Answering the Golden Question: How fast does pelagic sargassum grow in the Tropical Atlantic?

Respondiendo a la pregunta de oro: ¿Qué tan rápido crece el sargazo pelágico en el Atlántico tropical?

Répondre à la question d'or: à quelle vitesse les sargasses pélagiques poussent-elles dans l'Atlantique tropical?

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EXTENDED ABSTRACT

Pelagic sargassum was historically considered to be endemic to the North Atlantic. However, since 2011, massive influxes of pelagic sargassum from a new source region identified as the Tropical Atlantic NERR have been plaguing the Caribbean and West Africa. The beaching of pelagic sargassum and its subsequent decomposition have resulted in significant ecological and socio-economic consequences, requiring ongoing management of these sargassum influx events. To assist with these management efforts, several forecasting models have been developed to aid in the prediction of sargassum influxes. However, available forecasts are inherently unreliable, in part because they rely on the detection of sargassum from satellite images to seed advection models which then predict the passage of these inert pixels (Marsh et al. 2022). The addition of sargassum growth and mortality parameters to these models could potentially increase their accuracy. However, there is still generally very little known about the growth and mortality of pelagic sargassum, and no information for the new NERR sargassum population responsible for these influxes.

In this study we measured and compared in situ growth of pelagic sargassum morphotypes (S. fluitans III, S. natans I and S. natans VIII) from the NERR for the first time in neritic waters of Barbados in the Eastern Caribbean. Growth studies were conducted over two study periods: a cool water period (May 4th – 24th, 2022) and a warm water period (August 23rd – September 12th, 2022). During each study period, three consecutive 6-day trials were conducted. For each trial sargassum was collected offshore Conset Bay, on the eastern coast of the island and transported to Carlisle Bay, on the island's southwest coast where in situ growth of sargassum was monitored. Six replicates of each morphotype (~ 40 g wet weight, 3-10 thalli) were separated, wet weighed, placed into growth mesocosms, and deployed in nearshore waters. Mesocosms were constructed of 5L clear plastic bottles with multiple rows of perforations, kept buoyant by floats and secured to a mooring buoy. Three mesocosms were joined to form a triplicate set, and two triplicate sets were used to hold a maximum of 6 replicates for each morphotype. While we aimed to obtain a maximum of six replicates per morphotype whenever possible, the number of replicates per morphotype varied slightly among trails due to variability in relative morphotype abundance of sargassum arriving in Barbados at the time of the study. Replicates were held in mesocosms for 6 days and then re-weighed. Specific growth rate (SGR) was calculated as doublings per day (dd-1) and also expressed as number of days taken to double biomass. Growth rates of *S. fluitans* III, *S. natans* I and *S. natans* VIII were compared using one-way ANOVA and post-hoc Tukey HSD tests. Growth rate differences between cool and warm water periods were analysed using simple T-tests.

Temperature during the cool and warm periods ranged from 27.3 – 28.1˚C and 29.4– 29.9˚C respectively, and salinity ranged from 29.9 – 34.4 ‰ and 31.3 – 32.5 ‰ respectively. Results reveal a significant difference in growth rates among all pelagic sargassum morphotypes overall (Figure 1, One-way ANOVA: $F = 44.087$, $df = 2$, $p < 0.001$; Tukey HSD tests: $p < 0.05$ in all cases). Mean SGR of *S. fluitans* III was 0.053 dd-1 (i.e., taking 19 days to double in biomass). This was significantly higher ($p < 0.001$) than *S. natans* I (0.032 dd-1, 31 days doubling time) and more than twice the mean SGR of *S. natans* VIII (0.022 dd-1, 45 days doubling time). Growth rates of pelagic sargassum morphotypes were highest during the cool water period and generally slowed with increasing temperature across all morphotypes (Figure 2). However, only the growth of *S. fluitans* III differed significantly between cool and warm water periods (T-Test, $T = 6.395$, $df = 31$, $p = 0.023$). Furthermore, the difference in SGR among morphotypes was less marked during the warm period, with only *S. fluitans* remaining significantly different from both *S. natans* morphotypes.

