

## Catch and Store: How Sargassum Aquafarms can Flatten the Feedstock Fluctuation

## Captura y Almacenamiento: Cómo las Granjas Acuícolas de Sargazo pueden Aplanar la Fluctuación de la Materia Prima

## Capturer et Stocker: Comment les Fermes Aquacoles de Sargasses peuvent aplanir les Fluctuations des Matières Premières

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### EXTENDED ABSTRACT

#### INTRODUCTION

The valorization of Sargassum offers a solution to mitigate its negative impacts on Caribbean communities, but its effectiveness hinges on the freshness of the seaweed. Unfortunately, a significant portion of collected Sargassum either isn't fresh upon collection or isn't transported to valorization facilities promptly, resulting in much of it ending up in landfills. Moreover, valorization companies struggle with the unpredictability and variability of Sargassum arrival (Desrochers et al. 2020), making it challenging to secure large off-take contracts. Sargassum aquafarming presents a potential solution by providing a more stable supply. Firstly, on high influx days, excess Sargassum can be stored in the aquafarm and transferred to valorization companies on low influx days. Secondly, biomass can be grown in the non-Sargassum season.

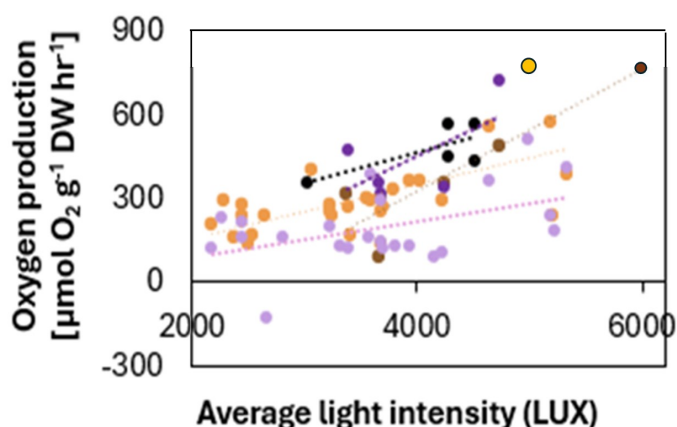
#### METHODS

A Sargassum aquafarm designed by Seafields Solutions was tested over a six week and a 3-month period in Mt Wynne Bay, Saint Vincent. The aquafarm was moored in the bay on a tethered line that allowed it to swing when the tides and current directions changed. It was filled with Sargassum, and cameras were installed below the Sargassum to determine if Sargassum escaped through sinking and to count the number of fish interacting with the farm. Growth rate was measured using 3 methods: (1) length measurements and tagging of individual pieces of Sargassum natans VIII, (2) drone shots to determine surface area paired with squares released into the Sargassum to estimate density, (3) weighting of entire biomass added to a 2.5 m cube attached to the aquafarm. The health of Sargassum was determined using a PreSens dissolved oxygen measurement kit that measured oxygen production by Sargassum natans VIII from wild mats and from the aquafarm. Furthermore, both wild and aquafarmed Sargassum fluitans III were used in 13C bottle incubations that determine how much carbon the Sargassum is incorporating into its biomass during 24 hours. Impacts of the farm on the surrounding water quality were measured using a Hobo dissolved oxygen meter and a Hobo pH meter from Onset. Fish surveys focused on fish associated with the aquafarm structure were conducted using snorkel gear, while fish associated with the Sargassum inside the aquafarm were surveyed using action cams that were deployed for 1.5 hours to take a picture every 6 seconds.

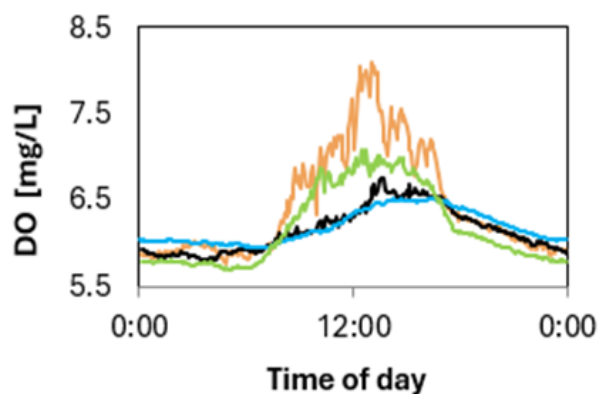
#### RESULTS AND DISCUSSION

All three methods used to measure growth found that Sargassum was growing in the Seafields aquafarm. The *S. natans* VIII individuals that were tagged had a mean daily growth of  $0.8 \pm 0.8$  mm. The doubling rate estimated from the surface area measured by drone shots and the density estimates with squares was 10.6 days. In the cube, a doubling rate of 37 days was measured. The growth measured/estimated differed substantially between methods and method refining as well as repeated measurements are needed to better understand how fast Sargassum is growing in the aquafarms.

