Sponge Morphology and Filter Feeding Efficiency in *Haliclona ecbasis, Ophlitaspongia pennata,* and *Mycale hispida.*

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Marine Invertebrate Zoology 2012
Summer Session A 2012

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Keywords: sponge, *Haliclona*, *Ophlitaspongia*, *Mycale*, morphology, filter feeding

Sponge Morphology and Filter Feeding Efficiency in *Haliclona ecbasis, Ophlitaspongia pennata,* and *Mycale hispida.*

Submitted to Invertebrate Zoology Summer Session A on July 20th, 2012
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Abstract

Filter feeding of microalgae is known to be a source of nutrients in sponges, but the relationship between sponge morphology and filter feeding rates have not been investigated. The demosponges *Haliclona ecbasis, Ophlitaspongia pennata,* and *Mycale hispida* of class Demospongiae are commonly found in the San Juan Islands, and were used in a comparison study of sponge morphology and filter feeding rates. Sponge samples were collected from two sites, one intertidal and one subtidal, and were treated with a microalgae monoculture of *Nannochloropsis.* Water samples were taken at regular intervals and measured by spectrophotometer at λ 440nm for absorbance. Post ANOVA statistical analysis samples from the intertidal site were found to not show any variance within species at any collection point. Specimens from the subtidal site failed to produce conclusive data possibly due to contamination of sponges by other organisms inhabiting the sponges or weakness in the methodology. Therefore, the results of this study conclude that the three species *Haliclona ecbasis*, *Ophlitaspongia pennata*, and *Mycale hispida* of class Demospongiae may not have significantly different filter feeding efficiencies even though each species exhibit different morphotypes.

Introduction

Demospongiae of phylum Porifera are widely accepted as the basal-most metazoans, evolving from a common Urmetazoa ancestor before the Cambrian explosion (Muller 2007). There are a variety of Demospongiae, yet most morphotypes use filter feeding as a means to collect food particles smaller than 10μm in size such as bacteria and microalgae from the water column (Duckworth 2004). Filter feeding in Demospongiae occurs via collared cells called choanocytes, which use flagella to move nutrient filled water to the cell surface (Leys 2006). Investigations into temperature effects on filter feeding rates have been completed to understand energy consumption rates within species (Riisgard 1993). Previous studies on filter feeding rates in sponges have focused on sponges with the same general morphology (Reswig 1971). Investigations at Lake Baikal, Russia (Pile 1997), the Mediterranean Sea (Ribes 1999), the Bahamas, Belize, Florida (Lesser 2005), and Jamaica (Reiswig 1974) all discuss feeding efficiency of like morphotype sponges. Through this investigation, morphological descriptions accompanied by data on filter feeding rates of common San Juan Island Demospongiae may lead to further investigations on species distribution, morphological adaptation, and environmental parameters of the San Juan Island sponges.

The first hypothesis for this study is if Demospongiae prominent in the intertidal zones are exposed to set concentrations of microalgae, then filter feeding rates will not vary within species. The second hypothesis for this study is if sponge morphology affects filter feeding efficiency, then morphology should determine which sponge morphotype is the most efficienct filter feeder.

Methods

Specimen selection

For the following investigations I chose the target organisms *Haliclona ecbasis*, *Mycale sp.*, and *Ophlitaspongia pennata*, due to the vast differences in morphology among these species, as well as their presence being either littoral or sublittoral. *H. ecbasis* was collected from the intertidal at Eagle Cove, San Juan Island, WA. The amount of *H. ecbasis* collected was 36cm wide by 24cm long so that 2cm wide by 2cm long samples could be developed. Sub-tidal *Mycale sp.* was collected from the dock atFriday Harbor Labs, Friday Harbor, WA. The amount of *Mycale sp.* collected was 24cm wide by 24 cm long so that 2cm wide and 2cm long samples could be developed. *O. pennata* was collected from both the Friday Harbor Docks site and the Eagle Cove intertidal site. The amount of *O. pennata* collected from each site was 24cm wide by 24cm long so that 1cm wide by 1cm long samples can be developed. Samples prepared from these collections were 1cm wide by 1cm long. By collecting these quantities of sponge, I will produce 12 individual samples to be used in trials I and II.

Filter feeding measurement and quantification

This investigation will use a total of 24 sponge samples in two trials. Each trial will have 5 experimental samples and one control sample of per species. For each trial run, a piece of sponge was placed in a vial of filtered sea water with a dilute concentration of algae. Then a 200µL water sample (with algae) was taken every 10 minutes for 1 hour. These water samples were collected in 96 well plates and measured for absorbance at wavelength 440nm (Brown 1987) by a µQuant™ 96 well UV/Vis spectrophotometer. Data analysis was completed on the statistical software SigmaPlot™ 11.0 for one way ANOVA of algae consumption rates over sample groups.

