RECRUITMENT AND DENSITIES OF *LORIPES LACTEUS*, A BIVALVE CONTAINING CHEMOAUTOTROPHIC SUMBIONTS, IN *A CYMODOCEA NODOSA* BED IN A COASTAL LAGOON

M.A. Johnson, C. Fernandez, C. Pergent-Martini*
EqEL, Faculty of Sciences, University of Corsica, Corte, France

Abstract

Loripes lacteus (bivalve) inhabiting a *Cymodocea nodosa* seagrass bed in a lagoon in Corsica was studied over a one year period. Bivalve densities within the sediment exhibited a high degree of heterogeneity. Recruitment was high in January, followed by a period of low level recruitment in May and a steady increase in the number of juveniles from September to December. Neither bivalve densities nor recruitment seem to correlate with water temperature, % organic matter of sediment, seagrass above- and below-ground biomass.

Key words: bivalves, symbiosis, phanerogams, lagoons

Introduction

Symbiotic chemoautotrophic bacteria occur in the tissues of a number of invertebrates where sulphide is present in their environment (1). These symbiotic bacteria provide the host with part of its nutritional requirements by chemosynthetically fixing carbon dioxide via aerobic oxidation of sulphide (2). Marine molluscs containing sulfur-oxidizing chemoautotrophic bacteria can be quite abundant in seagrass beds (3) and while large number of studies have been undertaken to characterize extreme reducing environments such as those at hydrothermal vents, very little attention has been given to characterizing lucinid habitats in littoral zones. The present work is a study of a lucinid bivalve, *Loripes lacteus*, inhabiting a *Cymodocea nodosa* seagrass bed in a lagoon in Corsica (France). The lucinid's habitat was characterized and the importance of this habitat on the lucinid population was evaluated.

Materials and Methods

Sampling was performed within the Urbino lagoon (Corsica France) from January to December 2000 by SCUBA diving, with a sediment corer of 162 cm^2 (for a sediment depth of 0-20 cm). Sediment samples were sieved on a 1 mm mesh to retrieve the clams and phanerogam tissue. We measured (i) clam size (in mm at their largest point), (ii) animal body weight (weight weight/m^2). (iii) above- and below-ground phanerogam biomass (dry weight/m^2) and (iv) organic content of sediment (% of dry weight).

Results and Discussion

Habitat characteristics: The % organic matter of the sediment was low (annual mean: 1.3%) and varied significantly throughout the year with higher values recorded in summer (Figure 1). These values are lower than most reported values for sediments containing lucinids (2 to 7%) (2, 4). Lucinid species are frequently found in seagrass sediments (3) due to the abundance of organic material. Such organic matter levels lead to an elevated activity of sulfate-reducing bacteria and the production of high levels of hydrogen sulfide (1, 5).

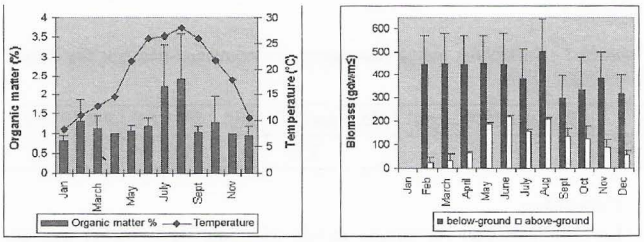

Figure 1: Left: Organic matter content of sediment and water temperature Right: Above- and below-ground biomass of *Cymodocea nodosa* seagrass bed (no biomass data for January).

Significant differences were observed in *Cymodocea nodosa* above- and below-ground biomass throughout the year (Figure 1). Above-ground biomass values were significantly greater during warm months than in colder months. Below-ground biomass values were relatively constant with a maximum in August and a minimum in September. Biomass in *Cymodocea nodosa* generally exhibits seasonal patterns with minimal leaf biomass in winter (6). Both the above- and below-ground biomass values are on the high end of the scale of literature values (6).

