Shipboard Observation of Pelagic *Sargassum* spp. Reveals Proliferation of a Rare Form and Differences in Associated Mobile Fauna Community Structure

La Observación de Especies Pelágicas del *Sargassum* spp. Revela la Proliferación de una Forma Poco Común y de Diferentes Estructuras de la Comunidad de Fauna Móvil

Observation à Bord de *Sargassum* Pélagique spp. Révèle Prolifération d'une Forme Rare et Différences dans la Structure Mobile Associé Faune Communauté

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EXTENDED ABSTRACT

Sargassum is golden brown algae with characteristic air-filled bladders and blades arising from a central stipe with various patterns of branching. Hundreds of benthic species with holdfasts are recognized and distributed worldwide. However, two pelagic species, *Sargassum natans* and *S. fluitans*, are found only in the North Atlantic, Caribbean Sea, and Gulf of Mexico; both drift at the sea surface and maintain their presence through vegetative growth. Parr (1939) described six distinct morphological forms between the two recognized pelagic species. All *S. fluitans* forms have small thorns along the stipe that are most prominent near the distal, actively-growing end, whereas *S. natans* forms have smooth stipes. Variations in bladder and blade shape and size account for unique form morphologies (Figure 1a - b).

Historically, *S. fluitans* Parr and *S. natans I* Parr were most abundant and widely distributed across extensive surveys in the North Atlantic, Caribbean, and Gulf of Mexico (Winge 1923, Parr 1939). Concurrently, *S. natans VIII* Parr was described as a rare form, occurring in low abundance and narrowly distributed in the western Caribbean, Gulf of Mexico, and edges of the Gulf Stream. From November 2014 to May 2015, we conducted twice-daily surface net tows during three SEA Semester® cruises onboard the SSV *Corwith Cramer*: Canary Islands to the Lesser Antilles, Grenada to Puerto Rico, and Puerto Rico to New York, USA. Three morphological forms of pelagic *Sargassum* were routinely observed. Each *Sargassum* form exhibited a distinct geographic distribution, with greatest range overlap occurring among the Leeward Islands. *S. natans I* Parr was most abundant in the south Sargasso Sea while *S. fluitans* Parr was observed at low abundance across the entire sample area; most surprising, the historically rare *S. natans VIII* Parr constituted the majority of *Sargassum* in the Caribbean region in 2014/15 (Schell et al. 2015).

Pelagic *Sargassum* harbors a unique community of epibiotic and mobile organisms while also providing essential nursery, spawning, and/or foraging habitat for a diversity of larger fish, seabird, and turtle species (Butler et al. 1983, Coston-Clements et al. 1991, Moser and Lee 2012). A number of *Sargassum*-associated species are endemic to this drifting ecosystem, including some hydroids, fish, crabs, and shrimp. We present the first description of eastern Caribbean *S. fluitans* Parr and *S. natans VIII* Parr mobile fauna communities.

Mobile fauna observations were obtained from a total of 31 *Sargassum* samples collected by dip net (50 cm circular frame, 335 um mesh) during Sea Education Association Cruise C257 (February to March 2015, among islands between Grenada and Puerto Rico). *Sargassum* was sorted by form and massed (g) using a spring scale. While dip net samples were targeted for a single *Sargassum* form, five contained mixed assemblages of drift algae; the dominant form was always greater than 70% by mass. Mobile fauna were separated from *Sargassum* clumps with a vigorous saltwater rinse followed by a freshwater soak. Clumps were then visually examined to capture any remaining mobile fauna. Samples were preserved in 70% EtOH. Identification and enumeration of mobile fauna species occurred onshore with the aid of dissecting and compound scopes. Species richness and abundance of each species were normalized to the total mass of *Sargassum* (combined mass of all algae in mixed assemblages) collected in each dip net sample.

