Examining the Quality of a Compost Product Derived from Sargassum

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SUMMARY. The free-floating algae known as sargassum (*Sargassum fluitans* and *Sargassum natans*) drifts onto coastlines throughout the Atlantic Ocean during spring and summer months. Beach communities seek to maintain tourist appeal and, therefore, remove or relocate the sargassum drifts once it collects on shore. Maintenance efforts have attempted to incorporate the sargassum into dunes and beach sand. However, not all communities have the resources to manage the biomass and must dispose of it in a landfill. The utility of the seaweed biomass as a fertilizer for plant growth has been renowned for centuries. The purpose of this project was to evaluate the appropriate proportion of sargassum for other compost ingredients used in a large-scale composting system to create a quality product for utilization in horticultural and/or agricultural products. This study used ≈ 32 yard³ of sargassum as part of 96 yard³ of compost material that also included food waste, fish waste, and wood chips. Four protocols were prepared and included either 25% or 41.5% sargassum and various proportions of food or fish waste and wood chips, which are ingredients that would be readily available in coastline communities, to determine the ideal ratios of materials to create a quality compost. Piles were turned regularly and monitored for pH, moisture, and temperatures according to compost industry standards and approximately every 5 to 7 days. Piles cured for 4 to 8 weeks and the entire composting process lasted 5 months. Samples of compost were collected and tested through the Agricultural Analytical Services Laboratory's U.S. Composting Council's Seal of Testing Approval Program at Pennsylvania State University. All final compost products and protocols had reasonable quality similar to those required by current compost standards. However, the protocol incorporating equal parts sargassum (41.5%) and wood chips (41.5%), fish waste (4%), and food waste (13%) had the best results in terms of organic matter content and overall nutrient levels. Therefore, this study determined that waste management industries can use sargassum as a feedstock through a large-scale composting system to create a desirable compost product that could be used in the horticulture industries. Sargassum could also be composted and then returned to the shoreline, where it would help build soils and vegetation.

The Sargasso Sea was once a place of frightening legends to sailors of centuries ago, known as a windless and gnarly trap of a distinct flora that shrouded the mysterious waters, hiding alien monsters within its dark waters (Genthe, 1998). Contained by the Atlantic gyre, the Sargasso Sea exists as a unique anomaly

because it is the only sea on earth without a coastline. When comparing the entire Atlantic gyre to a tropical storm system, the Sargasso Sea would be the “eye” of the vortex, with calm and still waters (Genthe, 1998). The ocean currents contain the warm waters of the Sargasso Sea like a shallow bowl that is still being sculpted. As life grows inside this bowl and branches out, the ocean currents randomly

distribute flora and fauna alike toward the coastlines throughout the Atlantic Ocean, most commonly in southern Europe, North America, and the Caribbean (Righton et al., 2016).

Sargassum is a planktonic species of macroalgae [Phaeophyceae (Wang et al., 2009)]. These free-floating organisms reach a seasonal peak in growth and mass each year and will typically reach the Texas coast during the summer months (Round, 1981). When the sargassum touches the shoreline, it forms “mats” that pile up to recorded heights of 4 ft and stretch several hundred yards (Williams and Feagin, 2010). Then, the sargassum begins to decay and releases its fish and crustacean passengers like tourists exiting a cruise ship. Incidentally, actual tourists are attracted to the beach during the same summer months. As the number of beachgoers increases, the more inconvenient a mat of sargassum becomes to maintain tourist appeal (Williams and Feagin, 2010). Additionally, with warming temperatures in the oceans and increased urbanization leading to excess amounts of runoff of fertilizers into waterways, sargassum blooms have become more intense worldwide and are predicted to continue being a problem for coastal communities (Akin, 2019).

Many beach communities employ efforts to physically remove the sargassum. Using front-end loaders, the biomass can be raked or shoveled and often relocated along foredunes, where it can continue to naturally decompose. Another method involves spreading the sargassum evenly along the shore and covering it with sand, thereby rebuilding the shore rather than the dunes (M. Smith, personal communication). However, due to either local attitudes or limitations in maintenance, not all communities are able to adopt these methods and will take the more convenient

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Units

To convert U.S. to SI, multiply by	U.S. unit	SI unit	To convert SI to U.S., multiply by
0.4047	acre(s)	ha	2.4711
0.3048	ft	m	3.2808
3.7854	gal	L	0.2642
2.54	inch(es)	cm	0.3937
1	mmho/cm	dS·m ⁻¹	1
1	ppm	mg·kg ⁻¹	1
0.7646	yard ³	m ³	1.3080
(°F – 32) ÷ 1.8	°F	°C	(°C × 1.8) + 32

option of having the sargassum removed entirely and disposed in a land-fill (Akin, 2019).

