

The Pieces Add Up: Marine Debris Outreach and Education Program for Sea Turtle
Conservation in Volusia County, Florida

by

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Executive Summary

Background. Sea turtles have played an important role in transporting nutrients across the ocean and coastal ecosystems for more than one hundred million years. They face many obstacles, and it is estimated that only 1 in 1,000 hatchlings will survive to adulthood. For example, they are adapted to life in an environment completely disparate from our own, yet they are being affected by human induced marine debris issues. Marine debris is anything manufactured that finds its way into the waterways from improper waste management or litter that blows or washes in through storm drains, such as balloons, single use plastics, and fishing gear. In the past several years, the negative effects of marine debris on wildlife have been increasing. The growing negative impact is clear at veterinarian clinics, wildlife hospitals, and in reports of turtles stranded on beaches. Even in small amounts, marine debris can severely injure or kill marine species.

Purpose. The purpose of this project was to analyze data from the Marine Science Center in Volusia County, Florida to form local decisions of marine debris affects to sea turtles. From the data analysis, marine debris educational materials and a strategic plan for an education and outreach program were created to increase awareness of this global issue.

Research Questions and Goals.

- 🌿 **Organize and Analyze Data:** How can the sea turtle stranding and treatment forms for the Marine Science Center be organized into an electronic format? How can the data be analyzed to show trends and relationships?
- 🌿 **Evaluate Marine Debris Impacts to Turtles:** How is marine debris affecting sea turtle populations that strand in Volusia County?
- 🌿 **Develop Educational Materials:** What type of educational programs would be the most effective to increase awareness of this issue?
- 🌿 **Create a Strategic Plan for an Outreach and Education Program:** What would be the most effective strategic plan for an outreach and education marine debris program that could be implemented in the future?

Methods.

Marine Debris and Sea Turtles in Volusia County, FL. I worked with the Marine Science Center to create a database for the 2015-2020 data for sea turtle intakes at the sea turtle hospital. All the paper-based documents were reviewed and recorded, paying special attention to marine debris related issues from entanglement or ingestion. This was detective work as some of this information was easily identifiable.

Analysis. I analyzed the data using Pivot and frequency tables to organize trends and ran a basic linear correlation to find percent marine debris impact for each species and then total percent marine debris impacts to sea turtles from 2015-2020.

Education Materials & Marine Debris. I used the data and analysis in conjunction with literature and the constructivism pedagogy to guide the creation of materials for my education program.

The educational materials include: (1) infographics highlighting the individual sea turtle species, the importance of a healthy ocean, and ways to reduce single-use plastics (2) formal presentation as an overview of sea turtle biology and conservation, marine debris, and ways to help the environment (3) Kahoot interactive review game that recaps the information covered in the presentation, and (4) hands on simulation activity where participants will take on the role of a conservation team member to evaluate the stranded sea turtle examples.

Strategic Plan. I also developed a strategic plan with the skills learned through the ENV 963 Program Management course at Duke University that will supply the framework for an education program. The contents of this plan include vision, mission and values statements, SMART goals, 7-S Framework for Organizational Structure, SWOT, and TOWS analysis, focus strategies, communications plan, and an action plan.

Results. The top three trends revealed that most marine debris issues are from monofilament line entanglement, green turtles (*Chelonia mydas*) are the most impacted species, and there is growth in the threats from marine debris.

Deliverables. The style of this education trunk for my program was inspired by Inwater Research Group. This specific trunk I developed is called, The Pieces Add Up: Traveling Sea Turtle Trunk and it focuses on marine debris affects to sea turtles strictly in Volusia County, Florida and original curriculum material was created to reflect this. This trunk will have several elements, such as sea turtle patient stories that correspond to actual patients treated at the sea turtle hospital, participant evaluation sheets where they record observations made to the replica sea turtles, presentation slideshow with a talking script, 3D printed sea turtle skulls, marine debris examples, measurement tools, and much more!

Discussion. It is important to note that this data and analysis is only a snapshot of the bigger picture since only 2015-2020 data was analyzed. Based on the literature I reviewed, it is important to know how marine debris ingestion is impacting the chance of survival for the sea turtles (Derraik 2002; Schulman and Lutz 1995) and plastics never leave the environment, but just become smaller in size (Worm et al., 2017). From the literature, it was also noted that earlier life stages are more severely affected than later stages due to their early feeding grounds on the floating *Sargassum* (Campani et al., 2013). These feeding grounds are noted in having high abundance of marine debris accumulation compared to other areas in the ocean. The data collected and analyzed reinforced these findings from the literature.














Conclusions and Next Steps. Based on the scope of this project more attention needs to be placed on proper disposal and use of monofilament lines and plastic based products due to the growing trends of impact. Also, there needs to be continued use of a systematic documentation process for recording marine related impacts at the sea turtle hospital.

Next steps for this project include (1) continuing the data organization of analysis of the 2002-2014 and 2021-onward data, (2) expand the focus area of not just strictly patients, but dead on arrival sea turtles, (3) implement the educational programming in a variety of formal and informal educational facilities, (4) make the strategic plan a reality within the county of focus.

Acknowledgements

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Introduction & Roadmap

The Pieces Add Up: Marine Debris Outreach and Education Program is a marine debris education program that aims to educate the public on the existence, importance, and significance of the ocean and marine species through the analysis of sea turtle intake and treatment forms from the Marine Science Center in Volusia County, Florida. This data was analyzed to see if there is a relationship between marine debris ingestion and entanglement and sea turtle populations that strand in Volusia County, Florida and are treated at the Marine Science Center. Educational materials were designed based on the data analysis results to highlight the issues with marine debris pollution, importance of the ocean and sea turtle populations, and ways to help reduce marine debris presence in the ocean. A strategic plan was designed to help guide the development and startup of the outreach and education program, highlighting the mission, vision, and values, organizational structure, communications plan, SMART goals, SWOT and TOWS analysis, and action plan.

Background

Marine Debris & Sea Turtle Impacts. Marine debris has become a frequent area of concern for marine organisms over the past several years, with increased cases flooding veterinarian clinics, hospitals, and stranding reports. Globally, plastics are the most prevalent form of marine debris (Derraik, 2002), with reaching about 300 million tons in 2013 (Wright et al., 2013). Every environment on Earth has been noted of having the presence of plastic in them (air, soil, freshwater, ice, and marine ecosystems) (Peeken et al., 2018).

Long- life plastics are of particular concern for the marine environment. These plastics are derived from petro-chemicals that were mass produced in the 1950s and they have been found to persist and accumulate in the marine environment (Worm et al., 2017). Plastics will disintegrate over time into smaller pieces, but will continue to have long lasting impacts to the environment for centuries (Worm et al., 2017).

The United Nations Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP) determined that 80% of the world's marine pollution originates from inland areas and not from just beachgoers (GESAMP, 1991). The plastics degrade over time and this has allowed researchers to generate distinct size classes (macro, meso, micro, and nano particles), all of which have been seen to have their own environmental impacts (Anderson et al., 2015; Rochman et al., 2016).

Based on the literature, it is important to assess how marine debris ingestion is impacting the survival rates of sea turtles. Studies from the Marine Science Center Sea Turtle Hospital have found that the ingestion of marine debris poses significant health risks to sea turtles, such as intestinal disturbances that cause blockages and entanglement. These disturbances can lead to excessive amounts of gas build up that impacts the buoyancy of the sea turtle and increases the vulnerability to predators (Derraik 2002; Schulman and Lutz 1995). It is important to note that even in tiny amounts, marine debris can have drastic impacts on marine species.

From previous studies, it has been noted that marine debris ingestion and entanglement cause morbidity and mortality in all sea turtle species (Franzen-Klein et al., 2020). The North Atlantic Subtropical Gyre is a “particularly complex habitat for plastic accumulation due to the presence of the pelagic brown algae *Sargassum*-dominated drift” (Witherington, 2002). Many pelagic invertebrates and vertebrate species, such as post-hatchling and juvenile sea turtles are known to take refuge in these floating *Sargassum* mats. These areas primarily serve as resting and feeding grounds before the sea turtles head out to the open ocean regions (Wyneken and Salmon, 1992; Bolten, 2003a). Since this area is known to have an accumulation of marine debris due to the converging currents, the oceanic juveniles will have an increased exposure to entanglement or ingestion of marine debris (Bolten, 2003a; Carr, 1987; Witherington et al., 2012).

From the literature, it was also noted that earlier life stages are more severely impacted than later stages (Campani et al., 2013). In one study, the prevalence of plastic ingestion in a population of post-hatchling sea turtle guts were examined. These turtles are considered “washbacks,” which are post-hatchlings that have begun to feed, thus increasing chances of marine debris ingestion (Campani et al., 2013).

Marine Plastics Education. Education programs have the potential to be an effective way to enhance a learner’s scientific content knowledge. To do this, the key is to find ways to connect with the learners to increase the likelihood of increasing awareness of their own individual actions and developing steps they can take to have a positive impact. Based on literature, “environmental education that supports pro-environmental behaviors has often focused on individual behavior and choice, rather than collective or community-relevant approaches” (Bellino and Adams 2017). The goal is to have citizens and stakeholder groups come together to implement policy change or enforcements of local littering fines or initiatives for proper waste disposal and reduction of single-use plastics (Kollmuss and Agyeman 2002).

Purpose

The purpose of this project is to analyze past data from the Marine Science Center in Volusia County, Florida to form local decisions and marine debris educational materials were created to increase awareness of this global issue. Moreover, the Marine Science Center was interested in exploring ways that it can mitigate marine debris related turtle strandings and death through education and outreach. The education plan will be a first exploration of this for Volusia County.

While the Marine Science Center has data on stranded seas turtles, including associated marine debris, from the early 2000s onward, the facility currently lacks electronic database to store this data. All the data is currently stored in paper form in notebooks consisting of intake forms, evaluation reports, necropsy reports, and patient care logs. These paper documents do get scanned into the computer after a certain amount of time, but no analysis have been run on the information.

With the data provided by the Marine Science Center, similar analyzes were performed to investigate not only the age of the sea turtle, but also the size (length, width, and weight), types of marine debris ingested, other underlying health concerns, and the time frame of the stranding or death. The data analyzed was from 2015-2020. This data was stored in paper documents from necropsy reports, stranding reports, and patient evaluation forms during treatment at the Marine

Science Center. From 2020 and onward there has been a specific location on these paper documents to record impacts to marine debris related issues. The Marine Science Center would record any sightings of marine debris impacts throughout the care of the sea turtle, but it was not a requirement and sometimes this data was never documented.

Being able to set up a database to store and organize this data for the Marine Science Center will allow for an in-depth data analysis to be performed to note potential local areas of concern. In addition, having real data to provide to the public in an appealing way will increase the awareness of the problem. It is important to highlight that manufactured plastic products are entering the coastal ecosystems at alarming rates and are having a huge impact on coastal marine life. Many of the sea turtles are impacted at the most vulnerable early life stages. The marine debris is not easily passed through the GI tract which causes issues with normal feeding patterns, migration, and predator-prey activities (McCauley and Bjorndal, 1999).

Methods: Research and Analysis

Marine Debris and Sea Turtles in Volusia County, FL. I worked with the Marine Science Center Turtle Rehabilitation Manager, Allison Bernstein to create a database to store data concerning marine debris impacts to sea turtles that come into the care of the facility from entanglement or ingesting the items. All the paper documents stored for each year from 2015-2020 were read and the following information was recorded- MSCID, date brought to the sea turtle hospital, turtle species, sex, age- determined from the size of the turtle, weight, condition (alive or dead), location retrieved (inshore or offshore), geographic location, any other information pertaining to condition of the turtle and impacts from marine debris, and impacts from marine debris (yes or no). This was detective work as some of this information was easily identifiable and at times the documents needed to be fully read to decipher information. One of the shortcomings and why this project was needed was that there was not a systematic process before 2020 to record information related to marine debris. If a team member at the sea turtle hospital noticed something related to marine debris during the treatment time of the sea turtle patient, they may or may not record the information within their file. After 2020 the sea turtle hospital started to pay more attention to marine debris related issues as they were becoming more prevalent with the sea turtle patients being treated at the hospital.

Analysis. The variables included in the database were organized and simplified to create a more user-friendly document for each individual year from 2015-2020. This document included the following information: date (month/day/year), turtle species (green, loggerhead, leatherback, hawksbill, kemp's ridley), age (hatchling, juvenile, sub-adult, adult), weight (in kg), location retrieved (offshore or inshore), geographic region (various cities around Volusia County), type of marine debris impact (entanglement from monofilament line, entanglement from monofilament line with fishhook(s) present, plastic found in fecal matter, balloon ingested, only fishhooks present, and entanglement from monofilament line and cast net. This data was analyzed using Pivot tables to organize trends and a linear correlation was used to identify trends in time of year, species, and percent impact of marine debris to sea turtles.

Education Materials & Marine Debris. I used the above data and analysis, in conjunction with literature on community-based social marketing approaches to behavior change and other successful marine plastic reduction campaigns, to guide the creation of educational materials that

highlight the issues with marine debris and the impacts to sea turtles, with a strong focus to the items of concern here in Volusia County. The educational materials will consist of lesson plans, brochures, flyers, and interactive activities for age specific groups. The plan is to distribute these educational materials to K-12 educational facilities, local universities, non-profit organizations and to be accessible at the Marine Science Center educational programs. In addition, the facility requested that I develop informational videos and interactive components for their social media platforms used within the county, as well as the website.

Results from Data Analysis

Based on the content of the database, frequency tables were used to analyze numerical data in detail and answer unanticipated questions about the data. The trends that were observed included that Green Sea Turtle (*Chelonia mydas*) make up most of the intakes at the Marine Science Center (Figure 4), most marine debris issues are from monofilament line entanglement (Figure 3), among impacted sea turtles, juveniles and sub-adults have the largest percentage of impacts (Figure 4), March is the busiest month of sea turtle intakes when all years are combined (Figure 2), Green sea turtles mostly come in from entanglement from monofilament lines with and without hooks and Loggerhead sea turtles were likely to be found with hooks present (Figure 3) and the months February and October are busier than others for marine debris impact to sea turtles (Figure 1).

