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## Florida Manatee (*Trichechus manatus latirostris*) Unusual Mortality Event Recovery Plan

### Introduction

The Florida manatee is a marine mammal species that lives in coastal waters along the eastern and western coastline of Florida. As of March 2021, an unusual mortality event (UME) was declared for this primarily herbivorous organism. [DT1] In 2021, there were 1,101 manatee mortalities recorded, twice the quantity from 2020. The majority of these mortalities were emaciated manatees. This is a direct result of the detrimental loss of seagrass killed by the red tide (Marine Mammal Commission, 2022). The red tide is a harmful algal bloom that swept the coastline of Florida blocking out the sunlight killing many aquatic plants (Ball et al., 2020). It is estimated that because of the red tide, Florida lost approximately 60% of its seagrass beds. These seagrass beds are the main source of food for the manatees. The red tide plankton, *Karenia brevis*, released toxins into the seagrass beds. When manatees ate the affected seagrass blades, they developed a disease called brevetoxicosis. This is a disease that damages the nervous and immune systems, and respiratory functions of manatees (Lazensky et al., 2020). Therefore, not only have the manatees lost a significant portion of their main food source, but they are also suffering from eating the toxic seagrass plants.

In Key Largo, Florida, a study conducted by Fitt (2020) showed Florida manatees feeding on the sponge *Chondrilla caribensis* (also known as “chicken-liver” sponge). This was the first direct evidence of manatees purposely grazing on sponges. This species of sponge has a symbiotic relationship with a photosynthetic cyanobacteria. Unlike other sponges, *C. caribensis* does not have chemical defenses and has a low spicule content. Spicules are silica based skeletal structures of sponges, so scientists suggest that the lack of skeletal structure might make these sponges more appealing to this plant consuming marine mammal. *C. caribensis* is consumed by reef fish, hawksbill turtles, and green turtles. This [DT2] sponge also thrives in the shade without the need for direct sunlight (Fitt, 2020).

Due to climate change, the Florida manatee is experiencing a loss of habitat during the winter months. Manatees are very susceptible to cold stress and can die from hypothermia in waters less than 20°C (Rommel & Caplan, 2003). There are four protected natural hot springs, 7 man-made thermal refuges, and four federally permitted rehabilitation centers that treat manatees in Florida (Edwards, 2013). The Crystal River, found in the northwest Florida region, is one of these protected natural hot spring refuges that the manatees use during the winter months (Laist, 2013). The percentage of manatees found in each of these locations is increasing annually because of cold stress and lack of food resources. There are also certain human made obstructions, such as, the fence that blocks the Homosassa Springs which limits manatee access points to these refuges (Laist & Reynolds, 2005).

Every year, over 100,000 people come to visit hot springs, like Crystal River, during the winter months to swim with the manatees (Marine Mammal Commission, 2022). In 2017, the U.S. Fish and Wildlife Service (FWS) reclassified manatees from endangered to threatened. The FWS also allows passive human interaction which enables the likelihood of harassment, and increased boating to facilitate these activities. Boat strikes are responsible for  $\approx 25\%$  of all reported manatee deaths (Rycyk et al., 2018). There is no monitoring system for human interaction with manatees in the water. Harassment is defined by approaching manatees too closely, and chasing manatees, poking/prodding/stabbing manatees with any object, separating a cow from her calf, separating an individual from its group, feeding manatees, or disturbing a sleeping manatee (Sorice et al., 2005). These rules are explained by each of the manatee ecotour boats; however, that does not mean that tourists follow them. The other issue is it is hard to prove this harassment in court based on verbal accusation. Because of increased tourism and decreased water output in the Crystal River (result of man-made obstructions), there is an increase in pollution and decrease in water visibility. This is negatively affecting both the animals that live in the environment, and the tour boats who depend on good visibility to see the manatees (Sorice et al., 2005).

This Florida Manatee UME recovery plan will incorporate all the previously mentioned threats to the manatee population. It is important that action is taken now as the effects of climate change continue to damage the environment on an exponential scale. With other sirenian species, like the dugong (*Dugong dugon*), action was delayed and now there are areas in China where their population is below 100 individuals (Lin et al., 2022). The Florida manatee could be at risk of getting reclassified as endangered if the annual deaths continue to plummet.

### **Aims of Study**

The current UME is evidence that manatees need a new food source. There is conservation effort to protect the seagrass beds that survived the red tide; however, *C. caribensis* could potentially prove to be an alternative resource. Around 20 minutes outside of the Crystal River is Homosassa State Park. This is one of the few locations that has Florida manatees in captivity. In this experiment, *C. caribensis* would be placed on hard substrates within the captive manatee's environment. Seagrass would then be limited to enough to feed the majority of the captive population, but not enough for complete population reliance. This would allow scientists to see if these manatees will choose to graze upon the sponge. It will also provide a controlled environment to see how this sponge will interact with the other organisms in this ecosystem.

