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Recent Sargassum Inundation Events in the Caribbean
Shipboard Observations Reveal Dominance of a Previously Rare Form

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During June 2011, pelagic Sargassum began washing ashore along Caribbean, Gulf of Mexico, West African, and Brazilian coastlines in unprecedented quantities. Tourist beaches were covered by more than a meter of seaweed. Economic impacts of this Atlantic basin-scale inundation event drew international media attention (Higgins, 2011). By summer 2012, our shipboard observations suggested the Caribbean portion of the event had run its course. However, another similarly extensive Sargassum inundation was underway by April 2014, persisting through 2015 (MercoPress, 2015).

Did the invading pelagic Sargassum drift out of the Sargasso Sea, a vast region bounded by the currents of the North Atlantic gyre (Smetacek and Zingone, 2013)? Alternatively, is its source the North Equatorial Recirculation Region (NERR), as suggested by satellite-derived observations of Sargassum mats (Gower et al., 2013) and hindcast models of Sargassum landfalls (Johnson et al., 2013)? Our recent net sampling indicates that the invading Sargassum did not come from the Sargasso Sea.

In late November 2014, Sea Education Association’s (SEA’s) SSV Corwith Cramer departed the Canary Islands. We sailed across the eastern Sargasso Sea without a sighting, but on day 15, after heading south into the tropics, we were surrounded by Sargassum. For the next three weeks, twice-daily surface net tows contained more Sargassum than ever recorded by SEA voyages. We noticed the seaweed looked different from the Sargassum fluitans or S. natans with which we were familiar from 20 years of sailing in the Sargasso Sea, the Caribbean, and Florida Straits (Figure 1a).

Most resources assert pelagic Sargassum is composed of two species, S. fluitans and S. natans. However, each species exhibits a diversity of...
morphological forms, originally described by Winge (1923) and refined by Parr (1939) but which are absent from contemporary field guides. Parr (1939) recognizes two forms of S. fluitans (III, X) and four forms of S. natans (I, II, VIII, IX). Presence or absence of thorns on the stem, especially on the distal portion, distinguishes between Sargassum species: all S. fluitans have thorns, whereas all S. natans have smooth stems (Figure 1b; Parr, 1939). Bladder and blade attributes differ widely among forms (Figure 1c, d).

Within the North Atlantic, Caribbean Sea, and Gulf of Mexico, Winge (1923), Parr (1939), and SEAs shipboard sampling over the past several decades (unpublished) indicate that S. natans I Parr and S. fluitans III Parr were most common while other morphological forms were rare. We provisionally identified the predominant form of Sargassum inundating the Caribbean during 2014/2015 as S. natans VIII Parr based on its consistent smooth stem, broad blades, and rare bladder spines across the entire range of this study. While future genetic analyses may resolve subspecies taxonomy, in practice, field observations rely on morphological identification to distinguish between forms. At first glance, S. natans VIII is easily mistaken for S. fluitans, although the latter has significantly smaller blades (Figure 1d). These and other differences in physical structure may influence the ecological role of each form.

Here, we present recent distribution and abundance data for three morphologically distinct pelagic Sargassum forms. Sampling occurred November 2014 to May 2015 aboard SSV Corwith Cramer. Cruises began in the Canary Islands, traversed the Sargasso Sea and western tropical Atlantic to the Lesser Antilles, and then sailed to the eastern Caribbean before heading to New England. Fifty-four surface neuston tows (net 1.0 m wide × 0.5 m high, 333 μm mesh) sampled 102,919 m². Sargassum was collected in 92.6% of tows, sorted by morphological form, and wet weighed (g). Stations were sorted into four oceanographic regions; Sargassum was absent east of 44°W and rarely encountered north of 34°N.

Composition of Sargassum forms differed starkly by region (Figure 2). S. natans VIII dominated the western tropical Atlantic (87.3% wet weight), eastern Caribbean (95.3% wet weight), and Antilles Current (92.0% wet weight). In contrast, S. natans I dominated the South Sargasso Sea (87.5% wet weight). Observed S. natans VIII proliferation throughout three of these regions is significant given its historic low abundance and rare occurrence limited to the western Caribbean (Parr, 1939).

The 2014/2015 Sargassum inundation event is exceptional, particularly in the western tropical Atlantic (Figure 2, inset). In autumn 2014, the mean concentration of all Sargassum forms combined (0.84 g m⁻², n = 8 tows, SE = 0.4) was 10 times greater than that during the 2011/2012 event (0.07 g m⁻², n = 163) were not different from each other (ANOVA, p = 0.89). On the basis of both Sargassum composition and abundance, the Sargasso Sea exhibited no connection to the Caribbean events.

SEA’s decades-long shipboard records establish an invaluable baseline and are the only quantitative assessment of Sargassum abundance prior to and during the Caribbean inundations; therefore, this data set enables recognition of a recent change in biodiversity and provides important context for future monitoring. With proper field identification of the distinct S. natans VIII morphological form, the source region and geographic extent of Sargassum inundation events can be tracked at finer spatial resolutions than permitted by remote sensing.
and modeling techniques. Furthermore, the occurrence and dominance of a previously rare pelagic Sargassum form has significant ecological consequences. Preliminary observations comparing resident fauna on S. natans VIII reveal lower species richness and abundance. Accordingly, compared to other pelagic Sargassum forms, we predict a lower value of S. natans VIII as foraging and nursery habitat for known macrofaunal associates, including fishes, turtles (Coston-Clements et al., 1991), and seabirds (Moser and Lee, 2012); indeed, few such organisms were present near the S. natans VIII-dominated mats encountered during our 2014/2015 cruises. While modeling and remote-sensing efforts continue to offer insights into basin-scale circulation processes influencing Sargassum distribution and transport, field observations are essential for evaluating and interpreting ecological impacts of future Sargassum inundation events.

REFERENCES

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The International Ocean Color Coordinating Group (IOCCG; http://www.ioccg.org) is an organization of experts from both the satellite data provider (space agencies) and user communities (scientists, managers) operating in the field of satellite ocean color. It provides a critical forum for sharing, coordinating, and disseminating information related to the measurement of ocean color radiometry from space. The IOCCG hosted the second International Ocean Color Science meeting in San Francisco, CA from June 15–18, 2015. The primary focus of the meeting was to build and strengthen the international ocean color community by providing a forum to collectively address common issues and goals, and to foster exchange between the research community and space agency representatives. Representatives from ocean and satellite agencies from the United States, Canada, Europe, South Korea, China, India, Japan, and Brazil briefed the participants on current and future plans for ocean color sensors from their respective agencies. The IOCCG supports all efforts to make the calibrated, geo-located radiances from all international sensors freely available to the global research community. Such data are important for development and validation of new ocean color products including methods to better estimate phytoplankton functional types across the world ocean. Further information on IOCS meeting can be found on the TOS website at http://www.tos.org/pdfs/IOCCG_TOS_7.20.15.pdf.