There remains much debate regarding the matter of removing sargassum. When tourists of Matagorda Island, TX, were surveyed, 63.89% of participants disagreed with the statement, “seaweed should be removed from the beach completely” (Williams, 2010). The City of Galveston, TX has recently launched a public education campaign to encourage beachgoers to embrace the seaweed and public opinions are beginning to view the biomass as less of a nuisance compared with past views (Rice, 2015).

The utility of the seaweed biomass as a fertilizer for plant growth has been renowned for centuries (Panda and Nayak, 2012; Verkleij, 1992). Algae species such as norwegian kelp or rockweed (*Ascophyllum nodosum*) are used as a reliable source of plant nutrients in agricultural applications (Eyras et al., 2008; Win and Saing, 2008). Sargassum itself works as a natural fertilizer for coastal flora along the Texas coast, and its use is advocated for the restorative maintenance of dune ecology after hurricanes (Williams, 2010).

Recent research has shown positive results of sargassum used as a feedstock in large-scale composting to produce organic soil amendments, such as compost (Eyras et al., 2008; Sembera et al., 2018). Limitations and methods of the previous study included incorporating a low percentage of sargassum biomass (Sembera et al., 2018). The past study did not reflect the extremes of sargassum accumulation that coastal beaches might experience (Sembera et al., 2018). Neither did this previous study examine the potentially high concentrations of salt when incorporating greater proportions of material, which could have undesirable results on the finished compost product (Illera-Vives et al., 2015; Sembera et al., 2018).

Composting is the natural process of breaking down organic matter into a usable, waste-free product, and it is increasingly used as a waste management system (Sanders et al., 2011). Compost products are valuable commodities to agricultural, horticultural, and related users (Rynk, 1992; Walker et al., 2006). During

the active stage of composting, bacteria and other microorganisms consume oxygen and release carbon dioxide, thus producing a large amount of heat (Rynk, 1992). Temperatures must reach higher than 57 °C to kill pathogens as well as plant propagules or seeds (Dougherty, 1999). Finished compost can process down to 50% or less of the original volume of raw material (Rynk, 1992), thus making it an effective means of waste management (Day and Shaw, 2001).

In addition to horticulture, compost is used in other agricultural operations. Amended into soil, compost boosts soil fertility and improves soil structure while increasing the water-holding capacity and decreasing runoff (Rynk, 1992). Compost is known to increase the number and diversity of microorganisms and to enhance beneficial chemical and physical properties of the soil, which helps plants develop natural immunities to diseases, insects, and parasites (Reardon and Wuest, 2016). This process is promoted by carbon-based materials that slowly release nitrogen, phosphorus, and potassium into the soil over time (Dougherty, 1999; Rynk, 1992).

This project first examined the large-scale compost management of sargassum as a method that could potentially be replicated near the regional communities burdened by the plant. Then, it investigated the limits of a compost management system when using sargassum as a feedstock to create a marketable product for utilization in horticulture and related industries. Therefore, the purpose of this project was to evaluate the appropriate proportion of sargassum for other compost ingredients used in a large-scale composting system to create a quality product for utilization in horticultural and/or agricultural products.

Materials and methods

MATERIAL COLLECTION. Sargassum biomass was collected from the shoreline at Mustang Island State Park in Texas by a front-end loader and placed into vehicles for transportation. Supervision of the removal and collection of the sargassum biomass was managed by the City of Corpus Christi Parks and Recreation

Department according to the permit established by the U.S. Corps of Engineers and the City of Corpus Christi Beach adaptive management plan. Additional supervision by the Turtle Patrol, overseen by Texas Parks and Wildlife Department ensured that habitat of the kemp's ridley sea turtle (*Lepidochelys kempii*) was not disturbed.

Approximately 80 yards³ of “fresh” sargassum (sargassum biomass that arrived on the shoreline during the previous 24 h) were harvested for the study. Significant dry-down occurred immediately after harvesting due to natural processes after it was removed from its saline, aquatic environment, thus altering the biomass to ≈50% less volume compared with the original amount harvested.

