Population level biodiversity of *Sargassum* associated mobile fauna

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Abstract Pelagic *Sargassum* provides a unique drift macroalgal habitat in the North Atlantic that supports a variety of important species. Using biodiversity as an indicator for ecosystem health, we evaluated the diversity of *Sargassum*-associated mobile fauna communities in the Sargasso Sea using variables such as *Sargassum* species, age, and size. We collected clumps of *Sargassum* through dipnetting during our cruise from San Juan, PR to New York, NY via Bermuda (April-May 2015). We observed two species of *Sargassum*, *S. fluitans III* and *S. natans I*, and *S. natans VIII*, a variant. Each species of *Sargassum* differs morphologically, with *S. fluitans III* and *S. natans VIII* offering greater surface area than *S. natans I*. We observed a significant difference in species' richness on clumps of *S. natans I* and *S. fluitans III* compared to *S. natans VIII*. We found a significant negative relationship between species' abundance and amount of *Sargassum* present. As a narrower lens for diversity in the Sargasso Sea, we used the slender *Sargassum* shrimp to test population connectivity in the Sargasso Sea. Through a comparison between collection sites based on dominant *Sargassum* species, we determined whether frontal dynamics acted as barriers between populations of *Latreutes fucorum*. We found that despite differences in *Sargassum* distribution, there was no significant genetic structure of *L. fucorum* in the Sargasso Sea. Through our analysis of biodiversity of mobile fauna and of *L. fucorum*, we concluded that biodiversity is highly varying and requires continued research to grasp the full picture in the Sargasso Sea.

Introduction

Two species of *Sargassum* act as the habitat and substrate for a diverse range of organisms in the Sargasso Sea[9,7,6]. *Sargassum fluitans III* and *Sargassum natans I* float on the surface of the ocean, relying on wind and currents for transportation[5]. Mobile fauna, defined by this study, are inhabitants of the macroalgae that are not attached to the *Sargassum* substrate. To better understand the ecosystem functions of the Sargasso Sea, data on the distribution, abundance, and connectivity of *Sargassum* associated organisms is essential. Biodiversity acts as a key indicator of ecosystem health and measuring biodiversity provides a critical assessment useful in future implications. *Sargassum* species and variants differ in phenotypic structure so we examined biodiversity in relation to clump size, age, and species type of *Sargassum*. Additionally, we used *L. fucorum*, the most abundant mobile fauna, to examine biodiversity on a population level. We hypothesized that *L. fucorum's* genetic structure relates to *Sargassum* species as currents act as a border for *Sargassum*.

Methods

- We recorded *Sargassum* clump size, age, and species and identified mobile fauna communities from each *Sargassum* clump
- Our population connectivity study used *L. fucorum* collected from neuston tows at equivalent dip net sites; we selected sites based on the dominant *Sargassum* species in the tow
- We extracted shrimp genomic DNA and conducted PCR amplification of the 16S mtDNA gene.
- We and sent the samples to Operon for sequencing and used Geneious to trim and align our sequences, and the BLAST tool to assure the correct species were sequenced

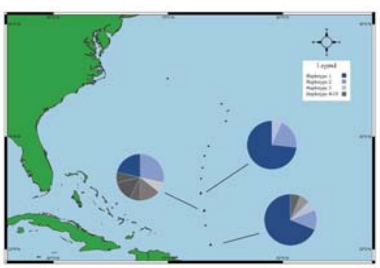

Figure 1. Locations of sample sites for biodiversity and molecular data. Black circles indicate a dip net site used as part of the biodiversity study while black triangles indicate site for molecular analysis 16S of *Latreutes fucorum*. Pie charts indicate 16S haplotype frequencies at each corresponding site, with haplotype restricted to one sample location marked in grey and haplotypes shared across multiple locations marked in blue. The size of pie charts is proportional to sample size. Map generated using QGIS.

Results

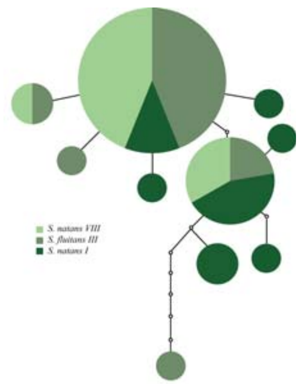

Figure 2: Haplotype network of mtDNA 16S sequences. Circles correspond to unique haplotypes. Green coloring indicates sample location, as identified by *Sargassum* spp., where the haplotypes were found and circle size is proportionate to number of individuals sharing a particular haplotype. Each line connecting circles and white dot indicate a singular nucleotide change. Across all sequences we observed ten haplotypes, with three haplotypes shared across all sites, and seven site specific haplotypes. The AMOVA indicated that most variation existed within populations (96.13%) opposed to among populations (3.87%), and there was no significant genetic structure (p=0.13392).

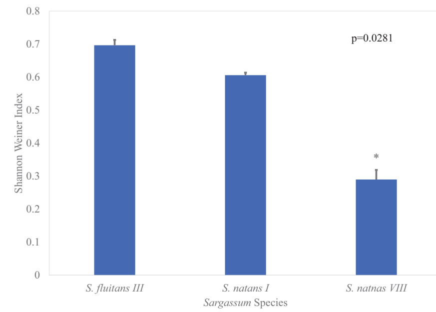

Figure 3. Average Shannon H index of mobile fauna (+/-SE) on *Sargassum* species found along the C-259 cruise track. Asterisk above bars represents significance with $p<0.05$. *S. fluitans III* and *S. natans I* were significantly different *S. natans VIII* but not from each other.

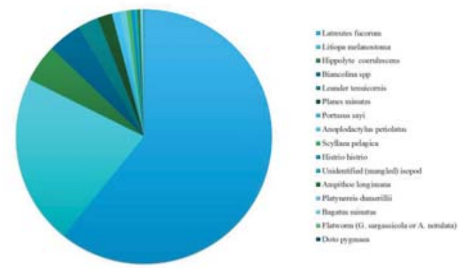

Figure 4. Total abundance of mobile fauna individuals across C-259 cruise track.

Figure 5. *Portunus sayi*

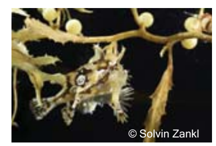

Figure 6. *Histrio histrio*

Figure 7. *Scyllaea pelagica*

Figure 8. *Hippolyte coerulescens*

Policy Implications

Sargassum-associated mobile fauna are a foundation food source for many ecologically and economically important migratory species. Our results suggest that mobile fauna communities are diversely dispersed. The importance of mobile fauna for the migratory species make these organisms highly valuable, and our findings support the need to conserve biodiversity to protect the health of the Sargasso sea.

Additionally, our results indicate that distribution of the slender *Sargassum* shrimp is not limited by the same factors that limit *Sargassum* distribution. This suggest that *L. fucorum* is unaffected by major ocean currents. This suggest establishing a network of areas rather than a singular area in the Sargasso Sea would be the most effective strategy to conserve biodiversity.

Concluding Remarks

- Mobile fauna species richness and abundance varies across the different *Sargassum* species present in the Sargasso Sea
- Neither habitat size nor age are the best variables for reliably determining biodiversity of mobile species
- Preliminary results show that mobile fauna display higher abundance per habitat structure when habitat is in lesser concentrations and is widely dispersed
- The most abundant invertebrate of the Sargasso Sea, the slender *Sargassum* shrimp, reveal a cosmopolitan population structure

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