The FWS allows passive human interaction with threatened Florida manatees which has created an opportunity for intentional and unintentional harassment. There has already been an increase in caution with manatees when FWS required tour boat companies to play an educational video for tourists on how to interact with manatees. Since there is no official monitoring program or system, a lot of harassment is unseen and without consequence. This recovery project would establish designated kayakers and snorkelers to patrol the Crystal River tourist boat hotspots [DT3]. There is kayaking volunteer-based monitoring, but only located at the roped areas which allows the manatees to avoid human interaction (Marine Mammal Commission,

2022). This program would expand upon what is already in place. In addition, an unmanned aerial system (UAS) used to fly over the manatee sanctuaries would be used to augment human patrols to further monitor anyone who crosses that boundary and provide abundance and distribution data for the Crystal River manatee population. This system was used in a study with Florida manatees for capture-mark-recapture in Collier County, FL (Edwards et al., 2021). This method of study allows us to collect accurate abundance and distribution data of a large marine mammal species without harassment and minimal disturbance.

Researchers who have studied knowledge and attitudes of people in relation to environmental subjects have found that educational interventions could improve environmental behavior (Aipanjiguly et al., 2003). This study could potentially take that a step further by incorporating more accountability. Many sociology experiments have proven that humans are more likely to follow the rules when they are being watched (Yuan, 2022). For the swimmers who do not follow the rules, this study would provide tour companies, FWS, and State of Florida enforcement officers proof needed to issue citations for manatee harassment.

## **Objectives**

There are multiple objectives of this project to help the current UME. First, is to decrease the amount of manatee harassment within the warm water refuges, and to better hold accountable those who do break the rules. Second, is to experiment with an alternative food resource that might help soften the damage the red tide and human influence has done to Florida manatees' habitat. Third, is to document the change in distribution and abundance of manatees in this warm water refuge during this UME.

## **Methods & Materials**

The *C. caribensis* experiment will take place in the captive manatee enclosure at the Homosassa State Park. The duration of this experiment will be 7 months. *C. caribensis* will be collected by Dr. Chris Freeman (who is conducting saltwater sponge research in the Keys in May 2023), from docks and pilings in Key Largo, FL, placed into gallon Ziplocs, and frozen in portable freezers for transport to the Crystal River. It will then be placed on hard substrates in a light accessible and non-accessible location. There will be two underwater SiOnyx Nightwave night vision marine cameras (for day and night observations) set to record the manatees (or other organisms) grazing on the sponge in each location. The health of the captive manatees will be monitored weekly, film footage will be collected on micro-SD cards and sorted daily, and water quality will be tested weekly. Manatees can be identified using their scars. Water quality results and manatee health records will be collected from the manatee husbandry personnel.

The monitoring study will take place in the Crystal River at the sanctuary locations and tour boat hotspots. Data collection will be conducted three days a week using the tour guide vessels that are willing to contribute to this research. This includes both boat tours and kayaking tours. There will be a small six-person research vessel used once a week for the HexH2O UAS drone data collection. The drone will fly 100 meters above the sanctuaries and across the duration of the

Crystal River to determine distribution and abundance. For this study, 15 snorkeling monitors (using pool noodles for floatation) and 5 kayak monitors would be ideal. GoPro Hero 11s will be used for all the monitoring positions, and GoPro handheld sticks will be used for the kayakers. This study will be conducted from September through March of 2023 documenting the peak winter tourist season.

- Portable freezer (for sponge transport) x2
- Gallon ziploc bags (for sponge collection) x10
- GoPro Hero 11 x 20
- GoPro handheld sticks x5
- Micro SD cards (1TB) x20
- Snorkel mask set ups x15
- Pool noodles x1
- Research vessel (6 person) x1 a week for 7 months
- HexH2O UAS device x1
- Wetsuits
- Kayaks
- SiOnyx Nightwave night vision marine camera x2
- Training
- Radios to coordinate with law enforcement

### **Timeline**

December 2022: Research Proposal Submission

January-April 2023: Outreach to Homosassa State Park, Crystal River tour boat & kayak companies, and freshwater sponge researcher, Dr. Chris Freeman, for sponge collection

May 2023-August 2023: Receive funds, purchase materials, and Dr. Freeman travels to Key Largo to collect sponges

