QUARTERLY PROGRESS REPORT

[Year 1: July1, 2021 to December 31, 2021 (year 1 extended to March 31, 2022)]
[Year 2: July 1, 2022 to June 30, 2022 (year 2 extended to March 31, 2023]
[Year 3: July 1, 2023 to June 30, 2024]

PROJECT TITLE: DOES *SARGASSUM* SPP. COMPOST IMPACT THE ARSENIC AND BACTERIA LEVELS WITHIN THE BEACH ENVIRONMENT? (YEAR 3)

PRINCIPAL INVESTIGATOR: Dr. Helena Solo-Gabriele
AFFILIATION: University of Miami, Dept. of Chemical, Environmental, and Materials Engineering
CONTACT INFORMATION: hmsolo@miami.edu, 305-284-3467

PRIOR CO-PRINCIPAL INVESTIGATOR: Dr. Peter Swart
AFFILIATION: University of Miami, Dept. of Marine Geosciences - Rosenstiel School of Marine and Atmospheric Science
CONTACT INFORMATION: pswart@rsmas.miami.edu, 305-421-4103

PRIOR CO-PRINCIPAL INVESTIGATOR: Dr. Amanda Oehlert
AFFILIATION: University of Miami, Dept. of Marine Geosciences - Rosenstiel School of Marine and Atmospheric Science
CONTACT INFORMATION: aoehlert@rsmas.miami.edu, 305-421-4405

PRIOR CO-PRINCIPAL INVESTIGATOR: Dr. Trent Blare
AFFILIATION: University of Florida, Food and Resource Economics Department
CONTACT INFORMATION: tblare@ufl.edu, 786-217-9248

LEAD POST-GRADUATE STUDENT: Afeefa Abdool-Ghany
AFFILIATION: University of Miami, Dept. of Chemical, Environmental, and Materials Engineering and Institute of Environment, Florida International University
CONTACT INFORMATION: aaa625@miami.edu, 954-298-4073

PROJECT WEB-SITE: https://hmsolo.miami.edu/?page_id=722

Work accomplished during this reporting period:

- Journal articles from year 1 and year 2 of funding were published.
- The field and laboratory portion of Phase 1 of year 3 is complete. Three sampling periods were identified, and samples were collected and processed. Data is currently being consolidated and analyzed.
- Phase 2 of year 3 was started but due to limited amounts of fresh Sargassum at the time we decided to start over. We will restart the mesocosm experiments in March 2023, at the anticipated beginning of the upcoming Sargassum season.

TAG Meetings:

- Year 1: The first TAG meeting was held on December 15, 2020.
- Year 1 and 2: The second TAG meeting for Year 1 and the first TAG meeting for Year 2 was held on July 14, 2021.

- Year 1 and 2: The third TAG meeting for Year 1 and second TAG meeting for Year 2 was held on March 17, 2022.
- Year 1 and 2: The fourth TAG meeting for Year 1 and the third TAG meeting for Year 2 was held on March 7, 2023.
- Year 3: The first TAG meeting for Year 3 was held on September 19, 2023.

Metrics:

1. Research publications from THIS Hinkley Center Project.

JOURNAL ARTICLES

- Blare, T., Abdool-Ghany, A. A., Solo-Gabriele, H. M. 2023. Cost Estimates for Producing *Sargassum* spp. Compost- English. *University of Florida Institute of Food and Agricultural Sciences EDIS.*
- Blare, T., Abdool-Ghany, A. A., Solo-Gabriele, H. M., Gonzalez, E. 2023. Costos Estimados de la Producción de Sargazo Compostaje . *University of Florida Institute of Food and Agricultural Sciences EDIS.* (Spanish version, in press)
- Abdool-Ghany, A. A., Blare, T., & Solo-Gabriele, H. M. (2023). Assessment of Sargassum spp. management strategies in southeast Florida. *Resources, Conservation & Recycling Advances*, *19*, 200175. https://doi.org/10.1016/j.rcradv.2023.200175
- Abdool-Ghany, A. A., Pollier, C., Oehlert, A. M., Swart, P. K., Blare, T., Moore, K. K., & Solo-Gabriele, H. M. (2023). Assessing Quality and Beneficial Uses of Sargassum Compost. *Waste Management*, in press. https://doi.org/10.2139/ssrn.4423630 (This is the link for the preprint. The link for the paper will be provided once available.)