Month	Marine Debris Impact
January	3
February	11
March	7
April	3
May	5
June	6
July	5
August	1
September	6
October	12
November	3
December	7

Figure 1. Frequencies of sea turtles impacted by marine debris by month (Overall trends for 2015-2020 data)

Month	Total Sea Turtle Intakes
January	48
February	99
March	127
April	84
May	63
June	28
July	35
August	19
September	26
October	56
November	30
December	66

Figure 2. Frequencies of intakes to identify what month is the busiest for sea turtle intakes at the Marine Science Center
(Overall trends for 2015-2020 data)

Type of Marine Debris Impact	Green	Loggerhead	Hawksbill	Kemp's Ridley	Grand Totals
Entanglement from Monofilament Line	32	1	0	0	33
Entanglement from Monofilament Line with Fishhook (s) Present	23	5	0	1	29
Plastic Found in Fecal Matter	3	1	0	0	4
Balloon Ingested	3	0	0	0	3
Only Fishhook (s) Present	1	1	0	0	2
Entanglement from Monofilament Line and Cast Net	1	0	0	0	1
Grand Totals	63	8	0	1	72

Figure 3. Amount of each type of marine debris impact type per sea turtle species
(Overall trends for 2015-2020 data)

Age	Marine Debris Impact	Green	Hawksbill	Kemp's Ridley	Loggerhead	Grand Total
Adult	NO	4	0	0	18	22
	YES	0	0	0	2	2
Hatchling	NO	1	0	0	0	1
	YES	0	0	0	1	1
Juvenile	NO	436	1	7	3	447
	YES	52	0	1	1	54
Sub-Adult	NO	45	0	4	94	143
	YES	8	0	0	4	12
Grand Total		546	1	12	123	682

Figure 4. Impacts from marine debris from each age class within each sea turtle species
(Overall trends for 2015-2020 data)

Since the Marine Science Center needs a basic look at past data from sea turtle intakes to better understand and identify trends, basic summary tables were created to provide a quick snapshot of this data.

Turtle Species	Amount	Impacted by Marine Debris
Green	84	9
Loggerhead	26	0
Kemp's Ridley	7	0
Grand Total	117	9

Figure 5. Summary of the amount of sea turtle species and recorded impacts from marine debris based on the analyzed sea turtle intake and rehabilitation forms in 2015.

Type of Marine Debris Impact	Amount	% Impact
Entanglement from Monofilament Line	6	66.7
Entanglement from Monofilament Line with Fishhook (s) Present	1	11.1
Plastic Found in Fecal Matter	1	11.1
Balloon Ingested	1	11.1
Only Fishhook (s) Present	0	0
Entanglement from Monofilament Line and Cast Net	0	0

Figure 6. Summary of types and percentage of marine debris impacts to all recorded sea turtle species in 2015.

Turtle Species	Amount	Impacted by Marine Debris
Green	67	7
Loggerhead	17	1
Kemp's Ridley	2	1
Grand Total	86	9

Figure 7. Summary of the amount of sea turtle species and recorded impacts from marine debris based on the analyzed sea turtle intake and rehabilitation forms in 2016.

Type of Marine Debris Impact	Amount	% Impact
Entanglement from Monofilament Line	3	33.3
Entanglement from Monofilament Line with Fishhook (s) Present	3	33.3
Plastic Found in Fecal Matter	0	0
Balloon Ingested	0	0
Only Fishhook (s) Present	2	22.2
Entanglement from Monofilament Line and Cast Net	1	11.1

Figure 8. Summary of types and percentage of marine debris impacts to all recorded sea turtle species in 2016.

Turtle Species	Amount	Impacted by Marine Debris
Green	46	8
Loggerhead	38	2
Kemp's Ridley	0	0
Grand Total	84	10

Figure 9. Summary of the amount of sea turtle species and recorded impacts from marine debris based on the analyzed sea turtle intake and rehabilitation forms in 2017.

Type of Marine Debris Impact	Amount	% Impact
Entanglement from Monofilament Line	6	60
Entanglement from Monofilament Line with Fishhook (s) Present	4	40
Plastic Found in Fecal Matter	0	0
Balloon Ingested	0	0
Only Fishhook (s) Present	0	0
Entanglement from Monofilament Line and Cast Net	0	0

Figure 10. Summary of types and percentage of marine debris impacts to all recorded sea turtle species in 2017.

Turtle Species	Amount	Impacted by Marine Debris
Green	82	10
Loggerhead	30	2
Kemp's Ridley	0	0
Grand Total	112	12

Figure 11. Summary of the amount of sea turtle species and recorded impacts from marine debris based on the analyzed sea turtle intake and rehabilitation forms in 2018.

Type of Marine Debris Impact	Amount	% Impact
Entanglement from Monofilament Line	5	41.7
Entanglement from Monofilament Line with Fishhook (s) Present	4	33.3
Plastic Found in Fecal Matter	1	8.3
Balloon Ingested	2	16.7
Only Fishhook (s) Present	0	0
Entanglement from Monofilament Line and Cast Net	0	0

Figure 12. Summary of types and percentage of marine debris impacts to all recorded sea turtle species in 2018.

Turtle Species	Amount	Impacted by Marine Debris
Green	111	5
Loggerhead	6	2
Kemp's Ridley	3	0
Grand Total	120	7

Figure 13. Summary of the amount of sea turtle species and recorded impacts from marine debris based on the analyzed sea turtle intake and rehabilitation forms in 2019.

Type of Marine Debris Impact	Amount	% Impact
Entanglement from Monofilament Line	0	0
Entanglement from Monofilament Line with Fishhook (s) Present	6	86
Plastic Found in Fecal Matter	1	14.3
Balloon Ingested	0	0
Only Fishhook (s) Present	0	0
Entanglement from Monofilament Line and Cast Net	0	0

Figure 14. Summary of types and percentage of marine debris impacts to all recorded sea turtle species in 2019.

Turtle Species	Amount	Impacted by Marine Debris
Green	156	20
Loggerhead	6	1
Hawksbill	1	0
Grand Total	163	21

Figure 15. Summary of the amount of sea turtle species and recorded impacts from marine debris based on the analyzed sea turtle intake and rehabilitation forms in 2020.

Type of Marine Debris Impact	Amount	% Impact
Entanglement from Monofilament Line	12	57.1
Entanglement from Monofilament Line with Fishhook (s) Present	9	42.9
Plastic Found in Fecal Matter	0	0
Balloon Ingested	0	0
Only Fishhook (s) Present	0	0
Entanglement from Monofilament Line and Cast Net	0	0

Figure 16. Summary of types and percentage of marine debris impacts to all recorded sea turtle species in 2020.

Percent of Sea Turtle Patients at the Marine Science Center from 2015-2020

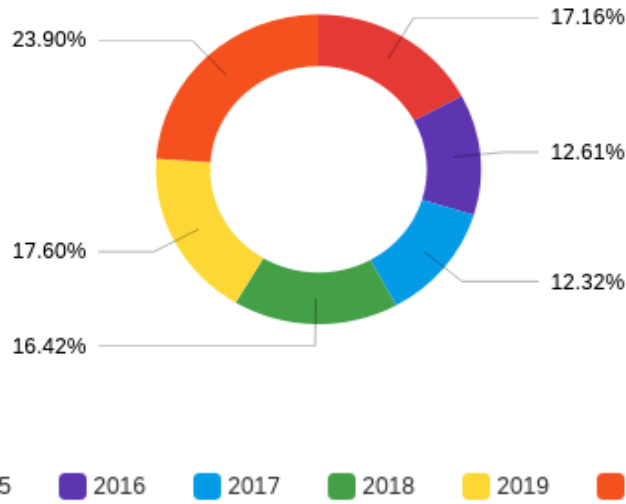


Figure 17. Percent of sea turtle patients at the Marine Science Center from 2015-2020

#	Field	2015	2016	2017	2018	2019	2020
1	Loggerhead	22% 26	20% 17	45% 38	27% 30	5% 6	4% 6
2	Green	72% 84	78% 67	55% 46	73% 82	93% 111	96% 156
3	Kemp's Ridley	6% 7	2% 2	0% 0	0% 0	3% 3	0% 0
4	Hawksbill	0% 0	0% 0	0% 0	0% 0	0% 0	1% 1
5	Leatherback	0% 0	0% 0	0% 0	0% 0	0% 0	0% 0
		117	86	84	112	120	163

Figure 18. Summary of percentage of sea turtle species each year from 2015-2020.

#	Field	2015	2016	2017	2018	2019	2020	Total
1	Entanglement from Monofilament Line	17% 6	9% 3	23% 8	17% 6	0% 0	34% 12	35
2	Entanglement from Monofilament Line with Fish Hook(s) Present	4% 1	12% 3	8% 2	16% 4	24% 6	36% 9	25
3	Plastic found in fecal matter	25% 1	0% 0	0% 0	50% 2	25% 1	0% 0	4
4	Balloon ingested	33% 1	0% 0	0% 0	67% 2	0% 0	0% 0	3
5	Only Fish Hook(s) Present	0% 0	100% 2	0% 0	0% 0	0% 0	0% 0	2
6	Entanglement from Monofilament Line and Cast Net	0% 0	100% 1	0% 0	0% 0	0% 0	0% 0	1

Figure 19. Summary of type of marine debris impact present each year from 2015-2020.

#	Field	2015	2016	2017	2018	2019	2020	Total
1	Hatchling	0.00% 0	0.00% 0	0.00% 0	0.00% 0	50.00% 1	50.00% 1	2
2	Juvenile	18.40% 92	13.20% 66	6.00% 30	12.60% 63	19.80% 99	30.00% 150	500
3	Sub-Adult	15.69% 24	11.76% 18	29.41% 45	24.84% 38	12.42% 19	5.88% 9	153
4	Adult	4.17% 1	4.17% 1	37.50% 9	45.83% 11	4.17% 1	4.17% 1	24

Figure 20. Summary of age of sea turtle each year from 2015-2020.

A linear correlation was run to evaluate the percent impact of marine debris impact over time for each of the sea turtle species (Green, Loggerhead, Kemp's Ridley) and total percent impact from marine debris for all sea turtle species over time.

Parameter	Value
β_0	8.27
β_1	0.00
ϕ	6.27
Lvk	1.00

Year	% Marine Debris Impact (Green Sea Turtle)
2015	6.6
2016	8.12
2017	9.52
2018	8.93
2019	4.17
2020	12.27

Figure 21. Percent Impact of Marine Debris for Green Sea Turtle Species from 2015-2020.

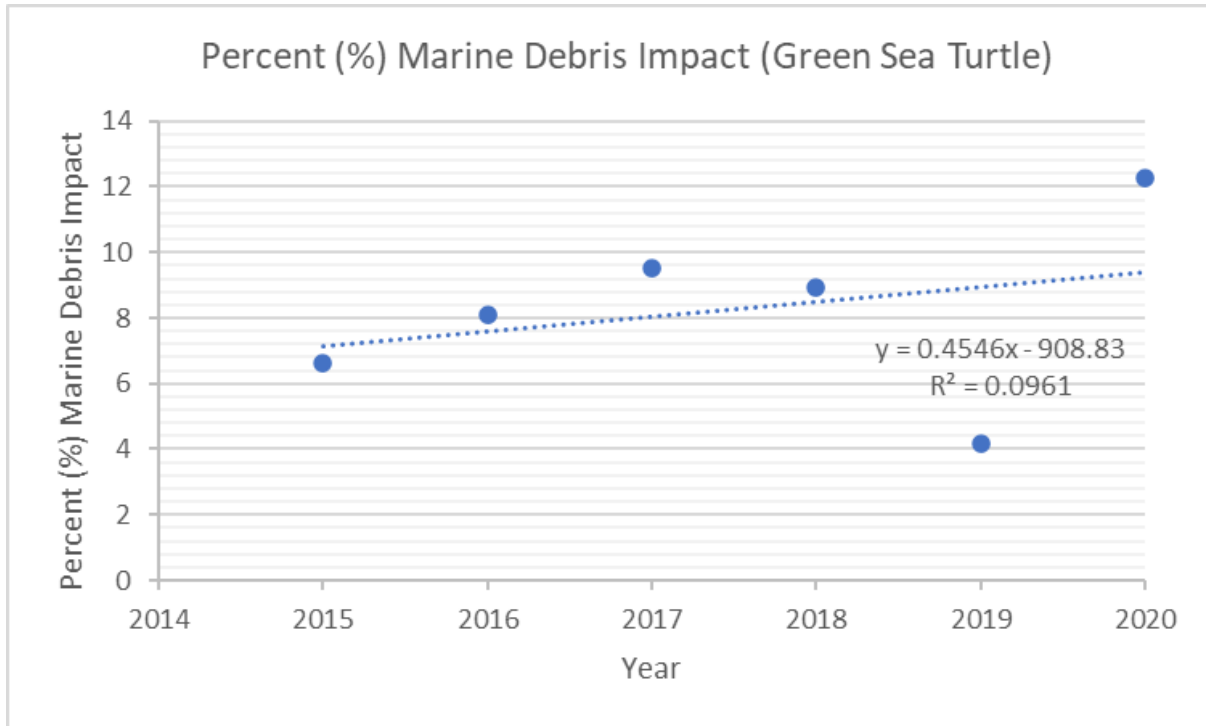


Figure 22. Percent (%) Impact of Marine Debris for Green Sea Turtle Species from 2015-2020.

The linear model reveals a positive trend on the impacts that marine debris is having on green sea turtles. The correlations between the x and y axis are $r = 0.31$ which further shows that there is a positive growth in the threat that marine debris poses to green sea turtles.

Parameter	Value
β_0	1.27
β_1	0.00
ϕ	0.62
Lvk	1.00

Year	% Marine Debris Impact (Loggerhead Sea Turtle)
2015	0
2016	1.16
2017	2.38
2018	1.79
2019	1.67
2020	0.61

Figure 23. Percent Impact of Marine Debris for Loggerhead Sea Turtle species from 2015-2020.

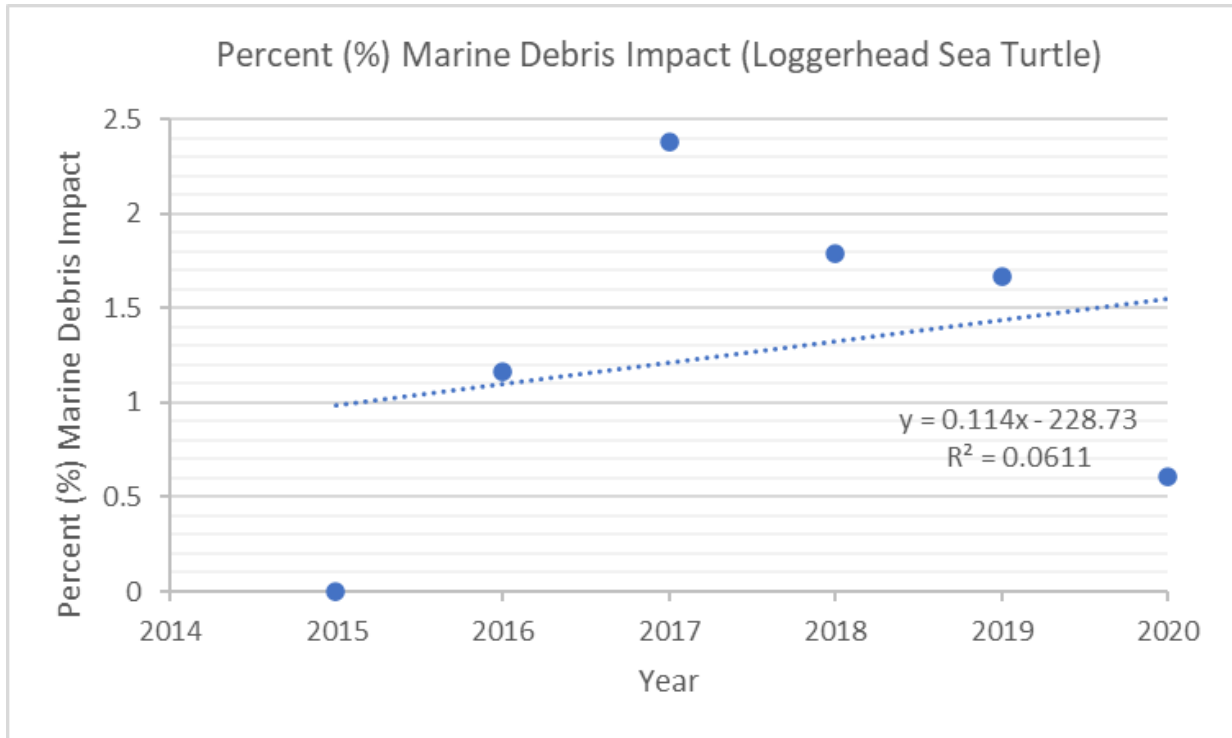


Figure 24. Percent (%) Impact of Marine Debris for Loggerhead Sea Turtles Species 2015-2020.