Results

Observation of filter feeding

From the first trial with *H. ecbasis* absorbance data for specimens with algae and data for the two control groups demonstrated sponge filter feeding from the water column as seen in figure 1. A t-test was completed to compare the absorbance values of the control with sponge only and the control with algae only, determining the two controls were significantly different as shown in table 1.

Filter feeding rates

Data from both trials were statistically analyzed by one way ANOVA to find the variance of mean rate per collection point of each sample group. Figure 2a shows the mean rates of absorbance per 10 minute collection period for *O. pennata* specimens. ANOVA analysis determined that the rates where significantly different, and pairwise comparison found the mean rates at the 10 minute and 60 minute collection points to have the greatest statistical difference in rates as shown in table 2. Figure 2b shows mean rate data from the *M. hispida* group. ANOVA analysis of the *M. hispida* group determined that rate steps were statistically significant as seen in table 2; however, negative absorbance values confound these results. Figure 2c shows mean rate data for *H. ecbasis*. ANOVA analysis of *H. ecbasis* found that these means were not significantly different as seen in table 2. When ANOVA was completed with control groups the data remained not significantly different as seen in table 2.

Discussion

The data collected from each of the sample groups produced results indicating separate filter feeding rates and behaviors. Data in figure 1 shows that filter feeding of *Nannochloropsis* from the water column by the sponges did in fact occur. Comparison of mean rates within species produced 3 different conclusions. With the *O. pennata* group one way ANOVA found that mean rates were significantly different; however, this ANOVA failed the normalcy test leading to further statistical analysis by pairwise comparison. The results of the pairwise comparison test found that the initial collection point at 10 minutes and at 60 minutes have the greatest statistically significant difference. This observation leads to the conclusion that the *O. pennata* sponges may have eaten all of the algae in the first 10 minutes of the trial, and then expelled a large portion of the ingested material during the final 10 minutes of the trial. This behavior of particle rejection may have occurred due the sponge's inability to digest *Nannochloropsis.*

ANOVA analysis of the data collected from the *M. hispida* group determined that the means among collection points were significantly different; however, the absorbance values reported from spectrophotometry data were confounded by negative values. This observation of inconclusive data may be a strong indication of weakness in the methodology of this study. Further trials and sterile, particulate free materials may prevent such inconclusive data in future investigations.

ANOVA analysis of the data collected from the *H. ecbasis* group determined that the means among collection points were not significantly different, and with further ANOVA of *H. ecbasis* to the no-algae-sponge control group all samples were not significantly different. This observation draws the conclusion that the *H. ecbasis* group did eat all of the algae present in the first 10 minutes of the trial, and that all *H. ecbasis* retained the algae for the duration of the trial. These conclusions may lead to an explanation stating that the sponge effectively filter fed the algae and digest the algae.

Future investigations into the filter feeding of sponges on microalgae should include detailed morphological descriptions along with phylogenetic analysis of samples to properly identify all trial specimens. Furthermore, a larger sample size and more conclusive analysis of sponge absorption of microalgae should be completed.

Acknowledgements

I would like to thank the professors for this course in Marine Invertebrate Zoology, Dr. Julia Sigwart and Dr. Mikhail Matz. I would also like to give special thanks to the course's teaching assistant Stephanie Crofts. Additionally, I would like to thank the Marine Invertebrate Zoology class for their support and guidance during this study; especially Ashley Garrison, Alex Medved and Benson Chow for their consultation throughout. Finally I would like to thank the University of Washington Friday Harbor Laboratories, the University of Washington faculty, and the University of Alabama at Birmingham for working together to make it possible for me to conduct research at world renowned institution.

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Tables

Table 1 T-test statistical analysis of control groups. One control contained algae without sponge and the other control contained sponge without algae. Both controls were found to be statistically different from one another.

T-Test	N	Degrees of Freedom	P-value
Controls	2	12	<0.001

Table 2 ANOVA statistical analysis of each species. Mean rates over 60 minute trial. *H. ecbasis* exhibiting no variance over all collection points. *O. pennata* and *M. hispida* were found to have statically difference rates at different collection points.