ABSTRACTS

- 2021 FSBPA Annual Conference Abstract
    - **Title:** Sargassum Invasion: Composting as a Solution
    - **Description of material**

Sargassum spp. is one of the dominant forms of marine macroalgae (seaweed) found on beaches throughout Florida. Excess *Sargassum* is washing up on the shores of Florida beaches and originates from the Sargasso Sea in the Northern Atlantic Ocean near Bermuda. Recently there have been large quantities of *Sargassum* reported in the central Atlantic Ocean and the Caribbean Sea. During the summer of 2018 and 2019, record amounts of *Sargassum* spp. were documented along beach coastlines resulting in local authorities hauling this seaweed to the nearest landfill. Hauling and landfill disposal of seaweed can cost the cities and municipalities hundreds of thousands of dollars per year.

The influx of *Sargassum* onto the shores is important to maintain the ecological balance. The difficulty has been when the amounts of seaweed stranding onshore are excessive. When excessive, the local ecology suffers and the aesthetics of the beach decline. In extreme conditions, the seaweed is so thick on the water surface that turtles are unable to surface for air, thus drowning in embayments where the Sargassum accumulates. When excessive amounts of *Sargassum* are found on the sand, it also contributes to a decline in the aesthetic quality of Florida beaches and ultimately impacts on the tourism industry. When left on the shore to decompose, the *Sargassum* will release unpleasant odors (hydrogen sulfide) into the environment. It also attracts insects, e.g. sand flies, as it decomposes. Bacteria levels in the seaweed also tend to increase. When the decomposing *Sargassum* is washed back to the water it results in the issuance of beach swim advisories due to elevated bacteria levels further impacting the economy of the area by limiting access to safe recreational waters along the coast. Thus, coastal communities are looking for alternative ways to handle the material once removed from the beach.

Alternative methods are needed for handling excessive amounts of Sargassum that are found on Florida's coastlines. In order to combat this problem, local government agencies are exploring how to

remove the seaweed and are looking for beneficial uses. Composting offers one potential and beneficial alternative. Instead of leaving the seaweed to decompose on shore, or hauling it off to landfills via trucks, Sargassum can be potentially composted. Compost consists of decomposed organic matter. This natural process of recycling organic matter can be used to produce a rich soil amendment. Compost maintains moisture more effectively and provides a rich environment for plants to grow. Seaweed is rich in nutrients that are absorbed from the sea and from the energy from the sun, making it a potentially rich soil amendment. In addition to its use as a soil amendment, it should be ensured that the composting of seaweed is within the standards of heavy metals and bacteria levels so that the constituents are within satisfactory health-based levels. The objective of this project is to evaluate the suitability of producing compost from seaweed in tumbler composters.

Four experiments were conducted to evaluate the need for pre-washing and suitable mixes. The recipes included: no washing of *Sargassum*, washing *Sargassum* with freshwater, grass clippings mixed with *Sargassum*, and mulch mixed with *Sargassum*. These recipes were sampled biweekly and measured for bulk physical-chemical parameters, nutrients, metals, and bacteria. Once the compost was cured, radish bioassays were setup to evaluate the plant growth in each of the recipes. Results indicate that electrical conductivity (saltiness) is not an issue when composting the seaweed (values are well below the U.S Composting Council standards). Preliminary carbon to nitrogen results show that the compost can be used to grow plants. Results from the radish bioassays indicate that the compost is able to support growth of plants.