Comparison of resident mobile fauna between *S. fluitans* Parr and *S. natans VIII* Parr revealed significant differences in community composition, species richness, and overall abundance. Specifically, *S. natans VIII* Parr hosts fewer species than *S. fluitans* Parr. In total, 14 mobile fauna species were collected from *S. fluitans* Parr samples (n = 15) in contrast to only nine from *S. natans VIII* Parr samples (n = 16; Table 1). Both species of *Sargassum* shared the following organisms but in all instances the percent occurrence was greater on *S. fluitans* Parr samples: the crab, *Portunus sayi*; the shrimp, *Latreutes fucorum* and *Leander tenuicornis*; the amphipods *Biancolina* sp.; the isopod *Bagatus minutus*; the snail *Litiopa melanostoma*; the flatworms *Hoploplana grubei* and *Gnescioceros sargassicola;* and the parasitic isopod *Probopyrinella latreuticola* (percent occurrences in Table 1). These species were unique to *S. fluitans* Parr samples and notably absent from *S.natans VIII* Parr: the shrimp *Hippolyte zostericola*; the amphipods *Ampithoe longimana* and *Sunampithoe pelagica*; the isopod *Paradynamene benjamensis*; and the flatworm *Acerotisa notulata*. Analysis of covariance comparing species richness across the range of clump sizes collected (Figure 2) confirmed greater mobile fauna richness associated with *S. fluitans* Parr (mean richness = 0.24 #/g) compared to *S. natans VIII* Parr (mean richness = 0.11 #/g; ANCOVA $F(1, 14) = 33.4$, $p < 0.0001$).

Total mobile fauna abundance was greater on clumps of *S. fluitans* Parr than *S. natans VIII* Parr. A greater number of crabs, *P. sayi*, were collected from *S. fluitans* Parr (18) compared to *S. natans VIII* Parr (4), and the mean density (#/g *Sargassum*) was significantly different ($p < 0.05$; Figure 3a). A greater number of shrimp were also collected from *S. fluitans* Parr: *L. fucorum* (*Sf* = 525, *Sn VIII* = 231), *L. tenuicornis* (*Sf* = 26, *Sn VIII* = 9), and *H. zostericola* (*Sf* = 1, *Sn VIII* = 0). The mean density (#/g *Sargassum*) of all shrimp combined was also significantly different ($p < 0.01$; Figure 3b). Though a greater number of snails, *L. melanostoma*, were collected from *S. fluitans* Parr (276) than *S. natans VIII* Parr (52), there was considerable variability from one clump to the next and the mean density (#/g *Sargassum*) was not significantly different ($p < 0.2$; Figure 3c).

Observed differences in species richness and organism abundance between *S. fluitans* Parr and *S. natans VIII* Parr could be the result of different source regions or physical branching structures. For example, *S. fluitans* Parr may be sourced from the Sargasso Sea while *S. natans VIII* Parr is likely originating in the North Equatorial Recirculation Region (Schell et al. 2015 and Johnson et al. 2013); each source ecoregion may contribute a signature mobile fauna community to the *Sargassum* prior to transport to other areas of the North Atlantic. Alternatively, *S. fluitans* Parr exhibits a more densely-branched morphology that could afford mobile fauna greater protection from predators. Regardless of underlying causes for the noted variability in species assemblage, richness and abundance, the presented results suggest that *S. natans VIII* Parr may provide less ecologically valuable foraging and nursery habitat for migratory populations. As such, the negative impacts of recent *Sargassum* beach stranding and coastal inundation events may not be balanced by the ecological and economic values attributed to pelagic *Sargassum* habitat occurring offshore. Further field investigations are encouraged to address this important consideration.

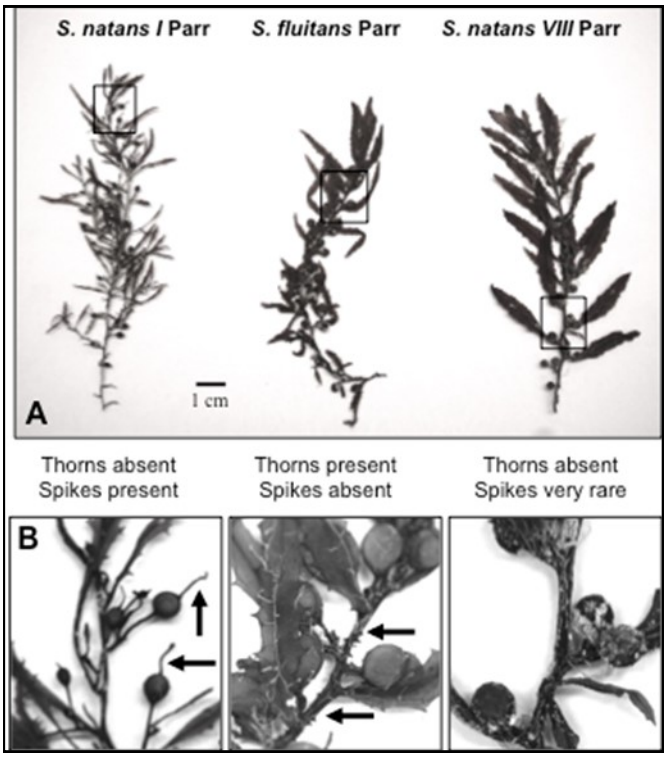

Figure 1. Comparison of three *Sargassum* forms observed in the eastern Caribbean during 2014/15, showing A) frond appearance and B) air bladder and stipe morphologies (figure after Schell et al. 2015).