ANOVA	N	F statistic	P-value
H. ecbasis	5	1.341	0.281
O. pennata	5	5.581	0.002
M. hispida	5	3.312	0.021

Figures

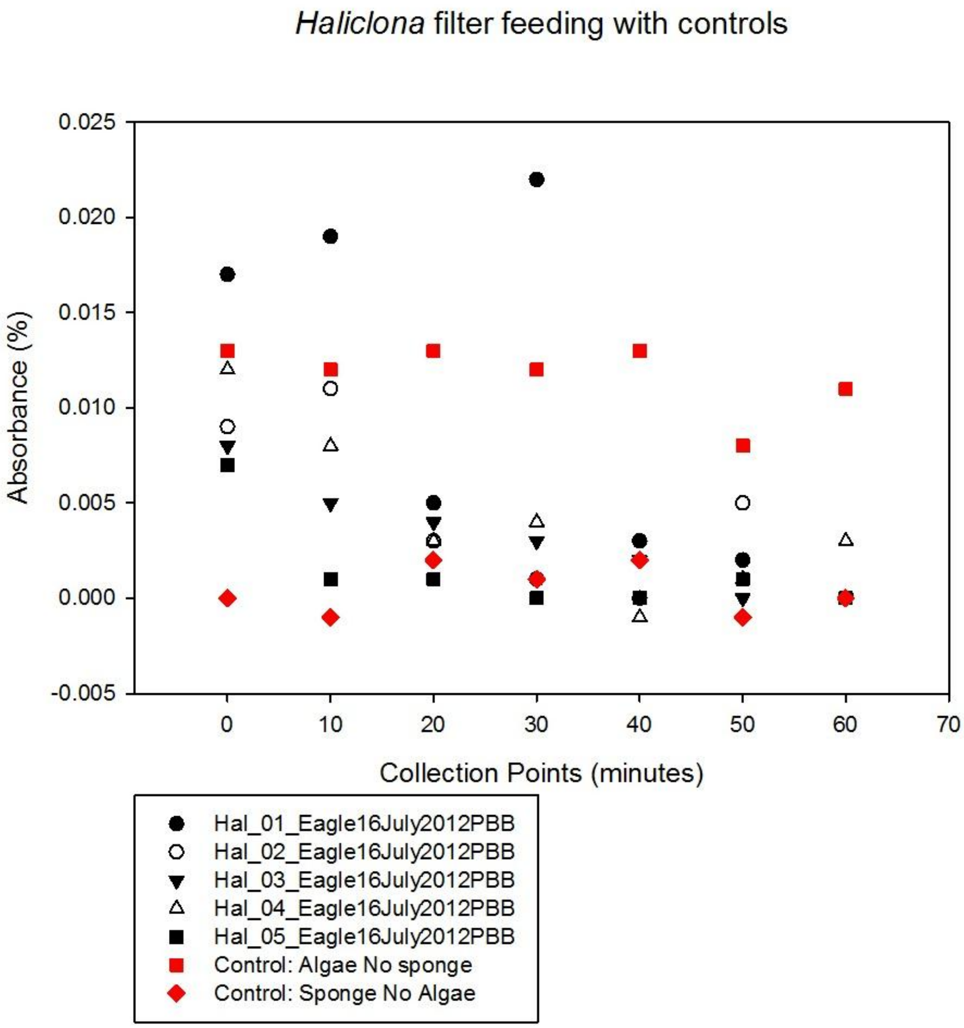

Figure 1 Filter feeding of *H. ecbasis* with controls.