COMPOST PILE CREATION AND MANAGEMENT. Compost piles were created on a 5-acre plot of land. Approximately 2.5 acres were allocated for the compost site and the other 2.5 acres surrounding the compost site served as runoff space and a catchment pond that could withstand a 25-year 24-h flooding event (Meier et al., 2014).

Piles were turned regularly to mix ingredients and aerate them. They were monitored according to compost industry standards approximately every 5 to 7 d (Dougherty, 1999) using a procedure involving five measurements obtained from sample locations in the pile and averaged to ensure the following ideals were reached: pH between 5.5 and 9.0 (Soil pH Tester; Kel Instruments Co., Wyckoff, NJ); moisture content between 40% and 65% (24-inch Moisture Meter; Lincoln Irrigation, Lincoln NE); and temperatures above 62 °C for a minimum of 3 d (60-inch Compost Thermometer Probe; ReoTemp Instrument Co., San Diego, CA) (Dougherty, 1999).

The entire composting process lasted 5 months. When active composting was completed, regular turning and irrigation were halted and piles were allowed to cure for 4 to 8 weeks (Dougherty, 1999; Rynk, 1992). Although food waste and wood chips are acidic feedstocks within compost, seaweed is slightly alkaline (Cooperband, 2002; Darlington, 2007; Dougherty, 1999; Maze et al., 1993). Compost research has indicated that piles allowed to cure for 3 to 4

months tend to have lower pH values (Dougherty, 1999). Therefore, curing piles for more than 1 month could allow the compost more time to become more acidic if deemed necessary.

COMPOST PILE PROTOCOLS AND TREATMENTS. Compost requires proper ratios of nitrogen and carbon sources (Rynk, 1992). During this research study, university cafeteria food waste (including vegetable, meat, dairy, and bread) was used as the primary nitrogen source. Invasive fish species plecostomus (*Hypostomus plecostomus*) and tilapia (*Oreochromis* sp.) were collected and included as an additional nitrogen source in the compost piles as part of ongoing invasive species removal from the San Marcos River, as contracted by the City of San Marcos, TX. Wood chips produced and donated by a local tree care company and leaf litter from the university campus were used as the primary carbon inputs and as a bulking agent to promote airflow through the compost piles. A previous study included sargassum in the compost protocols at an amount of 2% and did not reflect the extremes of sargassum accumulation that coastal beaches might experience (Sembera et al., 2018). Therefore, the compost protocols for this study included proportions of 25% and 41.5% sargassum. A total of 31.8 yard³ of sargassum was used for the project.

Each of the four protocols were replicated three times and placed into piles containing 8 yard³ feedstocks per pile (Table 1). Protocol A included 17% food waste (1.4 yard³), 41.5% wood chips (3.3 yard³), and 41.5% sargassum (3.3 yard³). Protocol B included 13% food waste (1 yard³), 41.5% wood chips (3.3 yard³), 41.5% sargassum (3.3 yard³), and 4%

fish waste (0.4 yard³). Protocol C included 21% food waste (1.6 yard³), 50% wood chips (4 yard³), 25% sargassum (2 yard³), and 4% fish waste (0.4 yard³). Protocol D included 25% food waste (2 yard³), 50% wood chips (4 yard³), and 25% sargassum (2 yard³). A total of 12 piles that were 6 ft in height and 8 ft in diameter were created, with the total amount of feedstocks equaling 96 yard³. The four protocols each had a total of 24 yard³ of material.

COMPOST QUALITY TESTS. After curing, samples were taken from the compost. It was noted during sampling that fish scales were present in the two protocols using fish waste and that a significant amount of beach sand was present in the final screened product of all four protocols.

Sampling techniques adhered to the collection procedures specified by the Agricultural Analytical Services Laboratory at Pennsylvania State University (2016). For each test, subsamples from each compost pile were collected from three different depths at five locations. These 15 subsamples were combined to create four 0.5-gal composite samples representative of each pile; then, subsamples were sent to the Agricultural Analytical Services Laboratory's U.S. Composting Council's Seal of Testing Approval (STA) Program at Pennsylvania State University (University Park). These are the current standards that the industry uses to gauge whether compost is suitable to market. The samples were evaluated based on the following characteristics: pH, soluble salt content or electrical conductivity (EC), moisture content, organic matter content, total nitrogen, total carbon, carbon-to-nitrogen ratio, phosphorus, potassium, calcium, magnesium, and metals (aluminum, copper, and zinc). Bioassay tests were

also conducted to observe maturity and stability measurements of compost samples (Meier et al., 2014; Montoya et al., 2013; Pennsylvania State University, 2016; U.S. Composting Council, 2002).