The linear model reveals a positive trend on the impacts that marine debris is having on loggerhead sea turtles. The correlations between the x and y axis are $r = 0.25$ which further shows that there is a positive growth in the threat that marine debris poses to loggerhead sea turtles.

Parameter	Value
β_0	0.19
β_1	0.00
ϕ	0.19
Lvk	1.00

Year	% Marine Debris Impact (Kemp's Ridley Sea Turtle)
2015	0
2016	1.16
2017	0
2018	0
2019	0
2020	0

Figure 25. Percent Impact of Marine Debris for Kemp's Ridley Sea Turtle species from 2015-2020

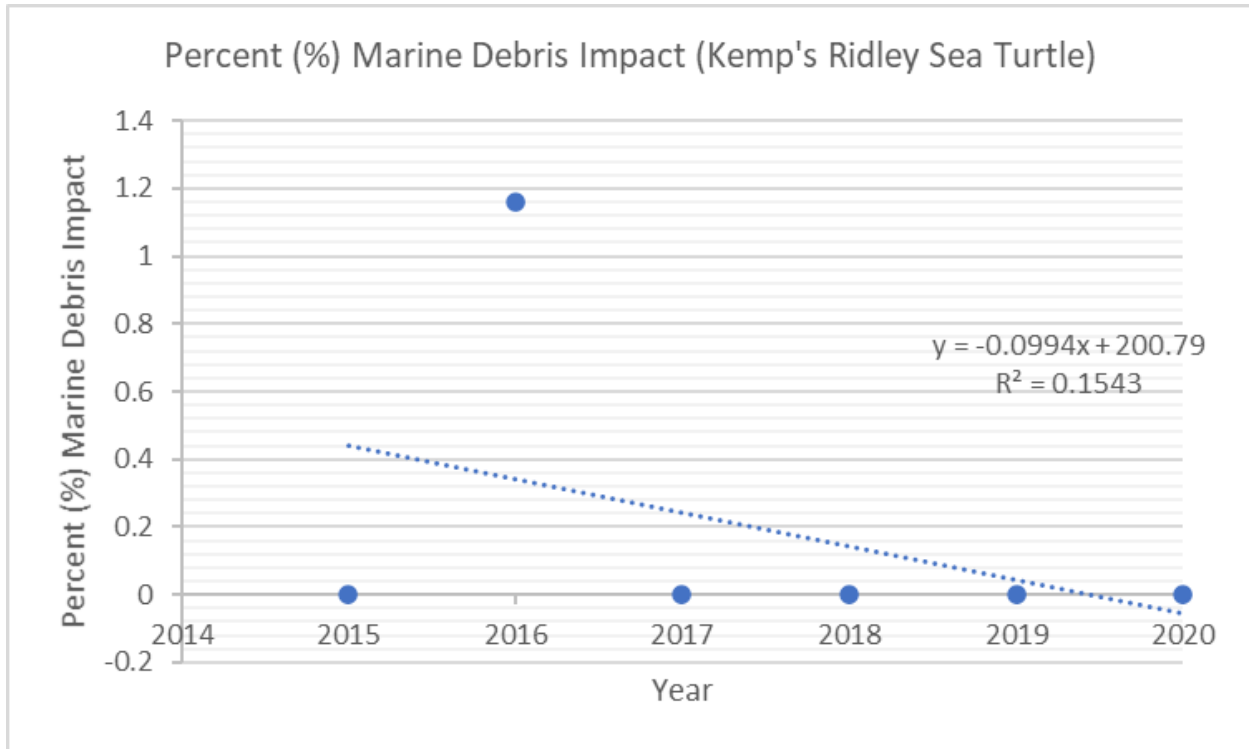


Figure 26. Percent (%) Impact of Marine Debris for Kemp’s Ridley Sea Turtles Species 2015-2020.

The linear model reveals a negative trend on the impacts that marine debris is having on kemp’s ridley sea turtles. The correlations between the x and y axis are $r = -0.39$ which further shows that there is a negative growth in the threat that marine debris poses to kemp’s ridley.

Parameter	Value
β_0	9.73
β_1	0.00
ϕ	6.89
Lvk	1.00

Year	Total % Marine Debris Impact (all species)
2015	6.57
2016	10.47
2017	11.9
2018	10.71
2019	5.83
2020	12.88

Figure 27. Total Percent (%) Impact of Marine Debris for All Species (Green, Loggerhead, Kemp’s Ridley) from 2015-2020.

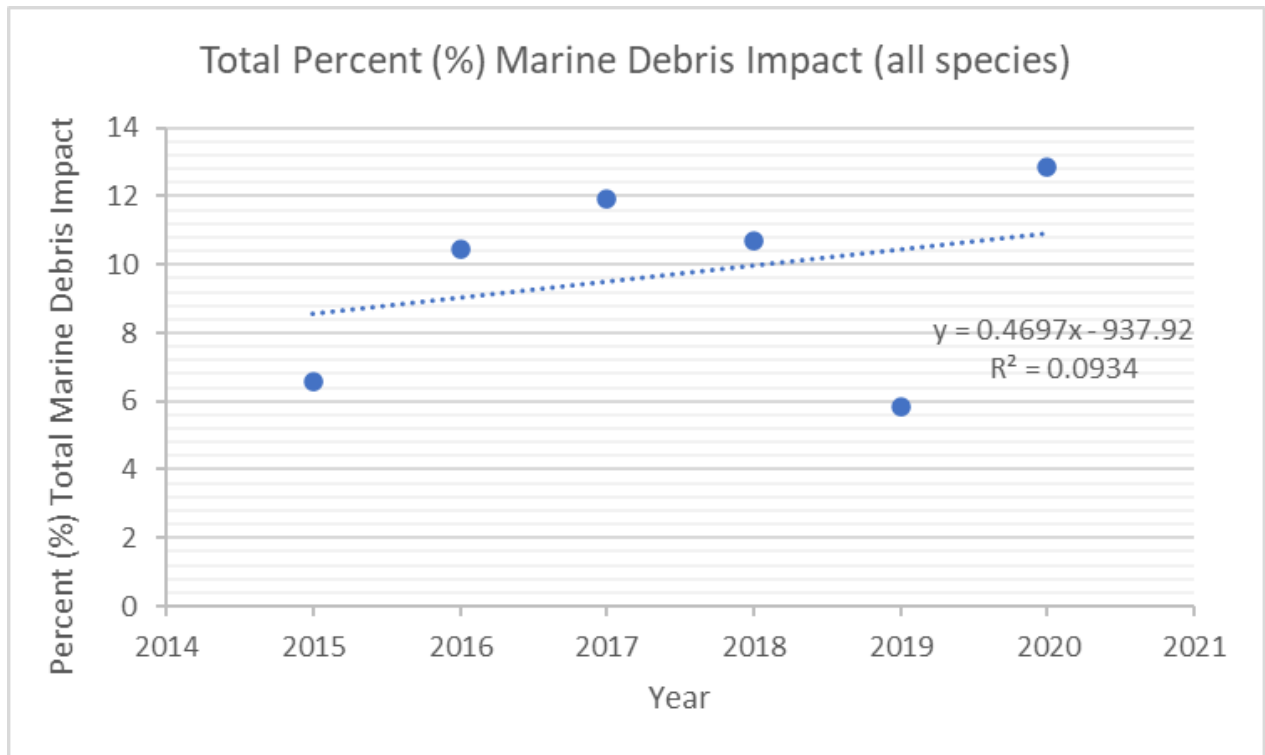


Figure 28. Total Percent (%) Impact of Marine Debris for All Species (Green, Loggerhead, Kemp’s Ridley) from 2015-2020.

The linear model reveals a positive trend on the impacts that marine debris is having on sea turtles without differentiation between species. The correlations between the x and y axis are $r=0.31$ which further shows that there is a positive growth in the threat that marine debris poses to the entire sea turtle species population.

Curriculum Programming

The Pieces Add Up-Traveling Turtle Trunk. One of the educational programs that was developed from the results of the data analysis was a Traveling Turtle Trunk Program. This traveling trunk will be the main educational tool to increase awareness of the collective marine debris issue around the world, but with a Volusia County, Florida focus. The Pieces Add Up: Traveling Turtle Trunk will be available based on reservation system to be used in K-12 educational institutions and other environment centers within Volusia County.

The trunk will explain the issues with marine debris, with examples of common items found in Volusia County, Florida, such as balloons, monofilament line, fishing hooks, and various micro and macro plastics. In addition, the trunk will highlight the three most common species of sea turtles in Volusia County (green, loggerhead, and leatherback sea turtle) with complete descriptions of the species, threats they are faced with, along with ways for people to take action to have influence. The participants using the turtle trunk will simulate being a part of the sea turtle conservation team and will work with replica sea turtles to record data as if they were the

ones responding to the stranding with measurements of the carapace, weight, and description of the appearance of the turtle. The participants will then determine the best treatment plan for the sea turtle.

The trunk will include five examples of sea turtles that have been admitted and treated at the Marine Science Center Sea Turtle Hospital for marine debris related injuries. After the participants evaluate the sea turtle, the actual story of the sea turtle, including descriptions, actual pictures, and the full treatment plan each sea turtle received will be provided for the participants to review to see how close they came to what the actual sea turtle conservation team determined to be the best course of action. There will also be three additional sea turtles highlighted with their patient stories, but there will not be a replica sea turtle to accompany them. All of the sea turtles highlighted in this educational programming were sea turtles that were impacted by some form of marine debris, whether initially identified by the conservation team, or discovered during their treatment at the Marine Science Center.

Environmental Education Overview and Pedagogy. The main roles of environmental education are to create awareness, change attitudes, and bring people together to act towards improving environmental conservation (EPA 2021). It is important to note that there are several different methods and pedagogies to use to do this. The educational materials that I developed for this education program were based on the constructivism pedagogy created by Jean Piaget in the 1930s (Brau and Kimmons 1970). This pedagogy focuses on learners increasing knowledge using experiences and reflection. Within this programming I achieved this with focus being placed on:

- 🌿 **Discussion:** this allowed for sufficient background information to allow for sufficient participant discussion throughout the program.
- 🌿 **Project Method:** this allowed for participants to acquire knowledge about the topic with active involvement and engagement in the content within the program.
- 🌿 **Problem Solving:** the problem of marine debris impacts to sea turtles was defined and explained and participants can identify and select solutions based on individual choice within the program activities.
- 🌿 **Dramatization:** this was used to create a role-playing activity that participants are engaged with, along with the storytelling aspect of the individual sea turtle patients highlighted within the program, and the use of an interactive Kahoot based review game to recap the information presented within the program.

Contents of The Pieces Add Up: Traveling Turtle Trunk

- 🌿 **Student Worksheets** that include the Sea Turtle Evaluation Report (laminated for reuse) that the participant will use to evaluate the sea turtle example included in the trunk (Appendix A).
- 🌿 **Pledge Sheet** will be used for participants to create an individual pledge of how they will help support sea turtle conservation and the ocean (Appendix B).
- 🌿 **Informational Sheets** for an overview of the sea turtle species common to Volusia County (green, loggerhead, and leatherback), importance of the ocean ecosystem, what is marine debris, and what are some alternatives to everyday single use plastic (Appendix C and Appendix E).

- 🌿 **Replica Sea Turtle Skulls** for each of the sea turtle species that are common in Volusia County (green, loggerhead, and leatherback). These are 3D printed generated skulls that look realistic. These are included to show the size of the skull and used to explain the eating behavior of each turtle species (Appendix D).
- 🌿 **Sea Turtle Patients** that were admitted and treated at the Marine Science Center Sea Turtle Hospital will be included that participants will use to collect stranding information before they are taken to the hospital. Each of the five replicas will have their actual stories included so that the participants can learn what happened to the sea turtle and what treatment plan the sea turtle hospital took (Appendix F).
- 🌿 **PowerPoint Presentation** of the overview of basic sea turtle biology and nesting activities in Volusia County, marine debris overview, action steps to have influence, and overview of each of the sea turtle patients represented in the turtle trunk. This will be accessible via USB Jump drive (Appendix G).
- 🌿 **Example Data Sheets** will be provided that the actual Marine Science Center Sea Turtle Hospital and the Sea Turtle Conservation Team use when evaluating a sea turtle and/or performing a necropsy of a sea turtle. Providing these as reference examples will provide a more realistic experience to see what happens behind the scenes for each sea turtle treatment plan.
- 🌿 **Marine Debris Examples** will be included based on the identified areas of concern (monofilament line, fishing hooks, balloons, plastic shopping bags, and micro and macro plastic pieces) and will serve as examples of the items that impacted the example sea turtles included in the turtle trunk.
- 🌿 **Food Examples** that each of the sea turtle species consumes will be included as visuals when the skull structure is being explained. This is especially important since many of the sea turtle species accidentally ingest marine debris that is mistaken for food.
 - Sea grasses- Green Sea Turtles
 - Jellyfish- Leatherback Sea Turtle
 - Mollusks- Loggerhead Sea Turtle
- 🌿 **Sea Turtle Egg Examples** will be included to help explain the nesting behavior of each of the sea turtle species
- 🌿 **Measurement Tools** will be included to allow the participants to take measurements of the sea turtles' carapace (shell). Calibers, straight measuring tape, and a scale will be included to weigh the turtles.
- 🌿 **Dry Erase Markers** will be included to use on the laminated components of the educational materials.
- 🌿 **SWAG Items** will be included to provide to participants after they have completed the program and completed the pledge form. Items that will be included are reusable straws, reusable shopping bags with the logo of the program, reusable cups, stickers, etc.
- 🌿 **List of Volunteer Opportunities** will be discussed and provided to participants that have been established in Volusia County to help with marine debris related issues and sea turtle conservation.

*Note: All the presentations, worksheets, information sheets, example data sheets, and list of volunteer opportunities will all be included as electronic copies via a USB Jump drive for additional printing needs.