- Goldschmidt 2022
    - **Title**: Is composting a feasible disposal option for beach-stranded Sargassum in South Florida?
    - **Abstract**: Over the last decade there has been increased proliferation of Sargassum in the north Atlantic Ocean, with massive strandings occurring on near annual frequency in the Caribbean, western Africa, and United States since 2011. Such events have environmental, health, and economic impacts, because Sargassum is known to have a high capacity to absorb metals from the environment [1]. A common disposal method is mechanical collection of the stranded Sargassum and subsequent landfill disposal. Thus, leachates of degrading Sargassum can contribute to contamination in soils and groundwater near landfills. Compost can be a potential solution and can present a sustainable management method if concentrations of potentially toxic metals are below EPA guidelines. The objective of this project is to determine whether composting is a feasible management solution for Sargassum strandings. We assessed compositional characteristics of the compost [nutrient ratios (C:N, P), elemental concentrations, abundance of indicator bacteria] in both small-scale and large-scale settings. The first phase (small-scale) of study involved experiments using tumbler composters, which independently evaluated the impacts of washing the Sargassum prior to composting, as well as the impact of mixing with other vegetative wastes (grass, mulch, etc). The second phase (large-scale) involved two 4 yd3 compost piles with different additives (a control pile and vegetative waste) in a municipal setting. In the first phase, the mixture of Sargassum and grass clippings produced compost with the best C:N ratios and lowest concentrations of toxic metals. Bacteria levels did exceed EPA regulatory limits in this treatment. Preliminary radish bioassay experiments also suggested best growth in the compost treatment mixed with grass clippings. Unwashed Sargassum produced compost with moderate C:N but the highest concentrations of toxic metals. Within the larger scale experiments conducted in the second phase, the Sargassum treatment produced the best C:N ratios and lowest bacteria levels compared to the Sargassum and vegetive waste treatment.

[1] Rodríguez-Martínez, R. E., et al., (2020). PeerJ, 8, e8667.

2. Research presentations resulting from THIS Hinkley Center Project. The interim results from this study have been presented during the following meetings:

- "Sources of Enterococci to a Coastal Beach Experiencing Elevated Background Levels" Webinar organized by SOP Technologies, Miami FL. July 2020. (Speaker presentation by H. Solo-Gabriele and A. Abdool-Ghany). [This webinar was attended by over 70 individuals.]
- "Sources of Enterococci to a Coastal Beach Experiencing Elevated Background Levels" Webinar organized by the City of Hallandale Beach, Hallandale Beach, FL. August 2020. (Speaker presentation by A. Abdool-Ghany).
- "Sargassum Seaweed Management in the State of Florida" Webinar organized by Recycle Florida Today. March 18, 2021. (Speaker presentation by A. Abdool-Ghany and H. Solo-Gabriele).
- "Sargassum Composting- A Solution" Presentation organized by Ana Zangroniz of Florida Sea Grant for Miami Dade County Parks and Recreation. June 24th, 2021. (Speaker presentation by A. Abdool-Ghany and H. Solo-Gabriele).
- "Sargassum Composting" Annual Conference organized by Recycle Florida Today. September 8th, 2021. (Speaker presentation by A. Abdool-Ghany).
- "Sargassum Invasion: Composting as a solution" Annual conference organized by Florida Shore and Beach Preservation Association. September 17th, 2021. (Speaker presentation by A. Abdool-Ghany).
- " Is composting a feasible disposal option for beach-stranded Sargassum in South Florida?" Annual Goldschmidt conference. July 10-15, 2022. (Speaker presentation by A. Abdool-Ghany).