DATA ANALYSIS. Frequencies and descriptive data were reported for each protocol regarding compost quality standard attributes. An independent *t* test was conducted using SPSS (version 20.0; IBM Corp., Armonk, NY) to statistically compare results from each of the four compost protocols (*P* < 0.05). Because the study was limited to one sample and one data point per variable per protocol, *t*-tests were used.

Results and discussion

A total of ≈20 yard³ of stabilized compost was created. All protocols exhibited results within the normal range of quality compost. The finished product created from the used waste materials was valued at approximately \$45/yard³ or \$900 on the local market (Garden-Ville, unpublished data).

COMPOST QUALITY TEST RESULTS. Results of the compost quality tests indicated that pH, soluble salt content, total nitrogen, total carbon, carbon-to-nitrogen ratio, particle size, and bioassay measurements of all samples regardless of the protocol were within normal to ideal ranges for compost typically sold in the horticultural industry (Table 2). Additionally, metal content did not exceed normal ranges.

Notably, the recorded levels of soluble salts indicated that salinity was not an issue when using sargassum as a primary feedstock (Table 2). The analyses identified the final compost product in all protocols as having a soluble salt content ranging from 2.92 to 4.2 mmho/cm and was well

Table 1. Compost protocol percentages and total yard³ per pile of feedstocks used to evaluate the appropriate proportion of sargassum for other compost ingredients to be used in a large-scale composting system.

Protocol group	Food waste	Wood chips	Sargassum	Fish waste	Piles (no.) and volume (yard ³) ^z
A	17%	41.5%	41.5%	—	3
Amount (yard ³) ^z	1.4	3.3	3.3	—	8
B	13%	41.5%	41.5%	4%	3
Amount (yard ³)	1	3.3	3.3	0.4	8
C	21%	50%	25%	4%	3
Amount (yard ³)	1.6	4	4	0.4	8
D	25%	50%	25%	—	3
Amount (yard ³)	2	4	4	—	8

^z1 yard³ = 0.7646 m³.

Table 2. Independent *t*-test comparisons of results of compost quality of protocols A, B, C, and D to evaluate the appropriate proportion of sargassum for other compost ingredients to be used in a large-scale composting system.

Variable (units) ^z	Protocol A results	Protocol B results	Protocol C results	Protocol D results	Normal range (USCC) ^y	<i>t</i>	df	<i>P</i>
pH	7.3	7.3	7.8	7.2	5.0–8.5	54.653	3	<0.001*
Soluble salts (mmho/cm)	2.92	4.2	3.87	3.01	1–10	11.052	3	0.002*
Solids (%)	63.6	65.4	69.2	71.2	50–60	38.825	3	<0.001*
Moisture (%)	36.4	34.6	30.8	28.8	40–50	16.987	3	<0.001*
Organic matter (%)	21.6	36.4	25.9	21.7	30–70 (dry weight)	8.049	3	0.004*
Total nitrogen (%)	0.84	1.56	1.16	1.06	0.5–2.5 (dry weight)	7.807	3	0.004*
Carbon (%)	12.6	23.6	15.4	14.7	<54 (dry weight)	7.2	3	0.006*
Carbon:nitrogen (ratio)	13.2	15.1	13.2	13.9	<20 (dry weight)	31.33	3	<0.001*
Phosphorus (%)	0.471	0.842	0.797	0.864	—	7.22	3	0.005*
Potassium (%)	0.35	0.49	0.45	0.43	—	12.844	3	0.001*
Calcium (%)	12.02	18.66	14.37	12.22	—	9.837	3	0.002*
Magnesium (%)	0.4	0.46	0.4	0.33	—	16.979	3	<0.001*
Sulfur (%)	0.18	0.23	0.21	0.18	—	15.545	3	0.001*
Sodium (mg·kg ⁻¹)	1,410	2,646	2,043	1,610	—	7.257	3	<0.001*
Aluminum (mg·kg ⁻¹)	3,872.52	5,556.41	4,496.53	4,646.16	—	12.698	3	0.001*
Iron (mg·kg ⁻¹)	3,932.41	4,348.22	4,193.09	4,172.5	—	26.860	3	<0.001*
Manganese (mg·kg ⁻¹)	206.26	155.9	187.86	145.46	—	14.493	3	0.001*
Copper (mg·kg ⁻¹)	19.09	15.74	17.8	16.78	—	24.884	3	<0.001*
Zinc (mg·kg ⁻¹)	49.01	61.29	59.99	59.13	—	15.179	3	0.001*
Bioassay: emergence (% of control)	100	100	100	100	>90 (very mature)	—	—	—
Bioassay: seedling vigor (%)	100	100	100	100	>95 (very mature)	—	—	—