Oxygen production increased with light intensity for both the wild and farmed Sargassum (Fig. 1). For the wild Sargassum there was also a big difference between Sargassum collected 24-25 April 2023 and 7-14 May 2023, with the first having much higher oxygen production. For the farmed Sargassum, there was no visible difference between those two periods. The samples collected from the cube had some of the highest oxygen production, potentially due to the Sargassum being less dense in there and receiving more light. Carbon fixation rate in *Sargassum fluitans* III was significantly higher for farmed Sargassum than wild Sargassum. The incubations were done in May, when also the oxygen production was higher in the farmed Sargassum compared to the wild Sargassum. It is therefore possible that the opposite results could have been found if the experiment was done in April. Additional data collection is needed to understand the differences in oxygen production and carbon sequestration between wild and farmed Sargassum. However, the results clearly show that farmed Sargassum is photosynthesizing and that its level of photosynthesis, oxygen production and carbon sequestration might be more constant than for wild Sargassum. This could potentially be due to environmental conditions experienced in the last few days to weeks being similar for samples from the aquafarm while they can differ quite a bit for wild Sargassum mats.



**Figure 1.** O<sub>2</sub> production of *S. natans* VIII increases with light. 24-25 April: Dark brown: Full aquafarm R<sup>2</sup>= 0.84, Dark purple Wild R<sup>2</sup> = 0.39. 7-14 May: Light brown: Half full aquafarm R<sup>2</sup>= 0.41, Light purple: Wild R<sup>2</sup>=0.23. 15 May: Black: Attached cage R<sup>2</sup>= 0.51.



**Figure 2.** Mean daily profile of Dissolved Oxygen. Black: Inside Paddock, 0-20% Sarg., Month 1 (N=11), Green: Inside Paddock, 0-20% Sarg., Month 2&3 (N=36), Orange: Inside Paddock, >20% Sarg., Month 1 & 2 (N=17), Blue: Outside of Paddock, 0% Sarg., Month 1,2,3 (N=65).

From September to December 2023 the aquafarm was deployed with 0%, 10% and 20-33% of Sargassum inside of it. While 10% of Sargassum did not affect the daily peaks in dissolved oxygen, pH and temperature in the bay, 20-30% did affect them and made the peaks higher. While the midday peaks of dissolved oxygen were the same in the empty farm and outside the farm in the first month, in month 2 and 3 dissolved oxygen midday peaks were higher in the empty farm than outside the farm (Fig. 2). This is likely due to algae biofouling on the farm and producing oxygen as well. However, that peak was still lower than with Sargassum present.

Fifteen Juvenile and 18 adult species of fish were observed inside and around the aquafarm. Very abundant species were Yellow Jacks with an average of 102 seen per fish survey, and Sergeant major with an average of 86 juveniles and 26.6 adults per survey. 78% of the fish surveyed were jacks and 18% were damselfish. The Sargassum aquafarm attracted eleven of the 13 fish species that were found in wild mats in Barbados waters (Alleyne et al. 2023), the only species missing were Chubs and Great Barracuda. Spear fishermen visited the aquafarm several times to shoot fish, showing its potential as a fish aggregation device. Furthermore, the farm proved to be a great habitat for juvenile fish and might contribute to fish stocks in surrounding areas. Lastly, snorkel tour providers might see the farm as an exciting snorkeling spot for their clients.

### CONCLUSION

This study showed that Sargassum can be kept alive and grown in aquafarms and that these aquafarms can contribute positively as fish habitat and nursery ground. As the next step, the commercial viability of the aquafarm should be tested alongside a Sargassum harvesting and processing operation.

### LITERATURE CITED

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**KEYWORDS:** Faunal interaction, Sinking speed, Carbon deposition, biochar, Decomposition rate.