3. List who has referenced or cited your publications from this project. Pending

4. How have the research results from THIS Hinkley Center project been leveraged to secure additional research funding?
    - We submitted a pre-proposal to EREF but it was not awarded.
    - We have also submitted a proposal to Commissioner Raquel Regalado of Miami-Dade County. It was intended to evaluate a composting operation located in Crandon Beach. The objective of the proposal was to evaluate the suitability of producing compost from seaweed on a large scale.
    - An NSF-RAPID proposal was submitted by Dr. Jiayu Li, PI, and Dr. Helena Solo-Gabriele, coPI. The purpose of the proposal was to evaluate sulfur emissions from Sargassum and to evaluate the microbial communities. This proposal has since been funded.
    - A proposal was submitted to the Google challenge to evaluate sequestration of carbon dioxide via Sargassum efforestration of the ocean. This proposal was not funded.
    - A proposal was submitted Miami-Dade Innovation Authority in collaboration with a local company to identify sustainable solutions for repurposing Sargassum seaweed.
    - A proposal was submitted to the Conservation, Food & Health Foundation to identify beneficial uses for Sargassum compost for farming in the Caribbean.
    - A proposal was submitted to the US Environmental Protection Agency South Florida Program to evaluate Biochar made from Sargassum for the reduction of CyanoHABs and toxins.

    Additional proposals are pending.

5. What new collaborations were initiated based on THIS Hinkley Center project?
    - Upon initiation of this project, we have been in contact with the City of Fort Lauderdale. Mark Almy and his team have been gracious enough to show us their composting operations.

- One of our TAG members (Chip Jones) has allowed us to tour his facilities and see the machines that are used in operation. We met with him and took a tour of his operations on December 11, 2020.
- Another TAG member (Mark Richards) offered for us to tour Crandon Beach to get an idea of the influx of seaweed that plagues the unique area. We toured Crandon Beach with Mark Richards on December 29, 2020.
- We are in contact with Dr. Kimberly Moore, from the University of Florida, IFAS. She has provided guidance on the quality of compost and helped to design the radish bioassay experiments. We are working with her to establish a set of standards that can exclusively be used for sargassum compost.
- Afeefa worked in Dr. Amanda Oehlert's lab to analyze the metals and phosphorous found in the tumbler composters as well as the compost piles.
- Dr. Peter Swart invited us to be a part of the proposals submitted to Commissioner Regalado. We also analyze for nutrients in his lab.
- Through Dr. Blare, we have collaborated with individuals in the agricultural community who are helping to set up interviews with growers that work with Sargassum compost.
- Recycle Florida Today and the Organic Compost Council have been big supporters of our research by promoting our work through meetings they organize.
- We have met with the CEO/founder of Sustainscape Inc, Dennis de Zeeuw. His company produces fertilizer from Sargassum. He has two products that he uses throughout his jobs in Broward County. Dr. Blare and Afeefa met with him on September 20, 2021.
- The CEO/founder of Algas Organics, Johanan Dujon, reached out to us to hear more about our research. We will also hear more about the operation he is running and how he deals with Sargassum. We plan on meeting him on September 22, 2021.
- Ana Zangroniz who is a Florida Sea Grant Extension Agent at the UF/IFAS Extension Miami-Dade County, reached out to us requesting that we present our research to Miami-Dade County. From this presentation we also were in contact with Tom Morgan, who is the Chief of Operations for Miami-Dade County Parks, Recreation and Open Spaces Dept.
- Rebecca Wakefield who is the Chief of Staff in the office of Commissioner Raquel Regalado, reached out to us to find out more about our research. She has indicated an interest in developing a coalition to address the seaweed disposal issue.
- Ultima, a start up sequencing company, process Sargassum samples we provided for microbial communities.
- We are currently working with UMiami faculty, Dr. Cynthia Silveira, in evaluating the results from the microbial community analyses.
- We have since teamed up with UMiami faculty, Dr. Jiayu Li, with whom we are collaborating on an NSF funded project focused on Sargassum emissions and microbial communities.
- We have been in communication with Dr. Schonna Manning of FIU who serves as Dr. Afeefa Abdool-Ghany's post-doctoral advisor. We have discussed research ideas that integrate micro- and macro-algae.