Next Steps and Application

Strategic Plan for Outreach and Education Program. A strategic plan for The Pieces Add Up: Marine Debris Outreach and Education Program was created in hopes for this program to grow within the county due to this data analysis project and curriculum development. Studies have shown that education programs have the potential to be an effective way to enhance a learner's scientific content knowledge (Bellino and Adams 2017). Literature further states that to have an effective marine debris education program in place, a program must highlight the following: "(1) clearly communicate that we are all part of both the problem and the solution, (2) align visuals with verbal and nonverbal messages to ensure more impactful and direct messaging about marine debris which is supported by a study from Houghton (1993) that showed that verbal anti-litter prompts in combination with visual prompts results in statistically significant reduction in the rate of littering and were demonstrated to be more effective than verbal or visual prompts alone, (3) provide ongoing educational support for complex marine debris topics to ensure all learners are able to understand the content being presented, and (4) when dealing with the youth, encourage and support adult role models, especially in schools" (Bellino and Adams 2017; Houghton 1993). This program aims to support these key areas from the literature and would be the first of its kind with this type of scope in the local county government Environmental Management Division. This strategic plan will provide the framework for a marine debris education program to be integrated into the county environmental management division to create a pathway forward for environmental awareness and action for marine debris impacts to the ocean and coastal communities.

This strategic plan would be valuable because the framework has been created to kick off this outreach and education program. While the Marine Science Center has data on stranded sea turtles from the early 2000s onward, the facility currently lacks an electronic database to store this data and has never attempted to derive patterns or potential outcomes based on this data. With the help of this strategic plan, the data will be analyzed to form local decisions and to create marine debris educational materials and community science programs. This will help to increase awareness of this global issue of marine debris impacts on the ocean ecosystem and to re-evaluate and create management strategies that support sea turtle populations. The intended audience for this program is K-12 educational facilities, environmental centers, and community members in Volusia County that wish to improve their knowledge on the issues surrounding marine debris.

The full strategic plan covering the vision, mission and values, SMART goals, 7-S Framework for Organizational Structure, SWOT, and TOWS analysis, focus strategies, communications plan and action plan can be found in Appendix H.

The strategic plan was developed first by creating a mission and vision statement, followed by an outline of the values. A framework was created to accomplish SMART goals over a five-year period of:

- Develop effective educational material
- Increase community engagement and volunteer involvement
- Solidify a long-term funding opportunity
- Ensure measurable success

- Direct effective allocation of resources
- Increase awareness of impacts of marine debris
- Support program cohesiveness within the program

The organizational structure and organizational change were created to help guide the communication flow and required tasks of the organization. The ultimate responsibility for the decisions for the program will be lie with the program director, but each of the leadership roles will have their own set of responsibilities to meet and decisions to make based on those outlined from the program director. There is open communication within this organization and ideas and suggestions will be accepted from all participating parties. The program director will be the main communicator to each of the individual leadership roles and then each of the leaders will communicate to their respective team. The organization's leaders serve as the liaison to the program director and to the stakeholders involved with this program. The leaders maintain organization within each department to ensure alignment with the mission, vision, and goals of the program. They create an atmosphere for diversity, equity, and inclusion to be present and abundant to maintain a positive and transparent work environment (Figure 1 in Strategic Plan Document in Appendix H).

The decision making for this program will be facilitated across all levels of the organization, thus there will be a hybrid of a horizontal organization structure and teams based organizational structure. This type of structure is in place due to the limited levels between upper management and staff-level employees. This structure will be used in the beginning stages of this program and will be reevaluated once it becomes large enough to branch out into more departments. This structure may continue to work even after growth happens because it requires less supervision, more involvement from employees, fosters open communication, and improves coordination and speed of implementing innovative ideas (Figure 2 in Strategic Plan Document in Appendix H).

A teams based organizational structure would be ideal for this program due to an alignment to the values of this program, such as a focus on collaboration, community leadership, passion, and empowerment. With a teams-based structure there would be a strong focus on problem solving, innovation, cooperation and giving the employees more control over the decisions and implementation processes. There would be a value placed on experience and ideas, rather than seniority.

To evaluate the effectiveness of the program, the 7-S framework for organizational alignment will be used covering the topics of strategy, structure, systems, staffing, skills, styles, and shared values (Figure 3 in the Strategic Plan Document in Appendix H). A Strength, Weakness, Opportunities, and Threats (SWOT) Analysis was performed (Figure 4 in Strategic Plan Document in Appendix H) to identify and evaluate the focus strategies to ensure a successful development of this program (Figure 5 in Strategic Plan Document in Appendix H). An action plan was developed to implement the focus strategies (Figure 6 in the Strategic Plan Document in Appendix H). The action plan for implementing the focus strategies for this program is laid out over a one-year timeframe. This process will shift into a more cyclical year by year pattern after the establishment of the roles and the program at large.

Phase I. The program director will develop a hiring process that meets the diversity, equity, and inclusion goals of the program. The leadership group will collaborate on the development of

action items and responsibilities to meet the outlined needs of each of the focus strategies. The leadership team will commit to working towards these action actions over the course of the year. **Phase II.** The department leaders will divide the action items into smaller parts that meet the SMART goal criteria. Responsible parties will begin implementation of the action items and periodically discuss progress made on each item or challenges experiences that need addressing. **Phase III.** In December, at the close of the year, successes, and challenges of the focus strategies from Phase II will be discussed. The leadership team will develop adaptation strategies for the following year to address any shortcomings and to redefine goals and change any action items. From this analysis, the program director will develop a summary report and will update the strategic plan, as needed.

A communications plan and a communication for change plan was developed (Figure 7-8 in Strategic Plan in Appendix H). In addition, a plan to implement, measure, and adapt the organizational change SMART goals that were determined for the program (Figure 9 in Strategic Plan in Appendix H).

Marine Science Center in Volusia County, Florida. The Marine Science Center will be provided the organized recorded data, the data analysis, determined trends, along with access to The Pieces Add Up: Traveling Turtle Trunk to use in their educational programming at the facility. In addition, I plan to continue to work with the Marine Science Center to analyze the data intake forms from 2002-2014 and then for future years to continue growing this marine debris education and outreach program.

New Smyrna Beach Marine Turtle Conservancy. This sea turtle conservation non-profit is in Volusia County, Florida and will be a partner for the marine debris education and outreach program. The Pieces Add Up Traveling Sea Turtle Trunk will be used with their educational outreach events to increase awareness of sea turtle conservation and marine debris issues in Volusia County, Florida.

Masters Project Presentation at Duke University Nicholas School of the Environment. An overview of this project was presented at the MP Symposium at Duke University on April 8, 2022, for partial fulfillment of the requirements for the Duke Environmental Leadership and Master's in Environmental Management (DEL-MEM) in the Nicholas School of the Environment.

You can access the Recorded Version of the MP Presentation Slideshow here: [The Pieces Add Up: Marine Debris Outreach and Education Program in Volusia County, Florida](#)

Appendix A

SEA TURTLE EVALUATION REPORT

A Day in the Life of a Sea Turtle Conservation Team Member

OBSERVER NAME(S):

STRANDING DATE:

TURTLE MSCID:

BACKGROUND

You responded to this stranded sea turtle and plan to transport it to the Marine Science Center in Volusia County, Florida for treatment. Before you do so, you need to perform an evaluation of the sea turtle to get some important information to determine the best treatment plan. So, what do you say? Want to be a sea turtle biologist for the day and help this sea turtle?

WEIGHT

A turtle's weight can tell us a lot about its health. If it is underweight, it can mean that they are very sick. Please weight your turtle on the scale and document below:

----- kg

The normal weight for this sea turtle size is _____ kg

This sea turtle is (circle one):

Underweight Healthy

SPECIES IDENTIFICATION

Circle which sea turtle you have based on the descriptions



Loggerhead (CC)- The carapace of young loggerheads has a jagged edge and brown body and shell



Green (CM)- Have a dark carapace and light plastron with greenish skin.



Leatherback (DC)- Largest of the sea turtles. Have a soft, leathery, black shell with white stripes.

EXAMINATION DETAILS

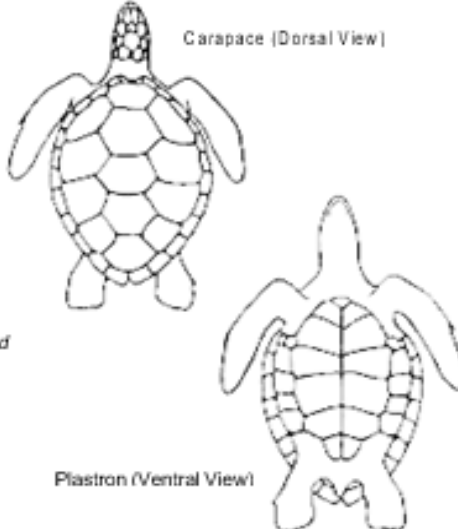
Type of examination: (check one)




- In-person exam by a sea turtle conservation team member
- Evaluated from photographs submitted by the public

Completeness of body: (check all that apply)

- Complete
- Missing head
- Missing one or more flippers
- Missing 50% or more of the shell (body)
- Not determined

TURTLE MSCID:

HEALTH AND BODY CONDITIONS	Note any noticeable injuries, which may include the following:
<ul style="list-style-type: none"> • <i>Monofilament fishing line</i> • <i>Hook in flipper or mouth</i> • <i>Boat strike or open wound</i> • <i>Plastic ingestion (i.e., balloon, bag, etc.)</i> • <i>Shark bite or teeth marks</i> <p><i>The turtle will have other marine life, what is referred to as epibiota growing on its shell and body, such as algae and barnacles. If the turtle is sick, these become very numerous.</i></p> <p><i>Please draw any epibiota that you observe growing on this turtle along with any observable injuries:</i></p>	<div style="text-align: right;">Carapace (Dorsal View)</div>  <div style="text-align: center;">Plastron (Ventral View)</div>

MEASUREMENTS	Now, you must take the straight carapace length and width using the SCL to determine which size class of turtle you have.		
<p>SCL (straight carapace length) _____ cm</p> <p>SCW (straight carapace width) _____ cm</p> <p>CCL (curved carapace length) _____ cm</p> <p>CCW (curved carapace width) _____ cm</p>			
			
	Loggerhead	Green	Leatherback
___ Hatchling	<5cm	<5cm	<7cm
___ Post-Hatchling	5-10cm	5-10 cm	unknown
___ Juvenile	10-60cm	10-60 cm	unknown
___ Sub-Adult	60-90 cm	60-90 cm	unknown
___ Adult	>90cm	>90cm	138.5 cm

TURTLE MSCID:

ACTUAL DIAGNOSIS	What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?
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TREATMENT PLAN	What was the provided treatment plan at the sea turtle hospital?
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END RESULT	Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?
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Appendix B

This pledge sheet will be filled out by participants after completing the educational program.

The Pieces Add Up: **PLEDGE SHEET**

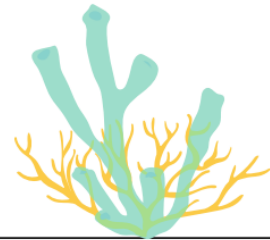
Write about the actions you will take to help support the ocean and sea turtles.

I PLEDGE TO...



SIGNED BY:


DATE:




Appendix C


Infographics for Green, Loggerhead, and Leatherback Sea Turtles that will be included in The Pieces Add Up-Traveling Turtle Trunk

FUN FACTS ABOUT LOGGERHEAD SEA TURTLES




<h3>OTHER NAMES</h3> <p>Scientific Name: Caretta caretta</p>  <p>Named for its large head</p>	<h3>SIZE & WEIGHT</h3> <p>Size: Typically 2.5 to 3.5 feet in carapace length (80 to 110 cm).</p> <p>Weight: Adult weigh between 155 and 375 pounds (70 to 170 kg).</p>
--	--

NESTING IN VOLUSIA COUNTY




- Nest at intervals of 2 to 4 years during the months of May-October.
- They lay 3 to 6 nests per season, approximately 12 to 14 days apart.
- Lays average of between 100 to 126 eggs in each nest.
- Eggs incubate for about 60 days.




HABITAT RANGE

Shallow water along the continental shelves of the Atlantic, Pacific, and Indian Oceans




MEAL PLAN (AKA DIET)


Their powerful jaw muscles help them to easily crush horseshoe crabs, clams, mussels, and other invertebrates.



Crabs



Clams



Mussels

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SEA TURTLE NEST ADOPTION IN VOLUSIA COUNTY



<h3>HATCHLING</h3> 	<h3>ADULT</h3> 
<h3>TRACKS</h3> 	<h3>THREATS</h3> <ul style="list-style-type: none"> Monofilament Line; Hooks; Nets Light Pollution Plastic Pollution Loss of nesting beach and human disturbance Natural Predators Boat Strikes

WHAT YOU CAN DO TO HELP

Each of us has an opportunity to make a difference!



Use turtle friendly lighting



Reduce use of single use plastic



Dispose of fishing materials appropriately



Educate yourself and others about the importance of a healthy ocean and sea turtle population



Support and volunteer with organizations working to help the environment



Be aware of sea turtle nesting areas and respect the process and regulations in place

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FINDE OUT MORE AT: NSBTURTLES.ORG AND APPROPRIATECENTER.COM

Front side of infographic

Back side of infographic

FUN FACTS ABOUT GREEN SEA TURTLES



OTHER NAMES

Scientific Name:
Chelonia mydas



Named for the green color of fat

SIZE & WEIGHT

Size: Adults are 3 to 4 feet in carapace length (83 - 114 cm).
Weight: Adults weigh between 240 and 420 pounds (110 - 190 kg).



NESTING IN VOLUSIA COUNTY



- Nest at intervals of about every 2 years, with wide year-to-year fluctuations in numbers of nesting females.
- Nests between 3 to 5 times per season. Lays an average of 115 eggs in each nest, with the eggs incubating for about 60 days.

HABITAT RANGE

Coastlines with a high abundance of seagrass beds. Found in all temperate and tropical waters



MEAL PLAN (AKA DIET)

Mostly seagrass and alga, the only sea turtle that is strictly herbivorous as an adult. Their jaws are finely serrated which aids them in tearing vegetation.



Worms, Crustaceans, and Aquatic Insects (when less than 8 inches)



Aquatic Vegetation (adult life)

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SEA TURTLE NEST ADOPTION IN VOLUSIA COUNTY



HATCHLING



ADULT



TRACKS



THREATS

- Monofilament Line; Hooks; Nets
- Light Pollution
- Plastic Pollution
- Loss of nesting beach and human disturbance
- Natural Predators
- Boat Strikes

WHAT YOU CAN DO TO HELP

Each of us has an opportunity to make a difference!