Bivalves : Bivalve densities varied throughout the year with periods of extreme density heterogeneity (Figure 2). There were thus no significant differences between the months. Mean *Loripes lacteus* density was 740 + 177 individuals/m^2, which is at the higher end of the scale of reported lucinid densities (3).

The 0-6 mm size class was counted to identify periods of recruitment. Juveniles were very abundant in January. An apparent low level recruitment was observed in May, followed by a steady increase in juvenile numbers from September to December. Neither bivalve densities nor recruitment seemed to correlate with the parameters measured (water temperature, % organic content of sediment, seagrass above- and below-ground biomass). Indeed, recruitment was observed during the colder months, when organic carbon content and *C. nodosa* biomass are at a minimum. A study of *Loripes lucinalis* similarly revealed that spawns did not correlate with the environmental factors often associated with spawning (temperature, chlorophyll a) (7). The high sediment carbon contents observed here in July and August may partly explain these results. Indeed, such high carbon loading generally involves a depletion in oxygen, leading to extensive sulfate reduction and the accumulation of sulfides (2). It is this dissolved sulfide that provides the energy source used to drive the bacterially-mediated carbon fixation (1) used in these types of chemoautotrophic symbioses. Thus, after a certain lag period, the high summer carbon loading would lead to the production of hydrogen sulfide. This added sulfide resource may stimulate the chemoautotrophic symbioses, with the production of energy that could be allocated to reproduction. This would of course imply that hydrogen sulfide is limiting during other periods of the year. It is clear that more work is needed to further characterize the seagrass environment before a better understanding of the role of seagrass habitat in chemoautrophic population dynamics can be reached.

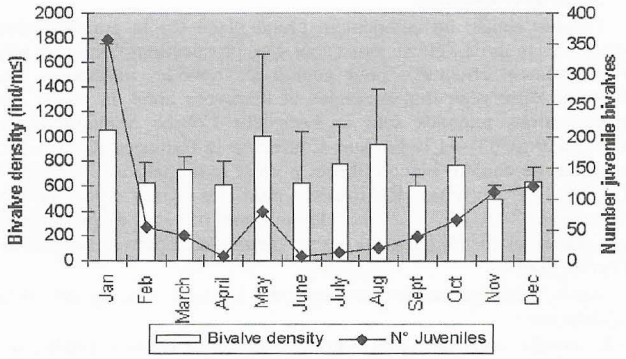

Figure 2: Bivalve and juvenile densities (0-6 mm size class).

References

(1) Cavanaugh C. M., 1983. Symbiotic chemoautotrophic bacteria in marine invertebrates from sulphide-rich habitats. *Nature,* 302 (5903): 58-61.
(2) Cary S. C., Vetter R. D. and Felbeck H., 1989. Habitat characterization and nutritional strategies of the endosymbiont-bearing bivalve *Lucinoma aequizonata*. *Mar. Ecol.-Progr. Ser.*, 55: 31-45.
(3) Johnson M., Fernandez C. and Pergent G., 2000. Potential autotrophic contribution of a chemoautotrophic symbiosis to primary production values in a *Cymodocea nodosa* seagrass bed. *Biol. Mar. Medit.* 7 (2) : 231-234.
(4) Dando P.R., Southward A.J. and Southward E.C., 1986. Chemoautotrophic symbionts in the gills of the bivalve mollusc *Lucinoma borealis* and the sediment chemistry of its habitat. *Proc. R. Soc. Lond.*, 227: 227-247.
(5) Fisher M. R. and Hand S. C., 1984. Chemoautotrophic symbionts in the bivalve *Lucina floridana* from seagrass beds. *Biol. Bull.*, 167: 445-459.
(6) Cebrian J., Duarte C.M., Marba Nuria and Enriquez S., 1997. Magnitude and fate of the production of four co-occurring Western Mediterranean seagrass species. *Mar. Ecol.-Prog. Ser.*, 155: 29-44.
(7) Johnson M. A., Diouris M. and Le Pennec M., 1994. Endosymbiotic bacterial contribution in the carbon nutrition of *Loripes lucinalis* (Mollusca: Bivalvia). *Symbiosis,* 17: 1-13.