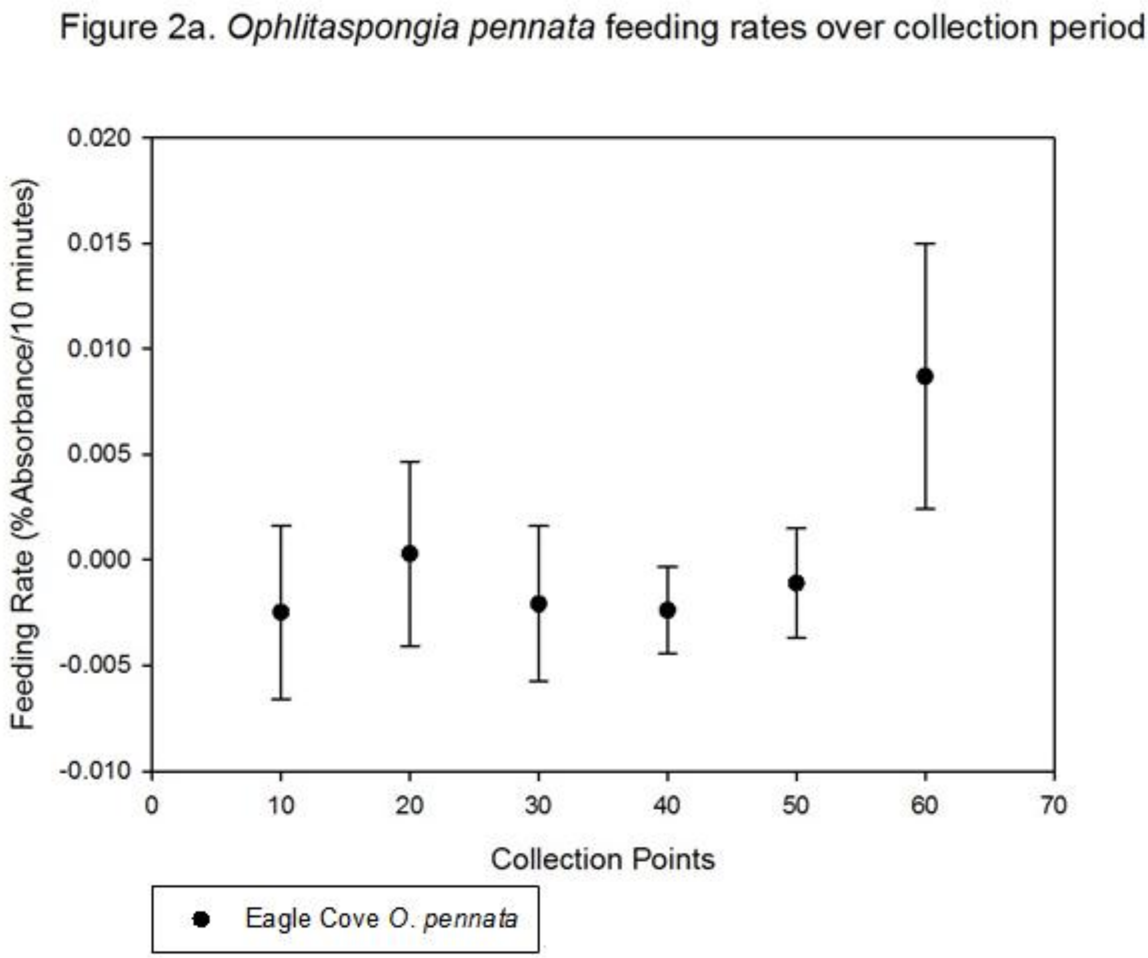

Figure 2a *O. pennata* mean feeding rates over a 60 minute trial. Feeding rates showed minimal variance until the final collection point. Error bars are standard errors.