6. How have the results from THIS Hinkley Center funded project been used by the FDEP or other stakeholders?
    - Members of the FDEP have participated in our TAG meetings and in meetings organized by our collaborators. They include Karen Moore, Lauren O'Connor, and Chris Perry. The FDEP has provided us with guidance in the process for obtaining permits for on-beach composting projects. They have also provided us with guidance in terms of applicable regulations. Currently they are considering classifying sargassum compost as yard trash. The regulations for yard trash do not include arsenic and as a result seaweed compost would pass FDEP regulatory thresholds. The

FDEP is interested in our work because it will help guide the agency in terms of classifying Sargassum compost. They appear to want to encourage recycling and have been keeping up with our work on this project.

- Representatives from the FDEP indicated during our TAG meeting on March 17, 2022 that they plan to develop regulatory guidelines specific for Sargassum compost. A key component of their decision making will be the results reported from the Hinkley Seaweed projects.
- Miami-Dade County DERM has since initiated their own Sargassum compost study to confirm levels of arsenic in the compost and its runoff. These results will be used to establish potential permitting requirements for Sargassum compost in the county.

Appendix: TAG Member List

Sargassum Composting
TAG Member List
Version dated: July 14, 2021

RESEARCH TEAM MEMBERS

Name	Affiliation and Address	Phone Number	Email
Helena Solo-Gabriele	Professor, Principal Investigator University of Miami, 1251 Memorial Drive McArthur Building Room 252, Coral Gables, FL 33146	305-284-3467 (office) 305-989-9103 (cell)	hmsolo@miami.edu
Peter Swart	Professor, Co-Principal investigator University of Miami		pswart@rsmas.miami.edu
Amanda Oehlert	Assistant Professor, Co-Principal investigator University of Miami		aoehlert@rsmas.miami.edu
Trent Blare	Assistant Professor, Co-Principal investigator University of Florida		tblare@ufl.edu
Afeefa Abdool-Ghany	Lead Graduate Student University of Miami, currently with FIU		aaa625@miami.edu

HINKLEY CENTER

Name	Affiliation and Address
John Schert (year 1,2) Timothy Townsend (year 3)	Director University of Florida, Gainesville, FL
Ana Pak (year 1)	Media Specialist University of Florida, Gainesville, FL
Steven Laux	Professor in Practice University of Florida, Gainesville, FL

Name	Affiliation	Email
Kimberly Moore	Professor in Environmental Horticulture, Distinguished Teaching Scholar University of Florida, IFAS|Fort Lauderdale Research and Education Center	klock@ufl.edu
Ligia Collado-Vides	Senior Lecturer; Associate Chair Department of Biological Sciences, Florida International University	colladol@fiu.edu
Dan Meeroff	Professor and Associate Chair Department of Civil, Environmental & Geomatics Engineering, Florida Atlantic University	dmeeroff@fau.edu
Ana Zangroniz	Florida Sea Grant Extension Agent UF/IFAS Extension Miami-Dade County	azangroniz@ufl.edu
Shelly Krueger	Florida Sea Grant Agent II University of Florida IFAS Extension, Monroe County	shellykrueger@ufl.edu
Randall Penn	UF IFAS Extension Agent - Sarasota County	rpenn@ufl.edu
Armando Ubeda	UF/IFAS Extension Sarasota County	aubeda@scgov.net
Michelle Mularz	Extension Services-Environmental Horticulture Agent	mularz-michelle@monroecounty-fl.gov
Vincent Encomio	Sea Grant- Martin and St. Lucie Counties Extension Agent	vencomio@ufl.edu
Ashley Smyth	Assistant Professor, Biogeochemistry Tropical Research and Education Center	ashley.smyth@ufl.edu
Emilio Lopez	CEO of SOP Technologies	emilio@soptechint.com
Alejandro Quintás	NEAT Sand	aquintas@neatsand.com
Chip Jones	President of Beach Raker	Chip@floridabeachraker.com
David Hill	Co-Chair Organics Recycling Committee Recycle Florida Today	hilldm@gmail.com