Use turtle friendly lighting



Reduce use of single use plastic



Dispose of fishing materials appropriately



Educate yourself and others about the importance of a healthy ocean and sea turtle population



Support and volunteer with organizations working to help the environment



Be aware of sea turtle nesting areas and respect the process and regulations in place



THE PIECES ADD UP! MARINE DEBRIS EDUCATION AND OUTREACH PROGRAM
FREE OUT GUIDE AT: NSBTURTLES.ORG AND WWW.DECORACKCOUNTRY.COM



Front side of infographic

Back side of infographic

FUN FACTS ABOUT

LEATHERBACK SEA TURTLES

OTHER NAMES

Scientific

Name:

Dermodochelys coriacea

Named for its leathery and tough shell



SIZE & WEIGHT

Size: 4 to 6 feet (130 - 183 cm)
Weight: 660 to 1,100 pounds (300 - 500 kg)



NESTING IN VOLUSIA COUNTY



- Nest at intervals of 1 to 3 years.
- Nests between 4 to 7 times per season, with an average of 10 days between nestings.
- Lays an average of 80 fertilized eggs, the size of billiard balls, and 30 smaller, unfertilized eggs, in each nest. Eggs incubate for about 65 days. Unlike other species of sea turtles, leatherback females may change nesting beaches, though they tend to stay in the same region.



HABITAT RANGE

Found primarily in the open ocean, with feeding happening just offshore. Known to be active in water below 40 degrees Fahrenheit, the only reptile known to remain active at such a low temperature.



MEAL PLAN (AKA DIET)

Leatherbacks have delicate, scissor-like jaws. Their jaws would be damaged by anything other than a diet of soft-bodied animals, so they feed almost exclusively on jellyfish.



Many times floating plastic debris, like bags, resembles jellyfish and the sea turtles accidentally ingest it.

THE PIECES ADD UP: MARINE DEBRIS EDUCATION AND OUTREACH PROGRAM
 NSBTURTLES.ORG

SEA TURTLE NEST ADOPTION IN VOLUSIA COUNTY



HATCHLING



ADULT



TRACKS



THREATS

- **Monofilament Line; Hooks; Nets**
- **Light Pollution**
- **Plastic Pollution**
- **Loss of nesting beach and human disturbance**
- **Natural Predators**
- **Boat Strikes**

WHAT YOU CAN DO TO HELP

Each of us has an opportunity to make a difference!

- **Use turtle friendly lighting**
- **Reduce use of single use plastic**
- **Dispose of fishing materials appropriately**
- **Educate yourself and others about the importance of a healthy ocean and sea turtle population**
- **Support and volunteer with organizations working to help the environment**
- **Be aware of sea turtle nesting areas and respect the process and regulations in place**



THE PIECES ADD UP: MARINE DEBRIS EDUCATION AND OUTREACH PROGRAM
 FIND OUT MORE AT: NSBTURTLES.ORG AND MARINESCIENCECENTER.COM



Front side of infographic

Back side of infographic

Appendix D

Here are some pictures of some of the supplies included in The Pieces Add Up- Traveling Turtle Trunk.



An example of some of the supplies included in the turtle trunk. Pictured here are replica sea turtle skulls for leatherback, loggerhead, green, hawksbill, and kemp's ridley sea turtle, replica sea turtles of the patient examples from the Marine Science Center, example food items for each species of sea turtle, measurement tools including calipers, straight measuring tape, and a scale. The style of this trunk was inspired by Inwater Research Group (Inwater Research Group 2022). This specific trunk for this education and outreach program will be focused on marine debris impacts to sea turtles strictly in Volusia County, Florida and original curriculum material was created to reflect this.

Appendix E

IMPORTANCE OF A HEALTHY OCEAN

THE AIR WE BREATHE
The ocean supplies half of Earth's oxygen- literally every other breath we take

COASTAL RESILIENCE
Coastal wetlands and other natural barriers help protect homes and businesses from flooding, storm surge, and coastal erosion

ECONOMY
Approximately 2.5 million U.S. jobs rely on a healthy ocean. Ocean-based tourism and recreation alone contribute about \$120 billion to the US Economy each year.

FOOD SOURCES
Several food sources come from the ocean

MEDICINE
Important medicines used to fight cancer, heart disease, COVID-19, and more come from the ocean

RECREATION
Millions of Americans along the coasts enjoy spending time in the ocean and at the beach

HABITAT
Many species rely on the ocean and beach ecosystems for reproduction and overall survival

CLIMATE REGULATION
The ocean covers more than 70% of the planet and its currents store and release heat across the globe playing a key role in stabilizing our climate.

This information sheet about the importance of a healthy ocean will be included in The Pieces Add Up Traveling Turtle Trunk

Appendix F

The following documents are the Sea Turtle Patient Story for the sea turtles being highlighted in the educational material. Five out of the eight of these will have corresponding replica sea turtles associated with them to be used in the hands-on educational travelling sea turtle trunk.

SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: TIMON **STRANDING DATE:** 11-21-2020
SPECIES: HAWKSBILL (ERETMOCHELYS IMBRICATA) **TURTLE MSCID:** EI20141

PATIENT SUMMARY

Timon, a juvenile Hawksbill Sea Turtle was found under a pile of sargassum a few days before Thanksgiving. Timon did not willingly eat for over 5 months. Patient was tube fed daily. Patient defecated plastics, rocks, and shells during the first month of treatments. Timon gained 0.75kg during rehabilitation.

MEET TIMON!

A JUVENILE HAWKSBILL SEA TURTLE
WEIGHT: .90 KG **SEX:** UNKNOWN



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Found under a pile of sargassum (seaweed).
- Underweight
- Defecated (pooped out) plastics, rocks, and seashells during the first month of under the care of MSC

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed.
- Tube feed for five months due to not willingly eating on its own.

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Timon gained 0.75 kg during rehabilitation at the Marine Science Center and was released on 07-15-2021



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: GUSTAVE

STRANDING DATE: 10-11-2020

SPECIES: GREEN (CHELONIA MYDAS)

TURTLE MSCID: CM20123

PATIENT SUMMARY

Gustave, a juvenile Green Sea Turtle was found stuck in a tide pool with predator rake marks along the plastron. Patient pooped out a piece of plastic bag a week after intake and a partial balloon a few days after that. Patient was only in our care for 18 days.

MEET GUSTAVE!

A JUVENILE GREEN SEA TURTLE
WEIGHT: 1.10 KG **SEX: UNKNOWN**



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Found stuck in a tide pool.
- Predator rake marks (parallel scratches) present along the plastron (bottom side of the sea turtle).
- Ingestion of plastic bag and partial balloon.

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed.
- Plastic bag and partial balloon were removed from the feces (poop).

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Gustave was treated at the Marine Science Center for 18 days and then released on 10-29-2020.



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: QILIN

STRANDING DATE: 12-14-2021

SPECIES: GREEN (CHELONIA MYDAS)

TURTLE MSCID: CM21216

PATIENT SUMMARY

Qilin, a juvenile Green Sea Turtle came in with a constriction wound of the right front flipper due to fishing line entanglement. The flipper was necrotic and osteomyelitis was seen in radiographs consistent with the constriction wound. The decision was made to amputate the flipper. Patient is on the current short list to be released.

MEET QILIN!

**A JUVENILE GREEN SEA TURTLE
WEIGHT: 2.65 KG SEX: UNKNOWN**



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Found trapped in jetty rocks.
- Fishing line wrapped around right front flipper with bone exposure.
- Slightly underweight.
- Epibionts (living organism on shell of sea turtle) present in the form of algae.

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed.
- Daily wound care
- Fecal float to check for parasites.
- Offerings of small amounts of fish and veggies.
- Surgery performed to amputate (remove) the flipper due to being necrotic (dead cells present) and osteomyelitis (bone infection).

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Qilin is currently still being treated at the Marine Science Center and is on the list for release.



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: AVOCADO

STRANDING DATE: 10-27-2018

SPECIES: LOGGERHEAD (CARETTA CARETTA) **TURTLE MSCID:** CC18104

PATIENT SUMMARY

Avocado, a sub-adult Loggerhead Sea Turtle came in with monofilament and hooks tightly entangling the right front flipper. During anesthetic procedure, four lines were down through esophagus and bunched in stomach. The lines were easily removed. Patient was also full of nematodes seen during scoping procedure. Right front flipper was amputated. A second procedure had to be done to clean out and reclose the amputation due to sutures not holding in underlying muscle tissues. Avocado was in our care for a little over 2 months.

MEET AVOCADO!

A SUB-ADULT LOGGERHEAD SEA TURTLE
WEIGHT: 58.0 KG SEX: UNKNOWN



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Monofilament line and hooks tightly entangled the right front flipper.
- Epibiota (living organisms on the shell on the turtle) consisted of algae and barnacles
- Nematodes (roundworms) present during an internal scoping procedure.

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed to treat the nematodes
- During anesthetic (put to sleep) procedure, the right front flipper was amputated (removed).
- A second procedure had to be completed to reclose the original amputation wound due to sutures (stiches) not holding in the muscle tissue.

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Avocado was treated at the Marine Science Center for a little over two months and was released on 1/9/2019.



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: YANARI

STRANDING DATE: 08-29-2021

SPECIES: KEMP'S RIDLEY
(LEPIDOCHELYS KEMPII)

TURTLE MSCID: LK21182

PATIENT SUMMARY

Yanari, a juvenile Kemp's Ridley Sea Turtle presented missing a right rear flipper, and was caught by a commercial fisherman. The hook and line were both still attached. Patient had to be anesthetized for endoscopic procedure to remove hook from stomach. Patient was in care for almost 3 months.

MEET YANARI!

A JUVENILE KEMP'S RIDLEY SEA TURTLE
WEIGHT: 2.75KG SEX: UNKNOWN



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Missing right rear flipper
- Hook and line attached to the sea turtle due to being caught by a commercial fisherman

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed.
- During anesthetic endoscopic procedure, the fishing hook was removed from the turtle's stomach.

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Yanari was treated at the Marine Science Center for three months and released.



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: VOYAGER

STRANDING DATE: 10-22-2019

SPECIES: GREEN (CHELONIA MYDAS)

TURTLE MSCID: CM1989

PATIENT SUMMARY

Voyager, a juvenile Green Sea Turtle was caught on a hook, and it was imbedded in the tongue/esophagus with a second hook lodged internally. Hook in esophagus was easily removed. Patient was taken for a CT scan to better assess location of second hook since unable to find during initial removal procedure. Hook and swivel were in distal 1/3 of colon. Subsequent radiograph showed no hook. Patient was able to pass the hook and swivel without complications. Voyager had around 7 small fibropapilloma tumors removed including on the eyelid. Patient defecated a plastic bag, and some pieces of plastic. Patient was released after 2 months of care.

MEET VOYAGER!

A JUVENILE GREEN SEA TURTLE
WEIGHT: 9.7KG SEX: UNKNOWN



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Caught on hook that was stuck on the tongue and esophagus (a muscular tube connecting the throat (pharynx) with the stomach.) with a second hook lodged internally.
- Defecated (pooped) a plastic bag and pieces of plastic.

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed.
- Hook in the esophagus was successfully removed.
- Radiographs and CT scans were performed to track down the hook and swivel that was internal.
- Hook and swivel were able to be passed without complications
- 7 small fibropapilloma tumors were removed

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Voyager was treated at the Marine Science Center for two months and then released.



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: OCEANUS

STRANDING DATE: 12-5-2021

SPECIES: GREEN (CHELONIA MYDAS)

TURTLE MSCID: CM21212

PATIENT SUMMARY

Oceanus, a juvenile Green Sea Turtle washed ashore on an oyster bed, and was rescued by kayakers. Patient was caudally buoyant with hypoglycemia. Radiographs showed a lot of trapped gas and feces. Soft plastic was found in fecal sample. It was determined that the patient had a pit tag on the right front flipper, which helps for identification and data collection purposes. Patient was only in care for 3 months before being cleared for release.

MEET OCEANUS!

**A JUVENILE GREEN SEA TURTLE
WEIGHT: 23.6 KG SEX: UNKNOWN**



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Hypoglycemic (a condition in which your blood sugar (glucose) level is lower than normal.)
- Caudally buoyant (floating tail side/ butt side upward above the water)
- Determined to have trapped gas and feces in the GI tract (a series of hollow organs joined in a long, twisting tube from the mouth to the anus)
- Plastic was found in the fecal (poop) sample

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Fluids and antibiotics were provided and regular check ins were performed to check the buoyancy issues
- Plastic was removed from the fecal matter (poop)

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Oceanus was treated at the Marine Science Center and released on 1-7-2022 in Ponce Inlet, Florida.



SEA TURTLE PATIENT STORY

A Day in the Life of a Sea Turtle Conservation Team Member

PATIENT NAME: GHOUL

STRANDING DATE: 10-20-2021

SPECIES: GREEN (CHELONIA MYDAS)

TURTLE MSCID: CM21200

PATIENT SUMMARY

Ghoul, a female juvenile Green Sea Turtle presented an edematous and missing left rear flipper. Radiographs showed impacted GI. The patient was hypoglycemic. There was no movement of GI despite multiple enemas. Manual fecal removal was done, and multiple small plastic pieces were removed embedded in the feces. The patient was with us for a month before passing.

MEET GHOUL!

**A JUVENILE GREEN SEA TURTLE
WEIGHT: 3.15 KG SEX: FEMALE**



ACTUAL DIAGNOSIS

What was the determined diagnosis of this specific sea turtle once at the sea turtle hospital?

- Hypoglycemic (a condition in which your blood sugar (glucose) level is lower than normal.
- Impacted GI (gastrointestinal tract, aka a series of hollow organs joined in a long, twisting tube from the mouth to the anus (butt).
- Missing left front flipper and edematous (swollen with an excessive accumulation of fluid)

TREATMENT PLAN

What was the provided treatment plan at the sea turtle hospital?

- Enema (injections of fluids used to cleanse or stimulate the emptying of your bowel) was provided multiple times.
- Manual fecal (waste/poop) was performed multiple times.
- Multiple pieces of plastic were embedded and removed from the fecal matter

END RESULT

Was this sea turtle released from the sea turtle hospital, did it pass away, or was it transferred to another facility?

- Ghoul was treated at the Marine Science Center for a month but passed away on 11/20/2021.
- A necropsy (dissection) was performed on 11/22/21 to collect further data
- Barium (part of the intestine) was loaded with hard microplastics within the size range of 0.2-1.5 cm

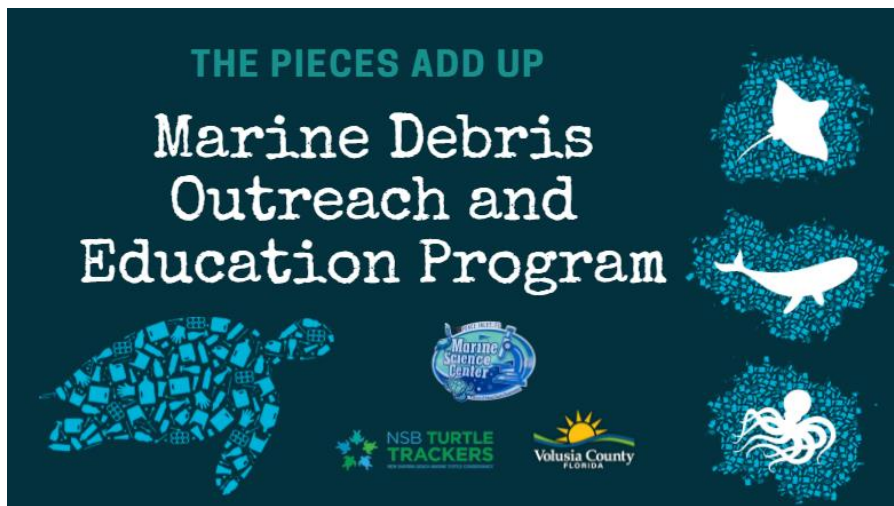


Appendix G

Example of the presentation and talking points that will accompany The Pieces Add Up Traveling Turtle Trunk Outreach and Education Program. The content for this presentation was created based on my background knowledge on the topics along with basic facts about the content topics from the Inwater Research Group, New Smyrna Beach Marine Turtle Conservancy, and Sea Turtle Conservancy.

