

## Abstract

In recent years, many nations and conservation organizations have shown interest in protecting the Sargasso Sea, possibly through a network of protected areas. Increased understanding of the ecology of the Sargasso Sea is needed for effective design of protection areas; hydroids on pelagic *Sargassum natans I*, *S. natans VIII*, and *S. fluitans III* were studied to support this effort. Samples were collected and examined by Sea Education Association research students aboard the *SSV Corwith Cramer* on a transect through the Sargasso Sea from Puerto Rico to New York in late spring 2015. Genus diversity of hydroids, along with population connectivity of the most common hydroid species, *Clytia noliformis*, was studied. A total of seven hydroid genera were represented in these samples, six on *S. natans I* six on *S. natans VIII*, and four on *S. fluitans III*. Following basic morphological identification, DNA barcoding was carried out by the DNA sequencing laboratory Operon. The study shows that hydroid community species composition differed between *Sargassum* species and across the Subtropical Convergence Zone. Haplotype network analysis showed nine different haplotypes that had little to no population structure or haplotype grouping between the north and south Sargasso Sea. Results suggest that this hydroid species, and potentially many other species crucial to the *Sargassum* ecosystem, can be managed as a single population across the Sargasso Sea.

## Introduction

- The Sargasso Sea is bound on all sides by currents, and is ecologically important because it provides habitat for many commercially harvested fish stocks [1].
- Sargassum* constitutes the most significant mobile ecosystem in the oligotrophic Sargasso Sea [2,3].
- Hydroids, colonial organisms in the phylum Cnidaria, are ubiquitous polyp epibionts [4] on *Sargassum*; Calder [5] found ten species of hydroids on *S. fluitans III* and *S. natans I* in the area, the most common species being *Clytia noliformis*, making it the ideal species for population connectivity studies.
- Hydroids are the base of the *Sargassum* food web [2].
- The Sargasso Sea is bisected by the Subtropical Convergence Zone (STCZ), which may act as a barrier to dispersal to hydroids.
- A good understanding of biodiversity and population connectivity is essential for determining areas for protection in order to better encompass a variety of organisms and ecosystem services.

## Objectives

- BIOGEOGRAPHY:**
- To investigate the distribution of hydroids in the Sargasso Sea
  - To investigate factors affecting hydroid biodiversity
- POPULATION CONNECTIVITY:**
- To investigate population connectivity in hydroids and how it may be influenced by the Subtropical Convergence Zone

## Methods

- Clumps of *Sargassum* were collected via opportunistic dip netting and twice-daily noon and midnight Neuston Net tows along the SEA C259 cruise track from Puerto Rico to New York.
- Clumps were processed for taxonomy, weight, size, and color.
- Each clump was examined by light microscopy to identify all hydroids present to species. All species present were photographed and samples were collected and kept in ethanol as voucher samples.
- 41 samples of *C. noliformis* and 20 samples from an array of other morphologically identified species were sent to Operon for genetic analysis.

## Results and Discussion

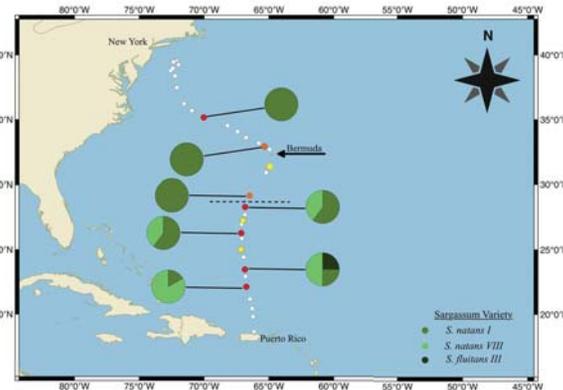


Figure 1: Sampling locations of SEA cruise C259. Pie charts indicate proportions of *Sargassum* varieties found at that location. Red circles indicate locations where morphological data was collected. Yellow circles represent areas where population connectivity data was collected. Orange circles represent where both data sets were collected. White circles represent sites where data was not collected for this study. Dashed line indicates the approximate location of the Subtropical Convergence Zone.

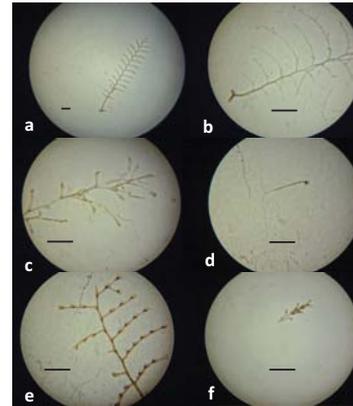


Figure 2: Photographs of six common hydroid taxa collected during this study: (a) *Aglaeophenia*, (b) *Plumularia*, (c) *Obelia*, (d) *Clytia*, (e) *Halopteris*, and (f) *Dynamena*. Scale bar in all photos is 1 mm.