September 2023-March 2024: Conduct experiment and monitoring study

### **Budget**

<b>Item</b>	<b>Cost</b>
Portable Freezer x2	\$1222.18
Gallon Ziploc Bags x20	\$4.69
GoPro Hero 11 x20	\$7,999.80
GoPro Handheld Sticks x5	\$99.75
Micro SD cards (1 TB) x20	\$379.80
Snorkel & Masks x15	\$1000.00
Pool Noodles x15	\$3.75
SiOnyx Nightwave Night Vision Marine Camera x2	\$3,190.00
Research Vessel x1 a week for 30 weeks/7 months	\$45,000.00
HexH2O UAS device x1	\$6,449.00
Wetsuits x20	\$1,600.00
Kayaks x5	\$2,145.00
Training per person x20	\$1000
Waterproof radios x5	\$399.75
<b>Total</b>	<b>\$66,202.75</b>

References

- Aipanjiguly, S., Jacobson, S. K., & Flamm, R. (2003). Conserving manatees: Knowledge, attitudes, and intentions of boaters in Tampa Bay, Florida. *Conservation Biology*, 17(4), 1098–1105. <https://doi.org/10.1046/j.1523-1739.2003.01452.x>
- Ball, R. L., Malmi, M., & Zgibor, J. (2020). Trends of the Florida manatee (*Trichechus manatus latirostris*) rehabilitation admissions 1991-2017. *PLOS ONE*, 15(7), 1-11. <https://doi.org/10.1371/journal.pone.0223207>
- Edwards, H. H. (2013). Potential impacts of climate change on warmwater megafauna: The Florida manatee example (*Trichechus manatus latirostris*). *Climatic Change*, 121(4), 727–738. <https://doi.org/10.1007/s10584-013-0921-2>
- Edwards, H. H., Hostetler, J. A., Stith, B. M., & Martin, J. (2021). Monitoring abundance of aggregated animals (Florida manatees) using an unmanned aerial system (UAS). *Scientific Reports*, 11(1), 1-12. <https://doi.org/10.1038/s41598-021-92437-z>
- Fitt, W. (2020). Florida manatees *Trichechus manatus latirostris* actively consume the sponge *Chondrilla caribensis*. *PeerJ*, 8, 1-12. <https://doi.org/10.7717/peerj.8443>
- Marine Mammal Commission. (2022, September 8). Florida Manatee. Retrieved November 2, 2022, from <https://www.mmc.gov/priority-topics/species-of-concern/florida-manatee/>
- Laist, D. W., & Reynolds, J. E. III. (2005). Influence of power plants and other warm-water refuges on Florida manatees. *Marine Mammal Science*, 21(4), 739–764. <https://doi.org/10.1111/j.1748-7692.2005.tb01263.x>
- Laist, D. W., Taylor, C., & Reynolds, J. E. III. (2013). Winter habitat preferences for Florida manatees and vulnerability to cold. *PLoS ONE*, 8(3), 1-11. <https://doi.org/10.1371/journal.pone.0058978>
- Lazensky, R., Hunter, M. E., Moraga Amador, D., Al-Khedery, B., Yu, F., Walsh, C., Gitzendanner, M. A., Tripp, K., Walsh, M. T., & Denslow, N. D. (2020). Investigating the gene expression profiles of rehabilitated Florida manatees (*Trichechus manatus latirostris*) following red tide exposure. *PLOS ONE*, 15(7), 1-14. <https://doi.org/10.1371/journal.pone.0234150>
- Lin, M., Turvey, S. T., Han, C., Huang, X., Mazaris, A. D., Liu, M., Ma, H., Yang, Z., Tang, X., & Li, S. (2022). Functional extinction of dugongs in China. *Royal Society Open Science*, 9(8), 1-7. <https://doi.org/10.1098/rsos.211994>

- Rommel, S. A., & Caplan, H. (2003). Vascular adaptations for heat conservation in the tail of Florida Manatees (*Trichechus manatus latirostris*). *Journal of Anatomy*, 202(4), 343–353. <https://doi.org/10.1046/j.1469-7580.2003.00170.x>
- Rycyk, A. M., Deutsch, C. J., Barlas, M. E., Hardy, S. K., Frisch, K., Leone, E. H., & Nowacek, D. P. (2018). Manatee behavioral response to boats. *Marine Mammal Science*, 34(4), 924–962. <https://doi.org/10.1111/mms.12491>
- Sorice, M. G., Shafer, C. S., & Ditton, R. B. (2005). Managing endangered species within the use–preservation paradox: The Florida manatee (*Trichechus manatus latirostris*) as a tourism attraction. *Environmental Management*, 37(1), 69–83. <https://doi.org/10.1007/s00267-004-0125-7>
- Yuan Ju Chair professor in the Department of Economics, & Jiawen Li Lecturer in Economics. (2022, September 13). *Moral science confirms people behave better when they think they're being watched*. The Conversation. Retrieved December 6, 2022, from <https://theconversation.com/moral-science-confirms-people-behave-better-when-they-think-theyre-being-watched-114384>