

EVIDENCE OF PREFERENTIAL BROWSING ON *FUCUS VESICULOSUS* BY THE SMOOTH PERIWINKLE, *LITTORINA OBTUSATA*

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Abstract Earlier studies have shown the smooth periwinkle, *Littorina obtusata* (L.), to have a grazing preference towards *Fucus vesiculosus* (L.) over *Ascophyllum nodosum* (L.). The preference of *L. obtusata* was evaluated by quadrat sampling in a Massachusetts intertidal zone. Based on a ratio of observed smooth periwinkles to total mass of *F. vesiculosus* or *Ascophyllum* available within the quadrat, *L. obtusata* was found to have a significant preference for *F. vesiculosus* ($p < .05$).

Key words: *Fucus*, *Ascophyllum*, *Littorina obtusata*, Preference

Introduction

Primary consumer browsing is a major selective pressure on primary producers. The habitat modifying primary producer fucoid algae *Ascophyllum* and *Fucus* are the primary substrate for browsing by the smooth periwinkle *Littorina obtusata* (Williams 1990). *L. obtusata* is a small periwinkle native along the Eastern Seaboard from Newfoundland to New Jersey and primarily browses fucoid algae, including members of the genera *Fucus* and *Ascophyllum* (Trussell 1997).

Previous studies have shown preferential browsing on *F. vesiculosus* by *L. obtusata* (Cacabelos et al. 2010, Long et al. 2007, Loux-Turner 2008, Williams 1990). The objective of this study was to confirm or reject this perceived preferential browsing by observation of *L. obtusata* in situ.



Figure 1 *Littorina obtusata* on *Fucus* sp.

Typical specimen of the smooth periwinkle shown in situ on *Fucus*.

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Materials & Methods

The study occurred over a period of three mid to low tidal afternoons at Canoe Beach, Nahant, Massachusetts (42.420038°N, -70.906235°W). Thirty square quadrats of 625 cm² were randomly placed on areas in the *Ascophyllum* zone with one hundred percent *Ascophyllum* cover. Depth of the *Ascophyllum* canopy was measured at nine locations in each quadrat, and from five quadrats a 12.5 cm square corner was cleared and the *Ascophyllum* canopy was collected to determine the relationship between volume and mass (Figure 2). In the lab, the *Ascophyllum* samples were measured and a linear relationship between volume and mass was found. In each quadrat the number of *L. obtusata* found on both *Fucus* and *Ascophyllum* was determined, along with the lengths of *Fucus* fronds found within the quadrat. From two quadrats, all *Fucus* were cleared and brought back to the lab for length/mass measure. Using 17 individuals a *Fucus* length to mass ratio was determined. The *Littorina obtusata* found on each algal species were assumed foraging on that particular alga.

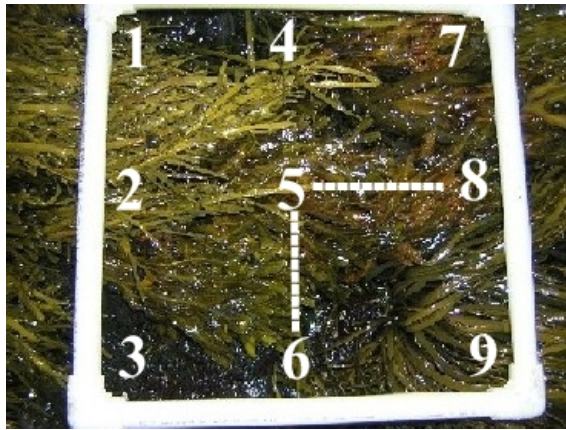


Figure 2 Diagram of quadrat methodology

Labels 1-9 show the areas measured for depth of fucoid algae, the average of these measures was used to compute the volume and mass. The dotted line shows the area removed for the purpose of determining a

Results & Discussion

A linear relationship was found between the volume of *Ascophyllum* and the mass of the *Ascophyllum* canopy (Figure 3A). The trend line was used to determine the mass of the four different corners of the quadrat, as the total quadrat volume may not be accurately measured by the metric. Similarly, a linear relationship was found between the length of a *Fucus* specimen and its mass (Figure 3B). This relationship was found to slightly over estimate the volume of *Fucus* in each quadrat, so the data may be skewed towards showing a higher preference for *Ascophyllum*.