Name	Affiliation and Address	Email
Nandra Weeks	GeoSyntec Consultants	NWeeks@Geosyntec.com
Alyssa Jones-Wood	Green Initiatives Coordinator for the City of Hallandale Beach	ajoneswood@hallandalebeachfl.gov
Cathie Schanz	Director of Park, Recreation, and Open Spaces	cschanz@hallandalebeachfl.gov
Mary Beth Morrison	Director of Environmental Programs, Solid Waste Authority of Palm Beach County	mmorrison@swa.org
Enrique Sanchez	Deputy Director, Parks and Recreation of the City of Fort Lauderdale	ESanchez@fortlauderdale.gov
Mark Almy	Park Operations Superintendent Parks and Rec. Admin.	marka@fortlauderdale.gov
Roland Samimy	Chief Resilience and Sustainability Officer	rsamimy@keybiscayne.fl.gov
Tom Morgan	Chief of Operations, Miami Dade Parks and Rec	tom.morgan@miamidade.gov
Paul Vitro	Division Chief at Miami-Dade County Parks, Recreation and Open Spaces Department	paul.vitro@miamidade.gov
Mark Richard	Senior Region Manager, Miami Dade County Parks and Rec	mark.richard@miamidade.gov
Heather Tedlow	Interpretive Nature Coordinator, Miami Dade Parks and Rec	heather.tedlow@miamidade.gov
Samir Elmir	Director of Environmental Health & Engineering Service Florida Department of Health in Miami-Dade County	Samir.Elmir@flhealth.gov
Karen Moore	Environmental Administrator-FDEP Division of Waste Management	Karen.s.moore@floridadep.gov
Lauren O'Connor	Government Operations Consultant-FDEP Division of Waste Management	Lauren.OConnor@floridadep.gov
Chris Perry	FDEP Division of Waste Management	Christopher.Perry@floridadep.gov

Appendix B: TAG Meeting Attendance and Minutes/Agenda

Minutes of the Technical Awareness Group Meeting (1st meeting)
For the Sargassum-Arsenic Research
Supported by the Hinkley Center for Solid and Hazardous Waste Management
Meeting held, September 19th, 2023, 10:00 to 12:30 pm (eastern)
Meeting Participation was through Virtual Connection (Zoom)

Attendees:
Speakers:
Afeefa Abdool-Ghany, University of Miami, now at FIU
Alexandra Stiffler, University of Miami
Cynthia Silveria, University of Miami
Helena Solo-Gabriele, University of Miami
Jiayu Li, University of Miami
Shahar Tsameret, University of Miami

Attendees via computer webinar:
Alejandro Quintas, NEAT Sand
Aliza Karim, Miami Waterkeeper
Amanda Oehlert, University of Miami-RSMAES
Angela Delaney, Broward County Marine Resources
Brittany Mc Intyre, University of Miami
Clara Sidan, Assistant Director at City of Miami, Resilience and Public Works Department
Craig Ash, Waste Management
Dan McChesney, Shapiro Enterprises
Doug Farrington, ADAR Technologies
Eli Rosa Estevez, City of Miami
Elizabeth Kelly, Martin County
Emilio Lopez, SOP Technologies
Griffin Alexander, Biscayne Bay Aquatic Reserve
Griselle Correa, City of Miami (NPDES and Stormwater Department)
Jared Jacobs, Fertile Earthworm Farms
Julia Poliadis, Fertile Earthworm Farms
Kimberly Moore, University of Florida, IFAS
Lanette Sobel, Fertile Earthworm Farm
Ligia Collado-Vides, Florida International University
Libbie, Farmer in the British Virgin Islands
Mary Beth Morrison, Solid Waste Authority of Palm Beach County
Melanie Cerna, Florida International University
Nohhyeon Kwak, University of Miami
Peter Klaich, Shapiro Enterprises