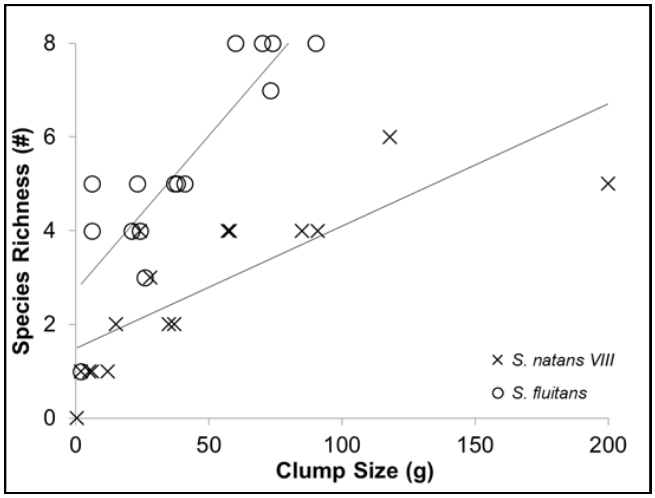

Figure 2. Mobile fauna species richness using clump size as a covariate. ANCOVA comparing *S. natans VIII* Parr (n = 16) with *S. fluitans* Parr (n = 15) was statistically significant ($p < 0.05$).

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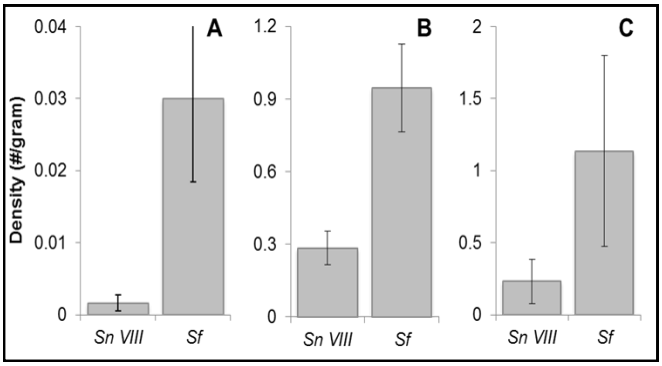

Figure 3. Mobile fauna densities of A) crab *Portunus sayi* ($p < 0.05$), B) shrimp *Latreutes fucorum*, *Leander tenuicornis* and *Hippolyte zostericola* ($p < 0.05$), and C) snail *Litiopa melanostoma* ($p > 0.05$). ANOVAs compare *S. natans VIII* Parr (n = 16) with *S. fluitans* Parr (n = 15).

Table 1. Frequency of occurrence (percent of total samples) for each mobile fauna species observed, as well as community assemblage (shaded cells) and cumulative species richness (total #) for each *Sargassum* form. Number of clumps sampled: *S. fluitans* Parr (n = 15), *S. natans VIII* Parr (n = 16).

		Frequency of Occurrence (% samples)	
	Species	***S. fluitans* Parr**	***S. natans VIII* Parr**
CRAB	*Portunus sayi*	53	13
SHRIMP	*Latreutes fucorum*	100	81
	Leander tenuicornis	60	25
	Hippolyte zostericola	7	0
AMPHIPOD	*Biancolina sp.*	20	6
	Ampithoe longimana	7	0
	Sunampithoe pelagica	7	0
ISOPOD	*Bagatus minutus*	27	6
	P. benjamensis	7	0
SNAIL	*Litiopa melanostoma*	93	63
FLATWORM	*Hoploplana grubei*	20	13
	G. sargassicola	27	13
	Acerotisa notulata	13	0
PARASITE	*P. latreuticola*	80	56
Cumulative Species Richness (#)		**14**	**9**

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