The entire presentation can be accessed here: [The Pieces Add Up: Marine Debris Outreach and Education Presentation](#)

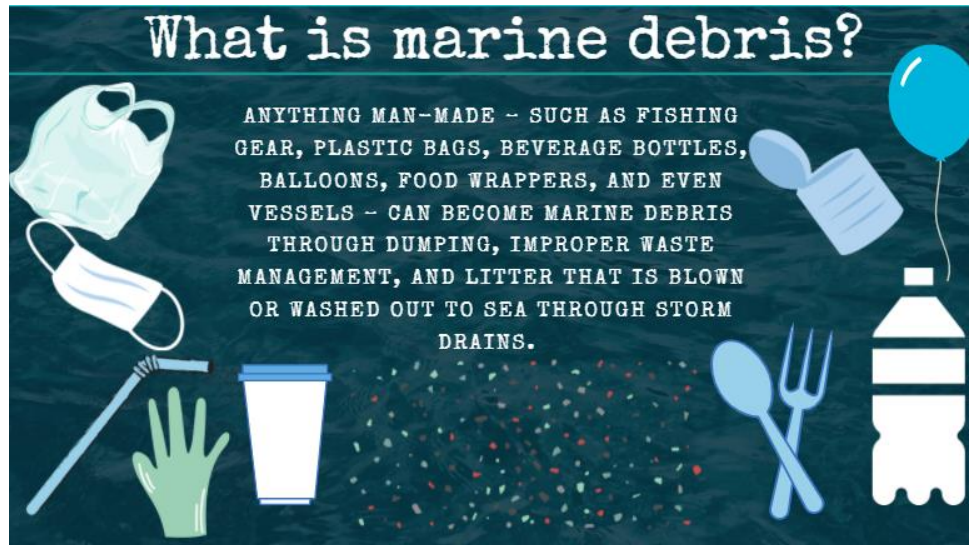
Slide 1 (Title Slide): Introduce the outreach and education program.



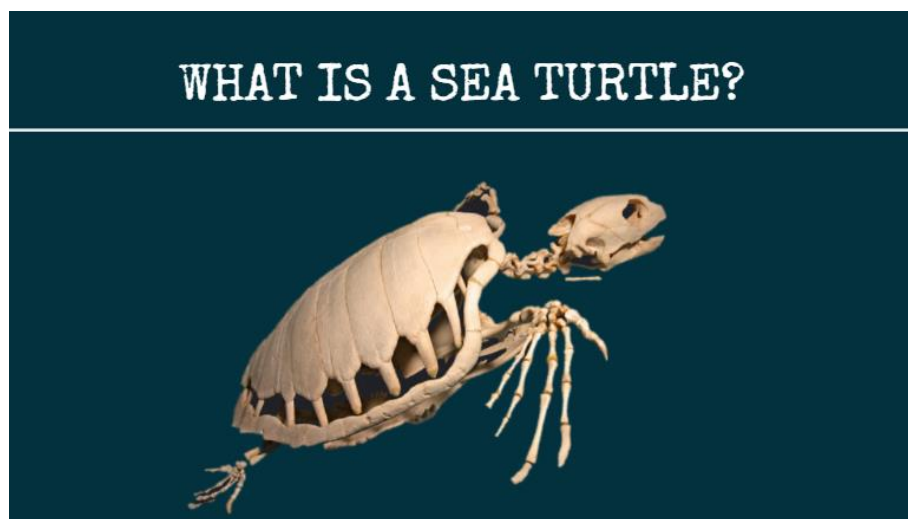
Slide 2: Have participants discuss what this quote means to them.



Slide 4: Have participants break into pairs or small groups if presenting this to a large group of people to discuss examples of marine debris and potential impacts they have on the environment.



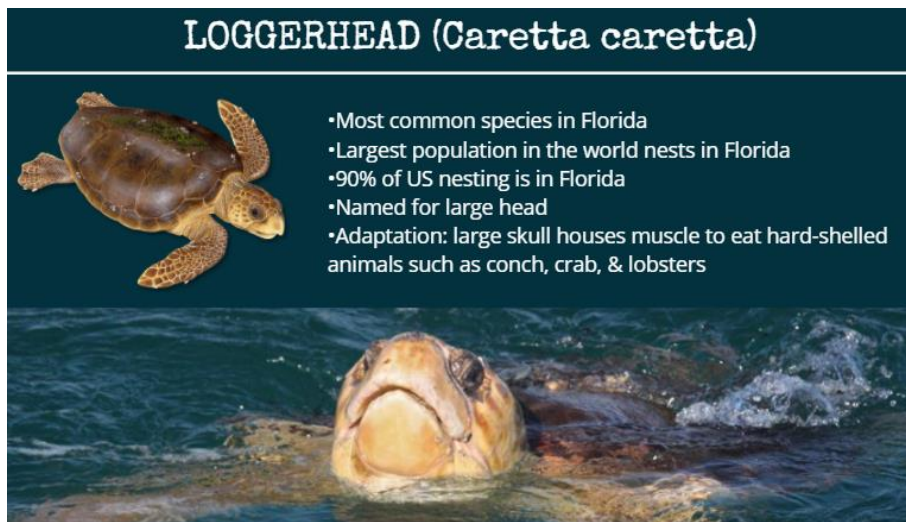
Slide 10: Provide an overview of sea turtle biology using this script: “So what is a sea turtle and why are they important? Sea turtles are classified as large, air-breathing reptiles that inhabit the ocean ecosystem. Sea turtles have played an important role in transporting nutrients across the ocean and coastal ecosystems for more than one hundred million years. Sea turtles are like us. They breathe air and have a skeleton with moveable jaws and four limbs, each with sets of five finger or toe bones. In fact, if you look at the skeleton of a sea turtle, their finger bones (phalanges) look very much like ours but elongated. But they are turtles, which means they have a unique protective shell. Their shell bones are rigidly attached to their ribs and spine” (Inwater Research Group 2022).



Slide 14: Discuss the common sea turtle species in Volusia County, Florida using this script to help guide the conversation: “Out of those five, three of them regularly nest on our beaches every summer. These include the loggerhead, green, and leatherback. Just as sea turtles are unique and built for life in the ocean, each of these sea turtles is unique and adapted for their specific habitat, diet, etc.”



Slide 15: Discuss the basics about the loggerhead sea turtle using this script to help guide the conversation: “The loggerhead is the most common species in FL and the smallest of these three, coming in at around 260 pounds. The nesting population in FL is the largest of any in the world, and in the US, 90% of all loggerhead nesting occurs in our state, making it vital that we continue to protect our coastlines. They derive their name from their exceptionally large head, which is an adaptation for the prey they eat” (Inwater Research Group 2022).



Slide 31: Discuss how sea turtle eggs look and feel using this script to help guide the conversation and pass around example replica eggs: “These eggs are quite different from bird eggs as they are soft and leathery. This pliability is an adaptation that is designed to allow the eggs to drop into the deep nest without cracking. It also keeps the eggs safe when piled on top one another with sand packed on top. Pass around the ping pong balls and preserved eggshells of the different sea turtle species” (Inwater Research Group 2022).



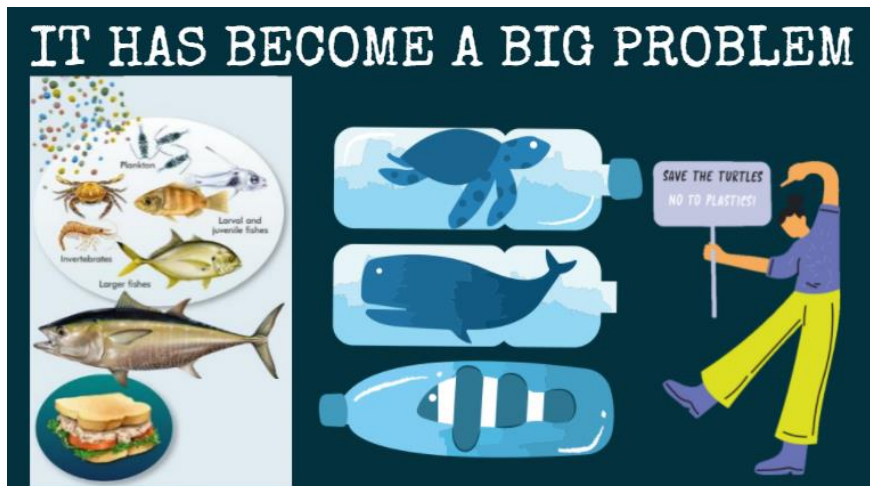
Slide 33: Discuss the hatching process for sea turtles using this script to help guide the conversation: “After 45-90 days, depending on the species of sea turtles, these eggs will hatch all at once, usually during the night, but this all temperature dependent. The gender of each turtle is determined by the temperature of the sand. Warmer parts of the nest produce females, while cooler parts produce males. You can remember this as “hot chicks and cool dudes.” Over 90% of the sea turtles laid in the state of Florida will be female. When it is time, the hatchlings will pip out of their shell using a tiny protrusion on the tip of their nose called a caruncle, which is like an egg tooth that helps them poke through the leathery egg. From here, they use the bodies of their siblings to climb out of the nest. We call this the elevator effect” (Inwater Research Group 2022).



Slide 40: Discuss the threats to sea turtles and ways to avoid these threats using this script to help guide the conversation: “If the odds were not already against these turtles, they also face numerous struggles with human interactions often resulting in injury or even death. In the water, the highest levels of interaction come from entanglement/ingestion from plastics and fishing gear. Fishing hook ingestion/line entanglement, bycatch on commercial boats, and vessel strikes. We can reduce these impacts easily by following posted boating speeds, fishing using appropriate gear and recycling our lines, as well as wisely choosing our seafood. Discuss ways to help avoid these threats to sea turtles” (Inwater Research Group 2022).



Slide 42: Discuss the issues with marine debris and explain how to use products that help to reduce and eliminate plastic in everyday life by using this script to help guide the conversation: “Plastic never biodegrades or disappears. It simply breaks down into smaller and smaller pieces called microplastics. This causes problems on all trophic or feeding levels. The tiniest of plastics are ingested by plankton which are then ingested by larger animals, and those by even larger animals and so on, sometimes even making its way onto our dinner plate. Please make sure to look at the alternatives to common individual use items that you can integrate into your lifestyle (they will be included to be displayed on a table during the presentation). Every participant will get to choose a reusable gift at the end of this program” (Inwater Research Group 2022; Cherry 2022).



Slide 47: Discuss ways to help sea turtles using the ideas presented on the slide. Make this a group-based conversation. Break up into smaller groups depending on size of the group presenting to.



Slide 49: Discuss the non-profit organization in New Smyrna Beach, Florida that helps with the conservation efforts of these sea turtles using this script to help guide the conversation: “For a very long-time sea turtles were unprotected, but since the 1980s, volunteers have monitored and recorded nesting activity in New Smyrna Beach under a government permit. Volunteers from various backgrounds joined forces to protect nesting sea turtles, their eggs, and hatchlings from beach driving and other human induced threats. We are committed to the tracking and conservation of threatened and endangered sea turtles and public education in New Smyrna Beach” (Cherry 2022).



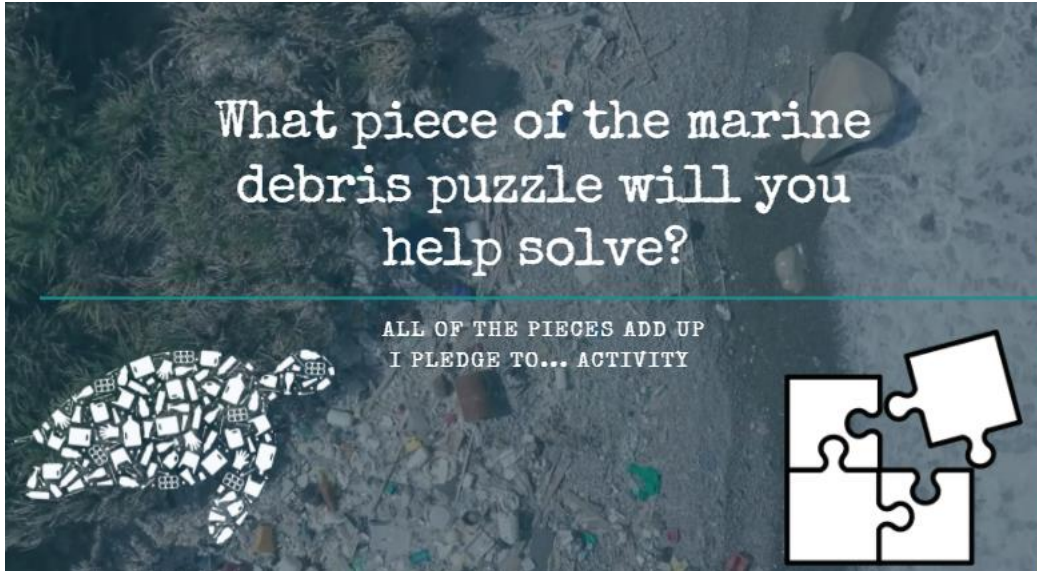
Slide 50: Discuss how people can help to protect the sea turtle species by adopting a nest in Volusia County through the local non-profit, NSB Marine Turtle Conservancy. The donation will go back into the nonprofit to aide in the efforts to help protect sea turtles and continue creating educational programs. The recipient will receive a nest adoption certificate, stickers, brochures and additional information about sea turtles, a t shirt, and a summary of the specific nest adopted (Cherry 2022).



Slide 51: Discuss a local business in Volusia County that is participating in the efforts for a cleaner ocean. This organization uses microplastics and macroplastics collected from the local beaches to create wearable reminders of the long-lasting affects plastic has on our environment (Cherry 2022; Clear Purpose Creations 2022).