^zThe variables of pH, soluble salts solids and moisture, bioassay (% of control) and bioassay (seedling vigor) were each measured on a fresh weight basis, while the remaining variables were reported from dry weight analysis; 1 mmho/cm = 1 dS·m⁻¹; 1 mg·kg⁻¹ = 1 ppm.

^yU.S. Composting Council (2002).

*Statistically significant at *P* < 0.05.

within the acceptable range of 1.0 to 10.0 mmho/cm (Pennsylvania State University, 2016). Although the levels found in this study were safe based on compost quality standards, there was a notable increase in the soluble salt content compared to that of a previous study of composting sargassum that had detected a range of 1.10 to 1.59 mmho/cm in soluble salts (Sembera et al., 2018). The increase in soluble salt content in the current study was likely due to the increased proportions of sargassum biomass incorporated.

During the collection process of the sargassum biomass, the front-end loader inadvertently collected beach sand along with the biomass. The beach sand became mixed with the sargassum during the loading procedure before being transported to the university compost site. The sand was not removed; instead, it was incorporated in the compost piles with the biomass. The characteristics of sand are reflected in the percentage of solids, moisture, and organic matter. The percentage of solids for the overall substrate ranged from 63.6% to 71.2%, which were outside the recommended levels of 50% to 60% (Pennsylvania State University,

2016). The percentages of moisture were below normal values (40% to 50%) and ranged from 28.8% to 36.4% in all protocols (Table 2). Three of the four treatments exhibited lower than normal percentages of organic matter. Noting these qualities, this sargassum-incorporated compost product would provide slightly less organic matter while potentially providing improved drainage and aeration in a “landscape mix” type of application and/or would be well-suited for clay-heavy soils (Rynk, 1992). Bioassay tests concluded that all measurements of compost samples were identified at 100%, ensuring the maturity and stability of the compost product (Pennsylvania State University, 2016; Sembera et al., 2018; U.S. Composting Council, 2002).

STATISTICAL COMPARISONS OF COMPOST PROTOCOLS. Results of independent *t* tests indicated significant differences between compost quality parameters. Protocol A incorporated the greatest amount of sargassum (≈41.5%), which was equal to the percentage of wood chips. The only nitrogen-rich feedstock in this protocol was food waste (≈17%), and the protocol included no invasive fish species waste. Of the four protocols,

protocol A produced the least desirable results for a quality compost product. Although all results for protocol A were within quality compost standards, the results for total nitrogen (0.84% dry weight), carbon (12.6% dry weight), phosphorus (0.471% dry weight), and potassium (0.35% dry weight) were the numerically lowest of all the protocols. Additionally, the results of secondary macronutrients (i.e., calcium, magnesium, and sulfur) and many of the micronutrients (i.e., iron and zinc) were the numerically lowest of all protocols. However, protocol A had the greatest amount of manganese (206.26 mg·kg⁻¹ dry weight) and the second greatest amount of copper (19.09 mg·kg⁻¹ dry weight) (Table 2).