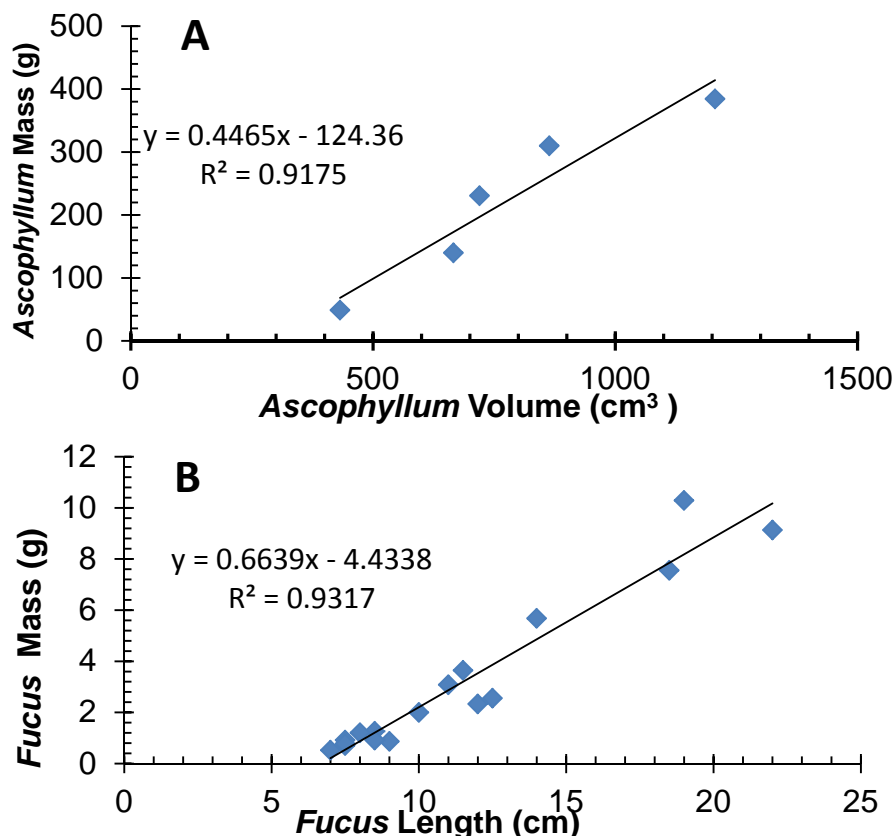


Figure 3 Linear relationship found between *Ascophyllum nodosum* volume and biomass and *Fucus vesiculosus* length and biomass

A shows the relationship between *Fucus vesiculosus* length and mass. *F. vesiculosus* individuals under 5 cm tend to be of nearly negligible mass.

B shows the relationship between *Ascophyllum* sp. mass, and the estimated volume of the quadrat. The relationship (density) seems to point to a negative mass of *Ascophyllum* for depths of less than 2 cm; no quadrats were sampled with an average depth of less than 2 cm.

The average number of *L. obtusata* found per gram of *Fucus* (0.45) in the thirty quadrats was almost one hundred times greater than the average for *Ascophyllum* (0.005). The difference between groups is easily visible when charted on a logarithmic (base 10) scale (Figure 4). The average number of *Littorina obtusata* found on *Ascophyllum* (0.005 *Littorina*/gram; Standard Error: 1.357) falls at significantly lower than the average number found on *Fucus* (Ave: 450.2 *L*/kg; Std. Err: 332.2). When five exceptionally high density quadrats are removed from the data set, the Standard Error of the *Fucus* dataset falls (Rev. Std. Err: 23.3). ANOVA results, Table 1, show that this difference in means is significant ($p=0.0077$).

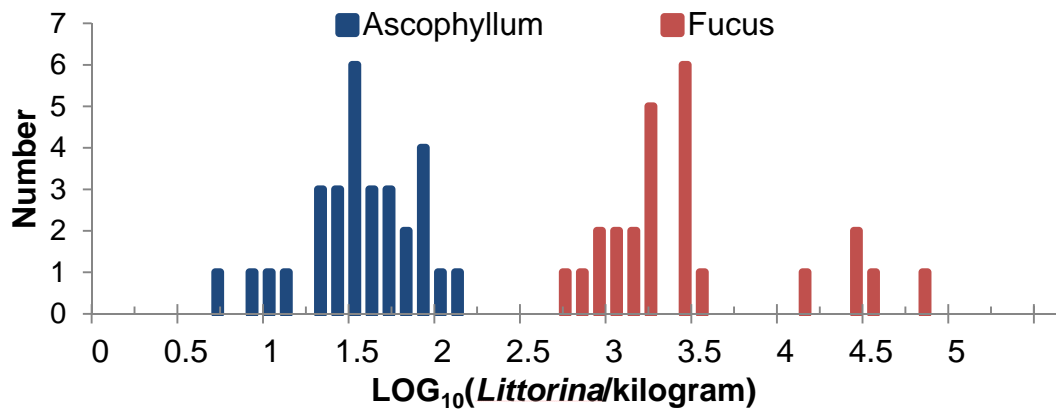


Figure 4 LOG₁₀ transformed histogram of *Littorina obtusata* found per kilogram algae. This histogram shows the distribution of the results. When transformed the data fall into two distinct, non-overlapping normal distributions. Five quadrats showed exceptionally high *Littorina* densities and are visibly not part of the normal curve.

ANOVA						
Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	9.943661	1	9.943661	7.656979	0.007771	4.023017
Within Groups	68.82794	53	1.29864			
Total	78.7716	54				

Table 1 Significant results found between number of *Littorina obtusata* obtained per gram from separate algal species

Single factor ANOVA between ratios of *L. obtusata* found per quadrat and total estimated mass of Fucoid algae. Significant results shown between the two study groups, *Fucus* and *Ascophyllum*.

The results of this study reaffirm preferential browsing on *F. vesiculosus* by *L. obtusata*, as found by earlier investigations. The new data which this study presents is the size of the preferential difference between the two algae. *F. vesiculosus* was shown to have on average almost one hundred times more *L. obtusata* per gram than *A. nodosum*. The reason for the observed preferential browsing is unclear. Immediately likely features which may influence this preference include: differences between the relative amount of surface area per gram between the two alga, the relative shelter underneath *A. nodosum* that *Fucus* in this study were found in, some mechanical difference making *F. vesiculosus* more easily graspable, and/or selection by *L. obtusata* for algae with higher amounts of polyphenols. More study is necessary to separate out both the motivation behind selection preference in Littorine snails, and its effects on the ecosystem at large.

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