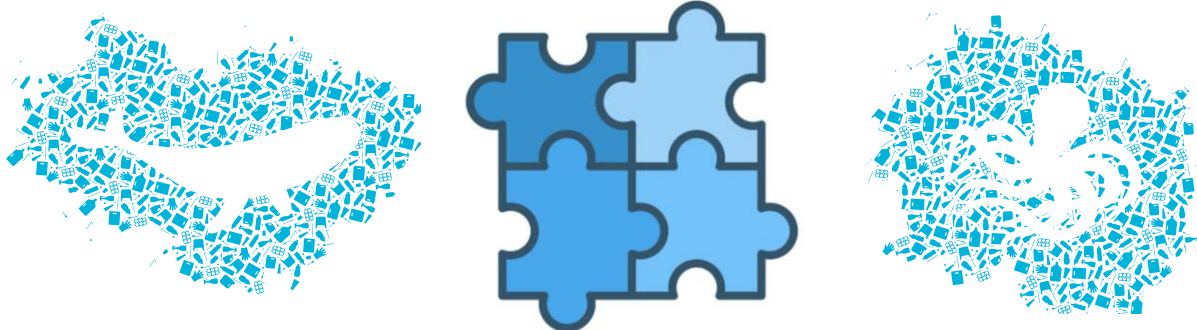


Slide 54: Pledge Activity- This is where the Pledge activity paper will be passed out. Each participant will use this time to reflect on actions they can take to have influence for the ocean and sea turtle populations. These will be shared in small or large group setting. Participants will take these pledge sheets with them and place them in a spot they regularly see as a reminder of the actions that are choosing to take to help protect the environment (Cherry 2022).



Appendix H

This strategic plan was created based on the skills learned in ENV 963 Program Management course at Duke University and presented as a final requirement for this course

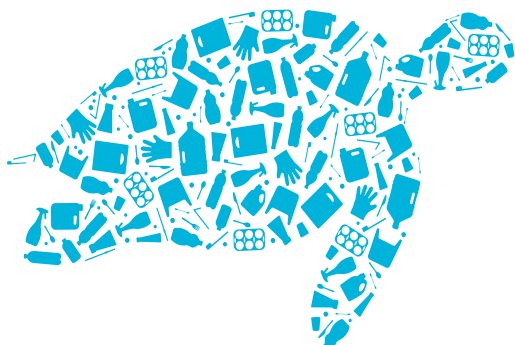


A STRATEGIC PLAN FOR THE MARINE DEBRIS OUTREACH AND EDUCATION PROGRAM CALLED- "THE PIECES ADD UP"

Creating a pathway forward for environmental awareness and action for marine debris impacts to the ocean and coastal communities.

"The greatest danger to our planet is the belief that someone else will save it."
-Robert Swann

"No water, no life. No blue, no green."
-Sylvia Earle



Jennifer Cherry, Expected Program Director
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Introduction

The program that I would like to implement is a marine debris education and outreach program called, “The Pieces Add Up - Marine Debris Outreach and Education Program in Volusia County, Florida”, using the marine debris data collected from a local sea turtle hospital called the Marine Science Center. This program will create a database to store data concerning marine debris impacts to sea turtles that come into the care of the Marine Science facility and develop an education plan for marine debris impacting sea turtles in Volusia County based on the data analysis. This program would be implemented through the Volusia County Environmental Management Division in local county government and our non-profit partner, New Smyrna Beach Marine Turtle Conservancy.

Marine debris is defined as “as any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment” and it has become a frequent area of concern for marine organisms (U.S. Department of Commerce 2008). Globally, plastics are the most prevalent form of marine debris (Derraik 2002), with reaching 300 million tons in 2013 (Wright et al., 2013). Studies from the Marine Science Center Sea Turtle Hospital in Volusia County, Florida have found that the ingestion of or entanglement of marine debris poses significant risk of morbidity and mortality (Derraik 2002; Schulman and Lutz 1995). The variables that will be collected in the database for this program to better understand impacts to sea turtle populations will include: turtle species, age, sex, weight, length, medical issues, how marine debris is associated with this issue, type of marine debris (i.e., plastic ingestion, fishing line entanglement, etc.), time, day, stranded location (offshore or inshore with geographic points), time, day, condition (i.e., alive, fresh dead, dried carcass).

In addition, studies have shown that education programs have the potential to be an effective way to enhance a learner’s scientific content knowledge (Bellino and Adams 2017). Literature further states that to have an effective marine debris education program in place, a program must highlight the following: “(1) clearly communicate that we are all part of both the problem and the solution, (2) align visuals with verbal and nonverbal messages to ensure more

impactful and direct messaging about marine debris which is supported by a study from Houghton (1993) that showed that verbal anti-litter prompts in combination with visual prompts results in statistically significant reduction in the rate of littering and were demonstrated to be more effective than verbal or visual prompts alone, (3) provide ongoing educational support for complex marine debris topics to ensure all learners are able to understand the content being presented, and (4) when dealing with the youth, encourage and support adult role models, especially in schools” (Bellino and Adams 2017; Houghton 1993). This program aims to support these key areas from the literature and would be the first of its kind with this type of scope in the local county government Environmental Management Division.

While the Marine Science Center has data on stranded sea turtles from the early 2000s onward, the facility currently lacks an electronic database to store this data and has never attempted to derive patterns or potential outcomes based on this data. With the help of this strategic plan, the data will be analyzed to form local decisions and to create marine debris educational materials and community science programs. This will help to increase awareness of this global issue of marine debris impacts on the ocean ecosystem and to re-evaluate and create management strategies that support sea turtle populations. The intended audience for this program is K-12 educational facilities, environmental centers, and community members in Volusia County that wish to improve their knowledge on the issues surrounding marine debris.

Mission Vision and Values (MVV)

Mission Statement To educate and empower residents of Volusia County to help clean our oceans and evaluate individual actions to help sea turtle populations.

Vision Statement To reduce impacts to sea turtle populations, local marine debris data will be analyzed to create educational materials to empower residents of Volusia County, Florida to reduce impacts to sea turtle populations and the ocean ecosystem.

Values

- ***Education*** We strive to use marine debris data and research to identify, analyze, and increase understanding of the environmental and societal impacts of marine debris impacts to the targeted sea turtle species to help promote management and restoration options.

- ***Collaboration*** We seek to collaborate with the local Marine Science Center for data analysis of sea turtle intakes impacted by marine debris and the Environmental Management Division in the development of a marine debris outreach and education program and database.
- ***Community Leadership*** We listen to the needs of the community, advancing change by providing structure and expertise through the development of community science programs.
- ***Passion and Empowerment*** We seek to ignite passion and inspiration in the local community to feel empowered to act in the efforts to reduce marine debris impacts to our ocean driven by our love of the ocean, marine life, and our local community.

Goals

The strategic plan seeks to establish a framework over the next five years to:

- **Develop effective educational material**
- **Increase community engagement and volunteer involvement**
- **Solidify a long-term funding opportunity**
- **Ensure measurable success**
- **Direct effective allocation of resources**
- **Increase awareness of impacts of marine debris**
- **Support program cohesiveness within the program**

Organizational Structure

The decisions are primarily made by the program director who will oversee the finances and leadership roles of data specialist, education specialist, volunteer and community engagement coordinator, and mentor coordinator. Priorities will be determined by the program director based on the needs of the program and will be evaluated during the scheduled meetings for this organization.

The ultimate responsibility for the decisions for the program will be lie with the program director, but each of the leadership roles will have their own set of responsibilities to meet and decisions to make based on those outlined from the program director. There is open communication within this organization and ideas and suggestions will be accepted from all participating parties. The program director will be the main communicator to each of the individual leadership roles and then each of the leaders will communicate to their respective team. The organization's leaders serve as the liaison to the program director and to the

stakeholders involved with this program. The leaders maintain organization within each department to ensure alignment with the mission, vision, and goals of the program. They create an atmosphere for diversity, equity, and inclusion to be present and abundant to maintain a positive and transparent work environment.

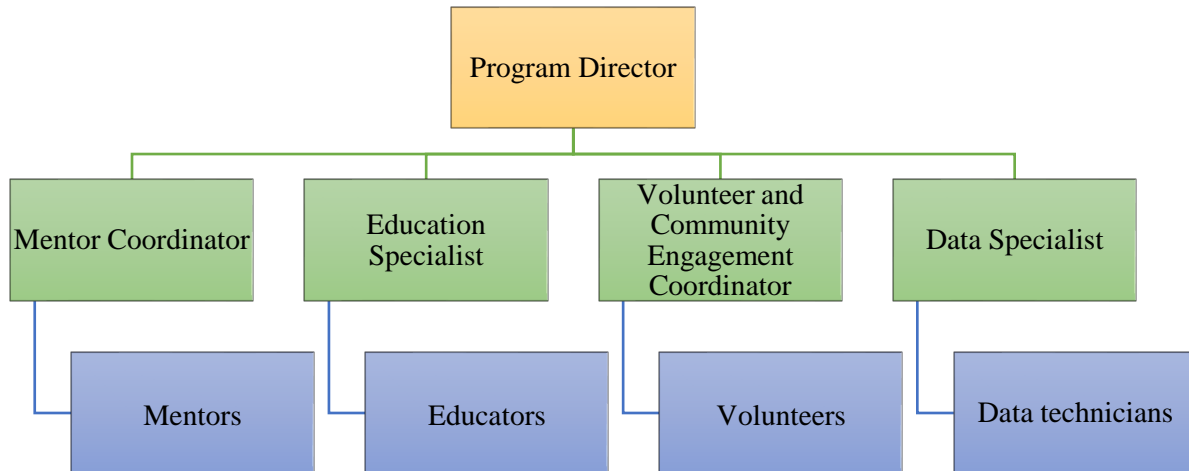


Figure 1. Organizational tree of the “The Pieces Add Up: Outreach and Education Marine Debris Program”

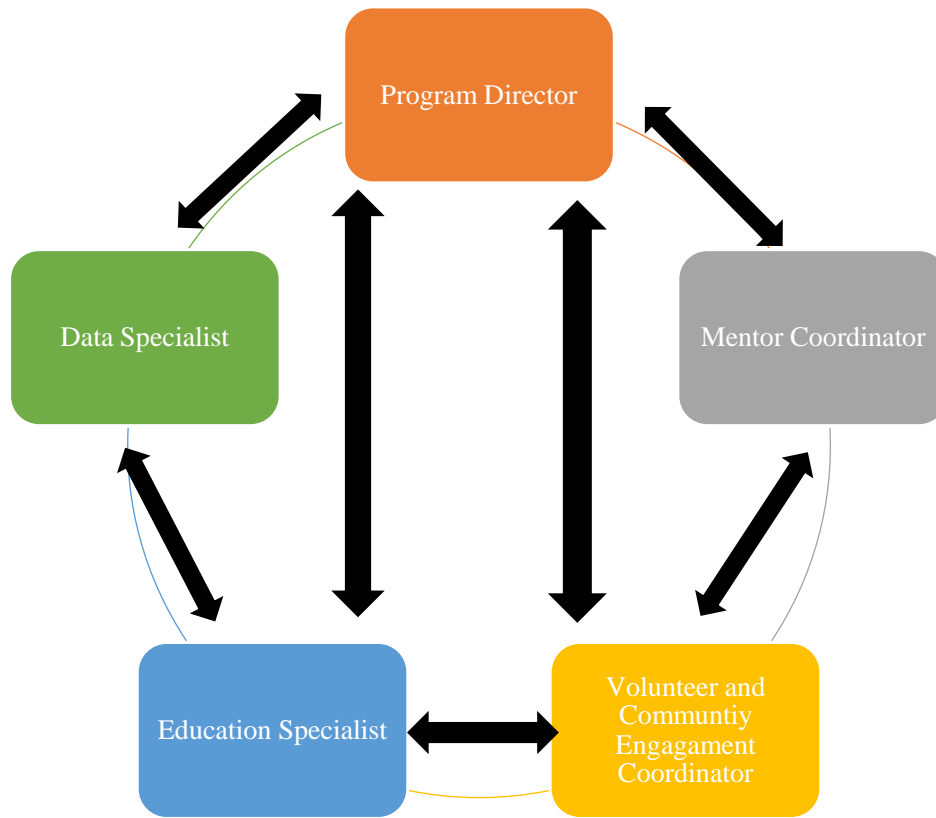


Figure 2. Illustrates communication lines within the leadership of The Pieces Add Up: Outreach and Education Marine Debris Program

Organizational Change

The decision making for this program will be facilitated across all levels of the organization, thus there will be a hybrid of a horizontal organization structure and teams based organizational structure. This type of structure is in place due to the limited levels between upper management and staff-level employees. This structure will be used in the beginning stages of this program and will be reevaluated once it becomes large enough to branch out into more departments. This structure may continue to work even after growth happens because it requires less supervision, more involvement from employees, fosters open communication, and improves coordination and speed of implementing innovative ideas.

A teams based organizational structure would be ideal for this program due to an alignment to the values of this program, such as a focus on collaboration, community leadership,

passion, and empowerment. With a teams-based structure there would be a strong focus on problem solving, innovation, cooperation and giving the employees more control over the decisions and implementation processes. There would be a value placed on experience and ideas, rather than seniority.

7-S Framework for Organizational Alignment

To evaluate the effectiveness of the program, the 7-S framework for organizational alignment will be used (Figure 3).

Strategy	Develop interesting educational material, partner with a wide range of stakeholders and develop a strategic outreach plan.
Structure	Educated on the issues with marine debris issues; data entry; enthusiasm for educating; mentorship; communication skills
Systems	Development of community science program, data entry, data analysis, educational program development, educational program deployed, analysis of the success of the program
Staffing	Program director; mentor coordinator, data specialist, education specialist, volunteer and community engagement coordinator, mentors, educators, data technicians and volunteers. Team members under each department will be determined based on the needs for each department.
Skills	Collaboration skills required across all departments; implementing educational materials to a variety of audiences, development of innovation educational material to meet the needs of all learners; data analysis and data management skills; ability to speak to a wide range of stakeholder groups; punctuality; growth mindset for continued focus on becoming better
Styles	Program director and department leaders offer creative freedom and are receptive to entrepreneurial ideas. They are consistently open, present, and supportive to all team members. Department leaders support community within the organization to maintain the teams-based structure through hosting team leadership retreats, potlucks, and highlighting success within each department.
Shared Values	Education, collaboration, community leadership, science and innovation, passion and empowerment, and integrity

Figure 3. 7-S Framework for organizational alignment

Strategy. The departments within this program are highly qualified in addressing the issues with marine debris and creating initiatives related to education, outreach, and environmental conditions within the county. Staff backgrounds in environmental science, data analysis, mentorship, and education enable them to be qualified to support the vision, mission, and values of this program. Since there is an integration of a horizontal and teams based organizational structure there would be cross training and communication among all the staff-levels. This would allow for the development of interesting educational material that is data driven and meets the needs of the stakeholder groups.

Structure. The desired structure enables open communication and collaboration, as well as specializations within departments to address unique challenges within the scope of work. When large issues arise within the program, departments can collaborate to address them.

Systems. Regular check-ins within the departments will be needed as much of the success of each department depends on the other. Having full team meetings where the junior level individuals are given equal space to contribute will allow space for open feedback on approaches taken to meet the needs of the program and to ensure alignment with the vision, mission, and values (see Figure 2). Department leadership should regularly communicate progress and challenges to the program director and other department heads, as needed.