Peter Swart, University of Miami-RSMAES
Roland Samimy, The Village of Key Biscayne
Ron Portell, ADAR Technologies
Samantha Tiffany, Environmental Resource Manager for the City of Miami Beach
Schonna Manning, Florida International University
Steve Laux, Hinkley Center for Solid and Hazardous Waste Management
Sonia Brubaker, Chief Resilience Officer & Director for the City of Miami
Tom Morgan, Miami-Dade County Parks and Recreation
Tracy Mincer, Florida Atlantic University
Valentina Caccia, Division of Environmental Resource Management (DERM)
Victoria Lewis, University of Miami
Vincent Encomio, Florida Sea Grant Agent for Martin and St. Lucie County
Xavier DeRoos, Renewable Composting

Agenda
TAG Meeting, Sargassum Composting and Beach Quality

Date: September 19, 2023 (Tuesday)
Time: 10:00 am to 12:00 am (Eastern)
Location: Virtual, Zoom Link, https://miami.zoom.us/j/96237537197

10:00 am	1. Welcome and Introductions	Solo-Gabriele
10:15 am	2. Summary of Prior **Hinkley** Research a. Year 1: Compost Production and Characteristics (Pause for Q&A) b. Year 2: Economics of Compost Production (Pause for Q&A)	Abdool-Ghany
10:25 am	3. Research Plan and Results to Date for New **Hinkley** Project: Arsenic/Bacterial Impacts Under Natural Decomposing Conditions a. Research Plan b. Progress/Results to date c. Next Steps d. Question and Answers	Abdool-Ghany
10:45 am	4. Research Plan and Results to Date for **NSF** Project focused on Air Emissions and Microbial Communities a. Introduction and Initial Results for Air Emissions b. Initial Results for Enterococci c. Next Steps d. Questions and Answers	Li/Tsameret
11:05 am	5. Microbial Communities in Sargassum	Abdool-Ghany
11:10 am	6. Microbial Ecology of Sargassum a. Virus and bacteria interactions (Pause for Q&A)	Silveira/Stiffler
11:30 am	7. Additional questions and answers, wrap up. Open and free discussion.	Solo-Gabriele
12:00 noon	8. Adjourn	

Questions: hmsolo@miami.edu

Minutes

Questions, Answers, and Comments (After item 2 on agenda, Year 1)

1. Q: Were temperature taken during the composting process?
   A: Yes, temperatures were taken during the composting process for both the small- and large-scale experiments. The temperatures within the large-scale experiments did reach the 131°C that is recommended. Within our small-scale experiments this temperature was not reached.

2. Q: Could this be a reason as to why the bacteria levels are different in both experiments?
   A: The temperature can play a role in the difference in the bacteria levels in both experiments. For the small-scale experiments, the compost was made in a covered, shaded area, while the large-scale piles were open to environmental conditions. The exposure to the sun, which causes solar inactivation, could have contributed to the lower levels of bacteria in the large-scale experiment versus the small-scale experiment.

3. Comment: Radishes are directly connected to the soil, so there will be more trace metal accumulations. Perhaps another vegetable that is not developed in the soil will have a lower trace metal concentration than that of the radish. Also, there should be caution when trying to grow the mangroves in the Sargassum compost, as there is much more contact and inundation from water.

4. Q: Is there interest in exploring the growth of the other vegetables in the Sargassum compost?
   A: Radishes are known to bioaccumulate trace metals, which could have led to the higher levels of trace metals. As for other plants being grown in the Sargassum compost, we do not have plans to test out this theory. It would be great to look at other plants and vegetables being grown in Sargassum compost.