That the growth of *S. fluitans* III significantly exceeds the growth of *S. natans* I and S. natans VIII supports current trends in morphotype composition of NERR sargassum blooms in which *S. fluitans* III is the dominant morphotype (García-Sánchez et al. 2020, Alleyne et al. this volume). While high temperatures typical of the Tropical Atlantic seemingly facilitate the dominance of *S. fluitans* III we suggest that *S. natans* I may prefer cooler temperatures, hence supporting its historical dominance in the North Atlantic. Distinct differences in growth rates among morphotypes suggests that sargassum forecasts could be improved by considering this variability rather than modeling growth of sargassum as singular group

(Brooks et al. 2018). While the present study offers further insight into sargassum growth dynamics and provides the first growth rates for *S. natans* VIII, further studies are required to explore and clarify the growth responses of sargassum morphotypes under a wider range of environmental conditions likely to be experienced.

KEYWORDS: Sargassum, growth, Caribbean

LITERATURE CITED

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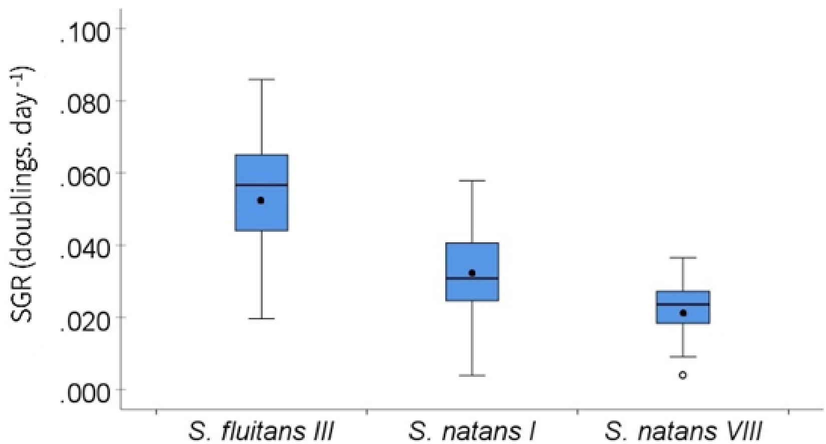

Figure 1. Specific growth rates (SGR) of sargassum morphotypes across the overall study period. Horizontal line indicates the median and dot indicates the mean SGR.

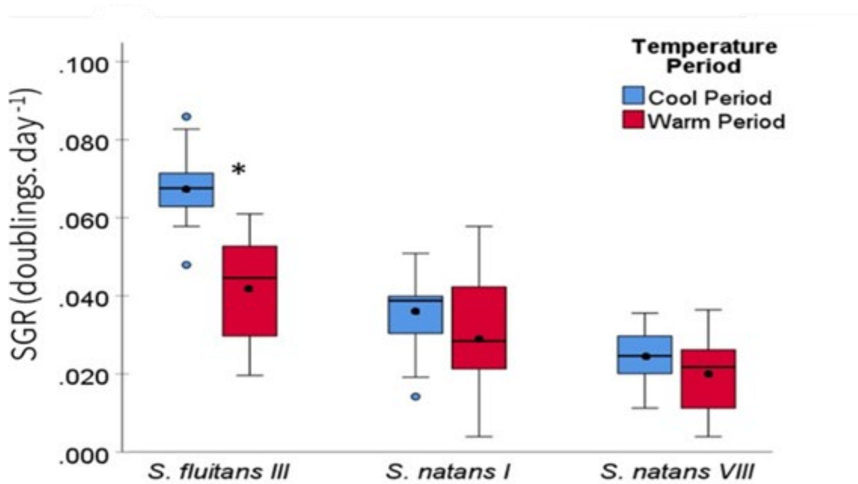

Figure 2. Comparison of SGR of sargassum morphotypes over cool and warm water periods. Star indicates significant difference in growth rates between cool and warm periods.