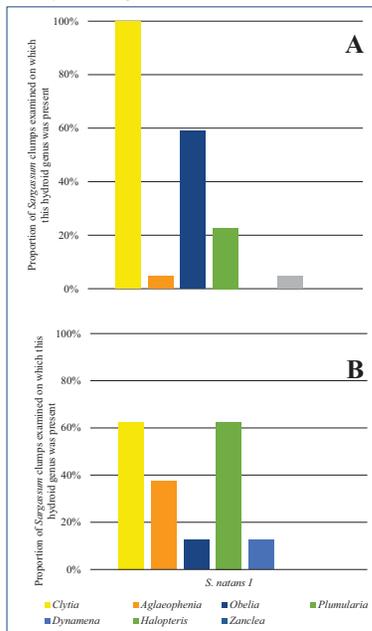


Figure 3: Percentage of *Sargassum natans I* clumps examined on which there was at least one individual of the specified hydroid genera, for (A) the North Sargasso Sea, and (B) the South Sargasso Sea, respectively. *Clytia* was the most frequently occurring overall, but less common in the South Sargasso Sea than in the North Sargasso Sea on *Sargassum natans I*.

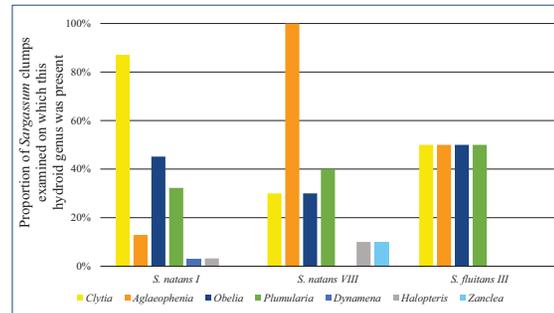


Figure 4: Percentage of clumps on which at least one hydroid of the specified genera was found, separated by *Sargassum* variety. *Clytia* was the most frequently occurring genus on *Sargassum natans I*, *Aglaeophenia* was the most frequently occurring genus on *Sargassum natans VIII*. Only two clumps of *S. fluitans III* were examined; the genera common on the two other *Sargassum* varieties occurred also on *S. fluitans III*.

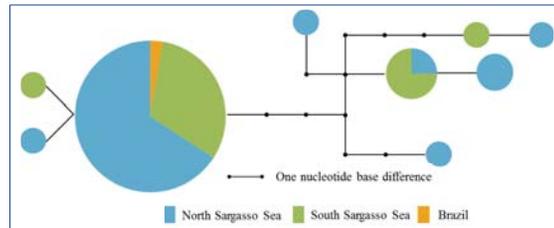


Figure 5: Haplotype network of 16S ribosomal gene sequences of 41 *C. noliformis* samples collected from *S. natans I* between San Juan, Puerto Rico, and New York, USA, and one sample collected off the coast of Brazil (Accession number DQ064792; [6]). Circles represent unique haplotypes, and circle size is proportional to the number of individuals sharing a particular haplotype. Results indicate nine distinct haplotype groupings of *C. noliformis*. Twelve samples from the south Sargasso Sea and 25 samples from the north Sargasso Sea, along with the sample from Brazil, all shared the same major haplotype.

## Policy Implications

Haplotype network analysis showed nine distinct haplotypes that had little to no population structure or haplotype grouping between the north and south Sargasso Sea (Fig. 5). It also shows that regardless of distance, *Clytia noliformis* populations are homogenous. These results suggest that this hydroid species, and potentially many other species crucial to the *Sargassum* ecosystem, can be managed as a single population across the entire Sargasso Sea.

## Conclusions

- Species composition varies between *S. natans I*, *S. natans VIII*, and *S. fluitans III*; however, all four major genera of hydroids that occur on *S. natans I* and *S. natans VIII* also occur on *S. fluitans III* (Fig. 4).
- Hydroid community composition varies between the north and south Sargasso Sea (Fig. 3).
- The STCZ does not appear to act as a barrier to dispersal for *Clytia noliformis*. Nine distinct haplotypes show no connection in near nor distant groupings of *C. noliformis* (Fig. 5).

## Works Cited

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