Protocol B produced the most desirable results of the four protocols. This protocol mirrored the proportions of sargassum (41.5%) and wood chips (41.5%) within protocol A. However, the inclusion of fish waste (4%) required a smaller amount of food waste (13%) compared with protocol A. Although the percentages of solids and moisture were higher and lower, respectively, when compared with normal ranges of compost

quality standards, protocol B was the only protocol in the study to exhibit an organic matter percentage within the normal range ($P = 0.004$). Protocol B had the highest concentrations of total nitrogen (1.56% dry weight), carbon (23.6% dry weight), and potassium (0.49% dry weight) of the four protocols, and the second numerically highest percentage of phosphorus (0.842% dry weight). Results for protocol B also showed higher concentrations of many secondary nutrients and micronutrients, with some notable exceptions. The results for sulfur (0.23% dry weight) and iron (4348.22 mg·kg⁻¹ dry weight) were similar to the results of protocol C, which had a slightly lower sulfur content (0.21% dry weight) and slightly greater iron content (4193.09 mg·kg⁻¹ dry weight), indicating a common trait between the two compost protocols that incorporated fish waste. Protocol B had the greatest concentration of calcium (18.66% dry weight) and had significantly greater results ($P = 0.002$) than the other three protocols (Table 2).

Protocol C incorporated a lower percentage of sargassum ($\approx 25\%$) in contrast to protocols A and B, and it included fish waste (4%). This protocol exhibited percentages of moisture and organic matter that were numerically lower than the ideal quality compost range. The concentrations of total nitrogen (1.16% dry weight), carbon (15.4% dry weight), phosphorus (0.797% dry weight), and potassium (0.45% dry weight) were numerically lower than those of protocol B, but they were still within normal ranges of a quality compost product. This protocol achieved the second highest results regarding macronutrients such as nitrogen, phosphorus, and potassium (Table 2), the second highest amount of manganese (187.86 mg·kg⁻¹ dry weight) and the greatest amount of copper (17.8 mg·kg⁻¹ dry weight).

Protocol D mirrored the amount of wood chips (50%) and sargassum (25%) as those used in protocol C. Food waste (25%) was used to provide nitrogen. The quality test results were within the normal compost quality standards, but their percentages of macronutrients were not as high as those of protocol B and protocol C (Table 2). Again, the presence of sand incorporated from the beach harvest

of sargassum increased the percent of solids and decreased moisture and organic matter compared with those of normal quality compost standards. However, the concentrations of total nitrogen (1.06% dry weight), carbon [14.7% dry weight ($P = 0.006$)], phosphorus [0.864% dry weight ($P = 0.005$)] and potassium [0.43% dry weight ($P = 0.001$)] were at ideal compost quality levels and significantly higher when compared with those of protocol A (Table 2).

All samples of the four protocols had salt content, pH, and nutrient levels within the normal quality compost standards, as well as successful bioassay results (Table 2). Noting the greater percentages of organic matter in the quality reports of protocols B and C, it is apparent that sargassum should be balanced with appropriate nitrogen-supplying feedstocks, such as food waste or fish waste. Fish waste improved the quality of compost, as was observed in comparisons of protocol A and protocol B. However, increasing the proportion of other nitrogen-rich feedstocks could also improve the quality of a sargassum-heavy compost protocol, as shown in protocol D when compared with protocol A. Although the statistical analysis showed a significant difference in the pH values of the four protocols, the range of pH values (7.2–7.8) in regard to horticultural practices would be generally acceptable. Additionally, over time, compost tends to become more acidic (Rynk, 1992). Although it was determined that all protocols met most of the quality compost product standards, the results of protocol B were the most desirable due to the presence of significantly higher organic matter ($P = 0.004$) and generally higher levels of nutrients.

Future studies like this one should include collecting additional samples to include more data points during statistical analyses. Furthermore, future studies should include a marketing analysis of the compost product as a boutique compost or soil blend and refine the protocols to achieve the most beneficial results. Additionally, as recommended in a previous study, a cost-benefit analysis of the removal of sargassum would be instructive for the communities impacted by sargassum. Comparisons of the various disposal

methods, composting, landfilling, or dune maintenance would provide additional information for beach communities, thus allowing them to make informed decisions regarding approaches to beach maintenance (Sembera et al., 2018).

There remains concern for coastal ecology. Although this study provided evidence that sargassum is a suitable feedstock for composting and can be incorporated into compost piles at high proportions, when evaluating how to manage sargassum drifts, it should be noted that coastal flora benefit greatly from them (Rice, 2015). Management practices should exercise efforts to incorporate the sargassum biomass into the beach, either by building foredunes or by raking the biomass into the shore. Compost created from sargassum could also be returned to the coastline. The process of composting can be used to appropriately decompose the biomass in large amounts and assist the Gulf Coast region with moving toward zero-waste goals.

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