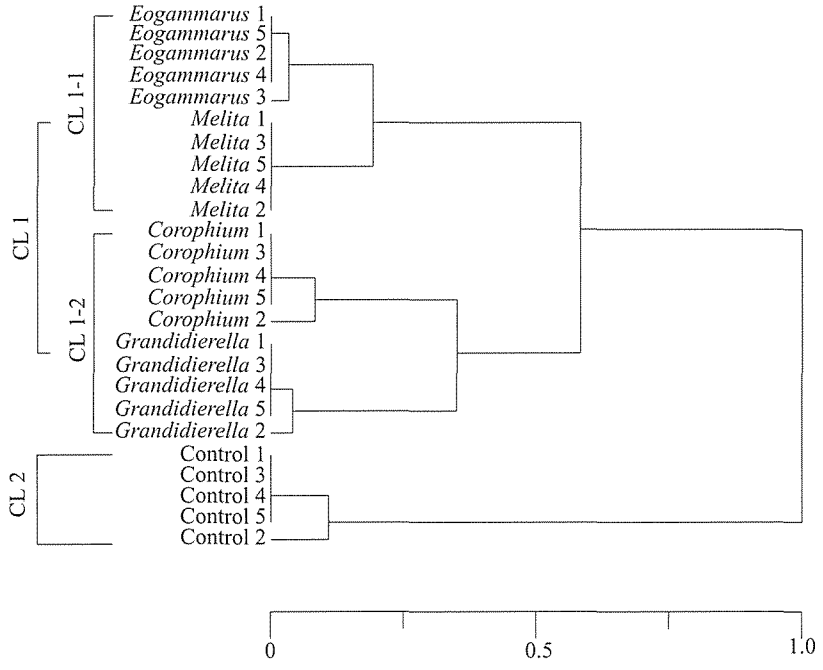

Fig. 2. Dendogram of diatom assemblages exposed to grazing by 4 amphipod species in Gamo lagoon, Japan. Analysis were carried by single linkage method based on similarities for their selection of diatom species. Twenty-five tubes were classifed into three main clusters, (CL 1-1, CL 1-2 and CL2).

dierella japonica. Whilst *Gyrosigma* sp. and *Melosira* sp. were selected by free-living species including *Eogammarus posijecticus* and *Melita setiflagella*.

In general, species with filamentous forms or low adhesive strength are apt to be grazed, while those with tighter adhesion are less affected by grazing pressure, Moore (1975). He similarly reported that *Melosira varians* and *Diatoma vulgare*, diatoms forming long filamentous colonies, have been shown to be ingested in disproportionately large quantities by amphipods whereas *Cocconeis* sp. with highly adhesive prostrate forms were rarely eaten. In Gamo lagoon, all four amphipod species selected *Melosira* sp. making up of a colony enclosed in a filamentous, arborescent, mucous tube, stressing on the importance of diatom morphology in amphipod feeding. *Amphora*, an adnate form (attached by almost or all of their width), was less selected by the amphipods, and this may be attributed to its strength of adhesion.

The results of the feeding experiment revealed that all diatom species were susceptible to feeding pressure exerted by both free-living and tube-dwelling amphipod species, even though grazing pressure on diatoms species differed, and this may be related to life style and cell size of diatoms and amphipod species.

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