Figure 2b. *Mycale hispida* feeding rates over collection period

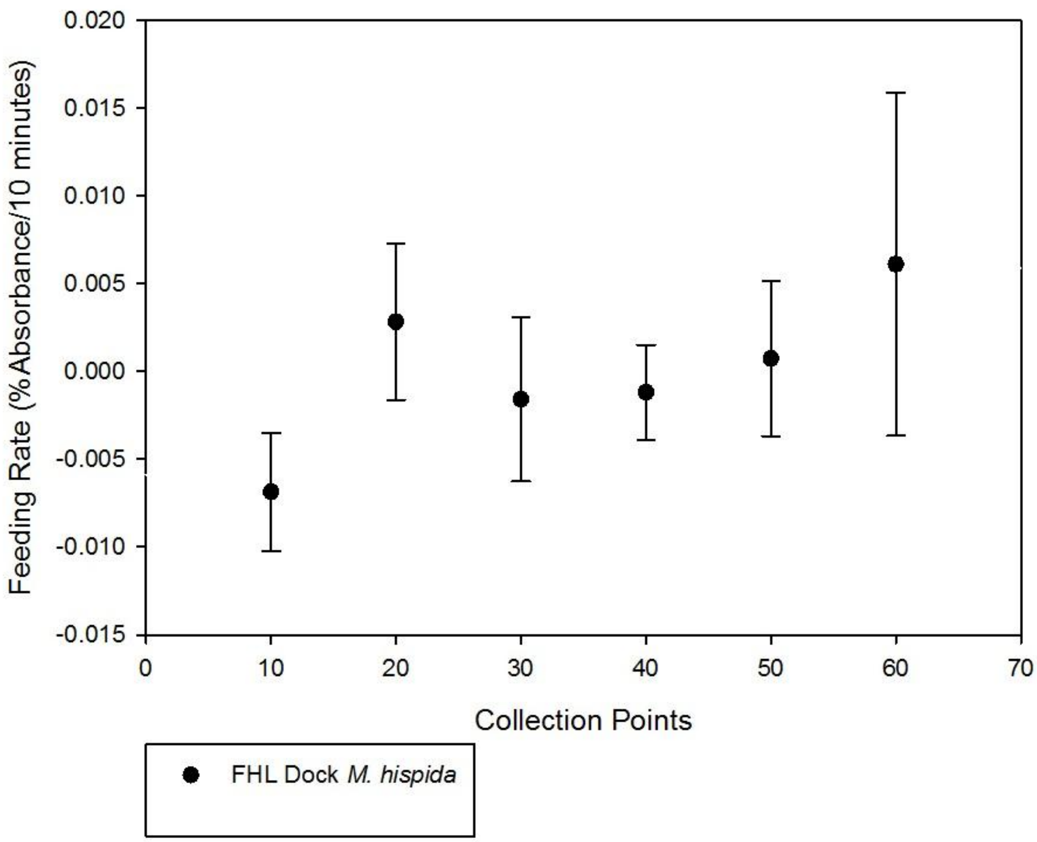

Figure 2b *M. hispida* mean feeding rates over a 60 minute trial. Feeding rates were inconclusive do to negative feeding rates recorded. Error bars are standard errors.

Figure 2c. *Haliclona ecbasis* feeding rates over collection period

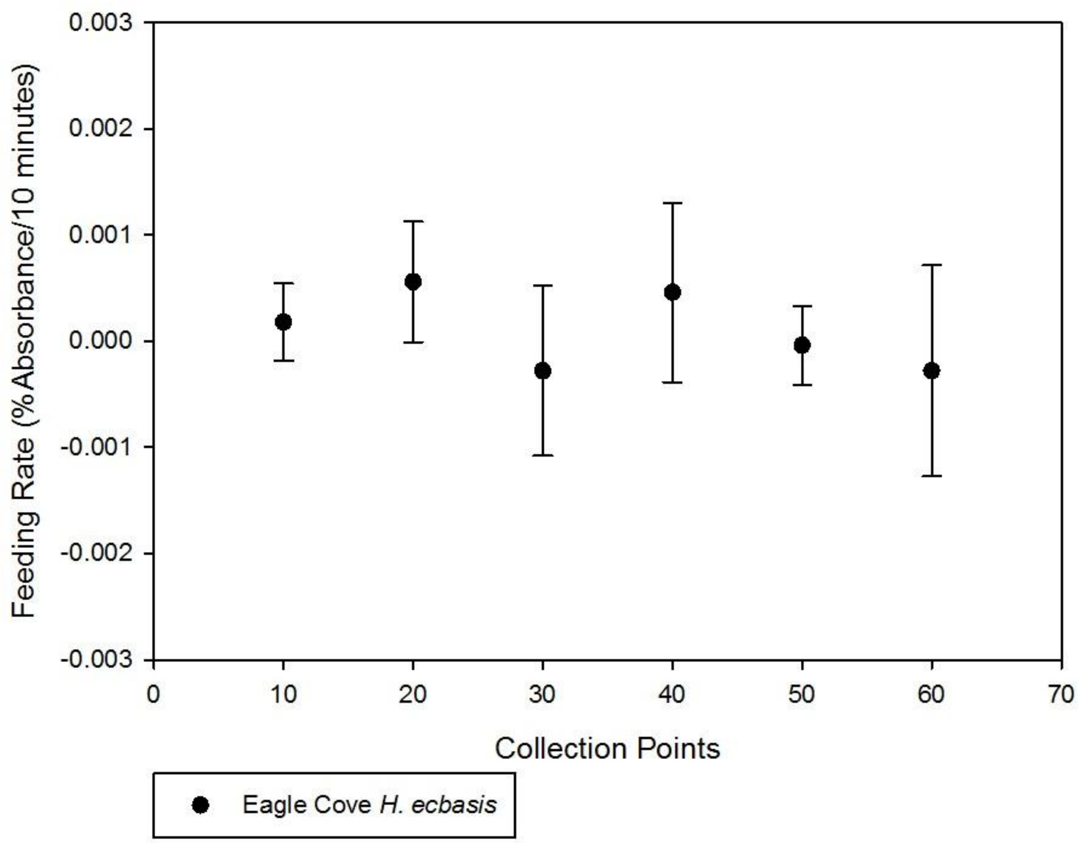

Figure 2c *H.ecbasis* mean feeding rates over a 60 minute trial. Feeding rates showed no significant variance over all collection points. Error bars are standard errors.