5. Q: Did you look at the arsenic levels in the Sargassum itself before composting to see if it increased or decreased during the composting process? Where is the arsenic coming from?
   A: We monitored the small-scale and large-scale composting experiments every two weeks and collected samples for trace metals analysis. There is data on the concentrationz of arsenic overtime, but what we found is that we did not see a consistent trend in the arsenic concentrations. We believe this is this due to the heterogeneity of Sargassum used to start the experiments. When the Sargassum samples were collected, there were other organic materials mixed into it and thus composted as well. This can alter the arsenic concentrations of the compost sample every time a sample was collected.

6. Q: There is a lot that needs to be explored with the fate of arsenic. Do you know of any studies that speak to the different forms of arsenic?
   A: As part of prior research on treated wood, it was found that there is a lot of arsenic in treated wood. There are methylated forms, and then there's the inorganic forms, and the inorganic tend to be more toxic than the organic forms. There is a tendency for the organic forms to degrade into the inorganic forms.

7. Q: Can vermiculture mitigate the arsenic in the Sargassum?
   A: There's evidence that there's multiple microorganisms that can sequester arsenic that are found in vermiculture systems. Running the Sargassum through a vermicomposting system can potentially mitigate the arsenic concentrations.

Questions, Answers, and Comments (After item 3 on agenda, Year 3)

1. Q: What season was this work completed in?
   A: The work for Phase 1 of this project was completed in from July 2023 and ended in September 2023. This corresponds to mid to late in the Sargassum season. Coming down to the last sampling period, we noticed a shift in more seagrass within the samples. The Sargassum that was collected for our Phase 2 experiments were collected in August. The Sargassum that was collected was not fresh. This is part of the reason as to why we want to start over this part of the experiment.

2. Q: Are you comparing the same amount of replicated Sargassum versus Seagrass for Phase 1? Do these results represent one collection period for all?
   A: There were more Sargassum samples collected for the Phase 1 across all beaches. The same number of replicates are not available for Seagrass. We have collected 2 Seagrass samples so far. These results also only represent two sampling efforts for the Phase 1. It will be interesting to add in the results from the third and last sampling effort to see how the results change.

3. Comment: in a previous study that we completed we did see that there were lower levels of bacteria in the Sargassum and as it decomposed the levels of bacteria started to increase.

4. Q: Did the beach see higher levels of arsenic when the Sargassum was removed?
   A: Looking at the results across all beaches we saw that overall, the water sample collected had lower levels of arsenic. The sand under the Sargassum and the supratidal sample types had similar levels of arsenic. Overall, we saw higher levels of arsenic in the sargassum samples. Now when we look at the results between samples where Sargassum is removed versus not removed we don't see much of a difference in the arsenic concentrations in the Sargassum samples collected. We are still analyzing the data and will be looking at whether beaches with and without Sargassum removal have different levels of arsenic in the sand.

Questions, Answers, and Comments (After item 4 on agenda, NSF Research)

1. Q: Is there nay thought in testing for arsenic or methane aerosols emissions in the chamber studies?
   A: We have not considered this for the study, but we can collect samples and test for it. The other part of our group focuses on methane, and it'll be interesting to combine the two parts.

2. Q: Have you thought about sampling at the Fort Lauderdale facility?
   A: That's a fantastic idea. We started our sampling campaign at Crandon Park and have gotten a lot of support. Our main concern with collecting samples in the field is having access to an electrical outlet for continuous deployment. We also must apply for permits to collect samples.

Questions, Answers, and Comments (After item 6 on agenda, Microbial communities)

1. Q: Do these viruses live outside of the environment? Does this virus get denatured or killed off through a composting effort?

   A: For the composting efforts, some of the viruses can be stable in the environment and stay around until the find the host that can support them. Some of them are very unstable and can be affected by UV light. This is a great way of inactivating the viruses. Now the viruses that we are talking about infect bacteria and do not affect humans. The viruses become of concern when they cause bacteria to become pathogenic to us. Viruses can impart genes into the bacteria which cause the bacteria to become pathogenic.