Staffing. The program director creates a thoughtful hiring process aligned with the program's goals of diversity, equity, and inclusion to ensure the staff are an appropriate fit to aide in staying in focus with the vision, mission, and values. Basic orientation and professional development are provided specific to the roles in the organization to all new members of the organization and as needed per department. The department leaders will choose the team members based on an interview status and special attention will be placed on their potential areas of growth for themselves and the organization, along with their credentials and how well they fit into the organization. Opportunities will exist for leaders to regularly record areas of staff excellence and improvement using an evaluation process and professional development offerings.

Skills. Team members are hired based on their relevant skills, background, and enthusiasm with to meet the needs of the organization. Department leaders work along with the program director to create cohesiveness around professionalism and new skill development for continued growth

of each of the team members. There will be a focus placed on professional development for each of the departments and opportunities to enhance internal learning and growth within the organization. Following program development and implementation, an open collaborative process takes place among all departments to analysis the success of the program in alignment with vision, mission, and values which would support more significant organizational learning.

Styles. To ensure a transparent and open organization, the program director and department leaders allow for creative decision making and entrepreneurial ideas and will hold cross-team meetings. Leadership within the organization are consistently open, present, and supportive to all team members to ensure diversity, equity, and inclusion is a top priority. To maintain the team based structural organization, monthly potlucks, birthday celebrations, and gatherings with the team and stakeholders are organized to highlight successes and areas for growth within each department and to solicit ideas from stakeholder groups in a less formal atmosphere.

Shared Values. Within each department, the department leaders will ensure the mission, vision and values are the foundation of the work being performed through continuous reference to them in weekly meetings, emails, newsletters, and public messaging to the community and stakeholder groups.

Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

<p>SWOT Analysis for an Education Program- “The Pieces Add Up- Marine Debris Outreach and Education Program in Volusia County, Florida”</p>	<p>Opportunities:</p> <ol style="list-style-type: none"> 1. Growing trend to protect the oceans 2. Community environmental education events sponsored around the county throughout the year 3. Presence on the beaches year-round to educate the public 4. Future ordinances and regulations on individual use plastics 5. Lack of implementation of marine debris education programs at the county level 	<p>Threats:</p> <ol style="list-style-type: none"> 1. Competitors better equipped to implement similar marine debris education programs 2. Lack of interest within the non-coastal communities 3. Lack of support from communities driven by cultural differences and socio-economic backgrounds. 4. High influx of unaware tourists within Volusia County 5. Lack of support from local K-12 educational facilities and environmental non-profit programs
<p>Strengths:</p> <ol style="list-style-type: none"> 1. Network of high-quality citizen scientists conducting data collection 2. High quality educators that conduct stewardship activities and conservation education 3. Partnerships with existing projects and suitable partners 4. Community interest in the protection of the sea turtle species 	<p>Domination Strategies:</p> <ul style="list-style-type: none"> • Utilize county partnerships and growing trends to protect the oceans to increase marine debris education program implementation within the community • Use data analysis to create recommendations for future local legislation for individual use plastics • Citizen scientists, educators, and scientists will always be in contact with the local community aiding in the development of rapport to increase awareness and support for marine debris reduction 	<p>Confrontation Strategies:</p> <ul style="list-style-type: none"> • Use well-trained and enthusiastic volunteers to implement educational programs • Build partnerships with local nonprofit and for-profit organizations • Analyze competitor’s programs to help identify areas for improvement • Develop a mentorship program to reach new audiences in non-coastal communities and communities of socio-economic and cultural differences
<p>Weaknesses:</p> <ol style="list-style-type: none"> 1. Lack of awareness of marine debris impacts 2. Lack of an electronic database that tracks marine debris impacts 3. Budgetary restrictions for educational material and programming 4. Potential lack of support due to county laws and ordinances that may develop from local findings with marine debris impacts 5. Lack of communication and training to those facilitating the educational programs 	<p>Mitigation Strategies:</p> <ul style="list-style-type: none"> • Develop a county level marine debris educational program • Direct communications to educators, community members, researchers, tourists, and advocacy groups to recruit for involvement in this program. • Utilize growing trends to expand resources and funding for this program 	<p>Minimization Strategies:</p> <ul style="list-style-type: none"> • Increase diversity of the educational team to better support the served communities • Utilize competitors program structure to aid in the development of a data collection system locally. • Equip educational facilities and environmental centers with curriculum and trainings to encourage them to implement these educational programs at their sites without expending too many of our resources

Figure 4. Strengths, Weaknesses, Opportunities, and Threats (SWOT) Analysis

Focus Strategy


Focus Strategy	Probability	Impact	Type	Cost
Increase marine debris education program implementation by utilizing county partnerships and growing trends to protect the oceans.	High	Medium	OC	\$
Develop a mentorship program to reach new audiences in non-coastal communities and communities of socio-economic and cultural differences	Medium	Medium	OC	\$\$
Spread awareness, facilitate, and educate about local marine debris impacts by utilizing local data to guide community involvement.	Medium	Medium	OC	\$\$
Increase the diversity of our educational volunteers to reach a larger range of communities and take a more hands off approach to save funds, but still spread awareness of marine debris.	Medium	Low	OC	\$


Key to abbreviations- OC; Opportunity Costs; \$=Low Cost; \$\$=Moderate Cost

Figure 5. Key focus strategies explaining probability, impact, and costs

Domination Strategies: Strengths and Opportunities

Strategy Recommendation: Increase marine debris education program implementation by utilizing county partnerships and growing trends to protect the oceans.

 The Pieces Add Up- Marine Debris Outreach and Education Program would take advantage of the opportunities of growing trends to protect the oceans by having citizen scientists that are also involved members of their communities to encourage local legislation in Volusia County.

 **Probability:** High- the county and nonprofits operating within the county are already interested in educating the community about the dangers of marine debris.

Impact: Moderately impacts the centralized education programs that would allow county partnerships to maximize on the amount of people being educated on marine debris impacts and potential legislative support.


Opportunity: Builds on the preexisting stewardship and educational programs in place within the county.

Cost: Cost is low to medium; however, there could be opportunity costs in losing personal connections due to staff operating at high capacity.

Implementation: This is a viable option for this program as it would increase volunteer outreach events to grow the stewardship team. It would also increase relationships with county council members to educate them about the needs for legislation for marine debris related issues, such as banning individual use plastics within the county.

Confrontation Strategies: Strengths and Threats

Strategy Recommendation: Develop a mentorship program to reach new audiences in non-coastal communities and communities of socio-economic and cultural differences

 The Pieces Add Up- Marine Debris Outreach and Education Program could take advantage of the opportunities to take more time with different non-profits and programs to tailor to their needs to implement these educational marine debris programs.

Probability: Medium- there may need to be more time spent with one stakeholder over another

Impact: Moderately impacts the overall level of engagement from stakeholders


Opportunity: Stakeholders will have a more personalized approach to implementing these programs and sense of ownership of the educational materials and strategy.

Cost: Cost is medium to high due to travel expenses and overall time spent with each stakeholder group.

Implementation: This is a viable and important option for this program. This would allow stakeholders to take a more personal approach to issues with marine debris, increase tourist knowledge, increase rapport with various programs within the county and increase awareness in non-coastal communities and communities driven by cultural differences and socio-economic backgrounds. A leader for the mentorship program would need to be named to facilitate trainings to outline program expectations, along with coordinating mentee participants in the program.

Mitigation Strategies: Weaknesses and Opportunities

Strategy Recommendation: Spread awareness, facilitate, and educate about local marine debris impacts by utilizing local data to guide community involvement.

 We would be able to take advantage of the opportunities of more involvement in the community due to laws and ordinances backing the efforts of reducing single use plastics in the community.

Probability: Medium- lack of support for the implementation of laws and ordinances to be initially created and passed

Impact: Moderately empower Volusia County Government Advisory Board to pass legislation relating to marine debris reduction and incentivize the local community to act.


Opportunity: To create marine debris educational programs based on Volusia County specific data to inspire community involvement and utilize laws and ordinances to recruit volunteers and increase the inventory of educational materials.


Cost: Cost is medium to high due to time and resources spent on the database setup and analysis of the data, recruitment at community events, and creating educational materials.

Implementation: This is a viable option for this program due to the high presence of volunteers from non-profit organizations advocating for similar goals within Volusia County. A coordinator for the database process, an actual database structure created and volunteers to input the data would be needed.

Minimization Strategies: Weaknesses and Threats

Strategy Recommendation: Increase the diversity of our educational volunteers to reach a larger range of communities and take a more hands off approach to save funds, but still spread awareness of marine debris.

 Based on survey data, the non-coastal communities, tourists, and communities driven by cultural differences and socioeconomic backgrounds have limited knowledge about marine debris impacts and this program would be able diversify the educational volunteers to meet the needs of these subgroups.

 This program could supply the educational curriculum and trainings to the facilities and groups to allow flexibility of structure of implementation and delivery of our message about marine debris, thus taking the burden of continuous production of materials off our program.

Probability: Medium- lack of interest from diverse groups of individuals to serve as volunteers with this program.

Impact: Low or moderate increase of diversity among the volunteer group for this program.

Opportunity: The communities being served will react positively to the diversity shown in the volunteer groups. This will increase the involvement in the program and its implementation

across the county and not just in the prime coastal communities that are currently being served with this type of information.

Cost: Cost is low as the volunteers will be the ones teaching and training the facilities wishing to implement these educational programming. There would be a minor cost of travel to these communities and initial creation of the educational materials, but these costs could be covered by fundraising and grants if they become too high.

Action Plan

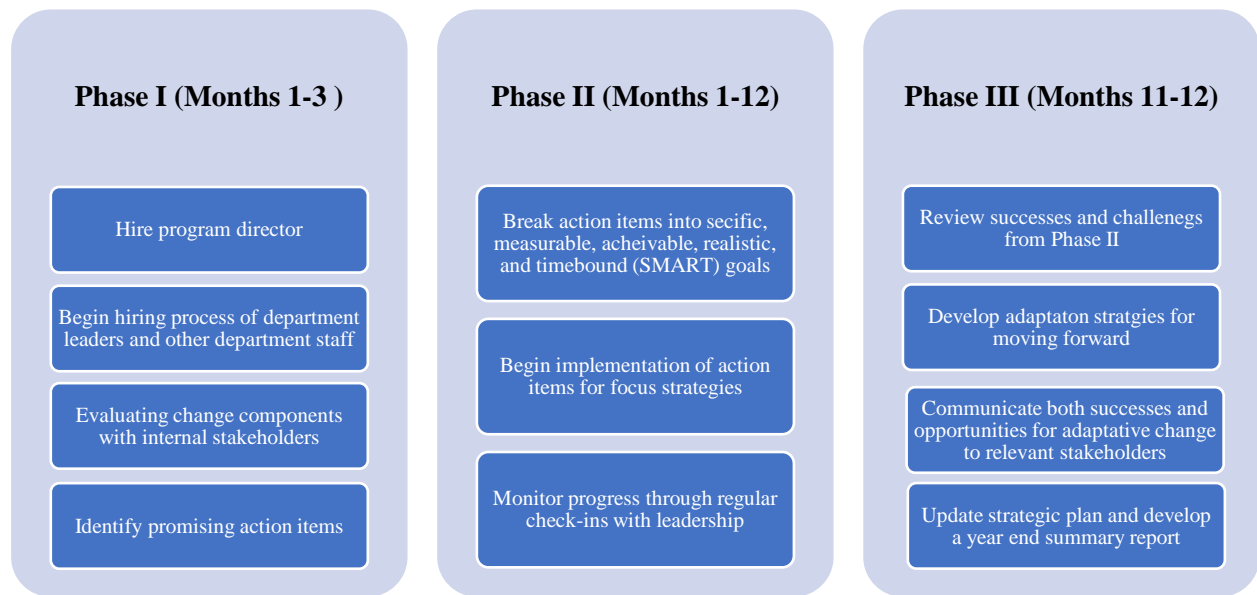


Figure 6. Action Plan for implementing the focus strategies outlined in Figure 5

The action plan for implementing the focus strategies for this program is laid out over a one-year timeframe (see Figure 6). This process will shift into a more cyclical year by year pattern after the establishment of the roles and the program at large.

Phase I. The program director will develop a hiring process that meets the diversity, equity, and inclusion goals of the program. The leadership group will collaborate on the development of action items and responsibilities to meet the outlined needs of each of the focus strategies. The leadership team will commit to working towards these action actions over the course of the year.

Phase II. The department leaders will divide the action items into smaller parts that meet the SMART goal criteria outlined in Figure 7. Responsible parties will begin implementation of the

action items and periodically discuss progress made on each item or challenges experiences that need addressing.

Phase III. In December, at the close of the year, successes, and challenges of the focus strategies from Phase II will be discussed. The leadership team will develop adaptation strategies for the following year to address any shortcomings and to redefine goals and change any action items. From this analysis, the program director will develop a summary report and will update the strategic plan, as needed.

Communications Plan

Stakeholder	Message	Purpose	Means/Frequency	Evaluation
Local Community Members	This program provides opportunities for engagement to learn about how marine debris impacts the oceans, specifically sea turtle species	Increase community awareness of the issues; recruit community members who want to be involved and engaged	Monthly social media posts through partnership organization pages; presentations at events held around the county monthly and yearly; informational emails sent out quarterly	The number of inquiries from the local community for more information or for ways to become involved.
General Audience	This program is committed to facilitating and communicating the importance of marine debris reduction in efforts to help protect the ocean and sea turtle species.	Generate awareness of the environmental efforts in place and needed to reduce marine debris presence.	Bi-monthly social media posts featuring environmental imagery and story about a sea turtle impacted by marine debris; include a relevant testimonial from those involved in the program in a quarterly newsletter that will be emailed out to our mailing list and contact lists from our partnerships	The number or views and comments on social media; the number of inquiries received after the email, social media post and newsletter distribution.
Potential Interns and Volunteers	We want you to have a space to share your passion, expand your learning, and make waves of change for the environment.	Recruit enthusiastic and knowledgeable stakeholders to serve as liaisons for this program.	Social media blasts during the end of semester and before the start of sea turtle season in May; outreach events to local high schools and universities; attend local events to recruit interested people.	The number of target area individuals that apply for positions with this program.
Project Partners (Schools, NGO's, Government)	This program will help to advance your knowledge of marine debris impacts and how to play a part in the growing trend to help save the ocean	Build mutually beneficial partnerships with a growing and diverse list of local non-profit environmental organizations, government legislatures, and educational facilities	Create a partner-specific list serv for contacts to expand the presence of this educational program locally; facilitate an annual partner meeting to increase networking; create a Q&A section on website for easy access; monthly social media blasts	Number of organizations and facilities that implement the educational programs created from this program; attendance at the annual partner meeting; likes and interaction on the social media posts

Figure 7. Communications plan for “The Pieces Add Up”: Marine Debris Outreach and Education Program

Communications for Change Plan

Since this program has not been developed yet I will outline what needs to be created and by whom to jumpstart this program:

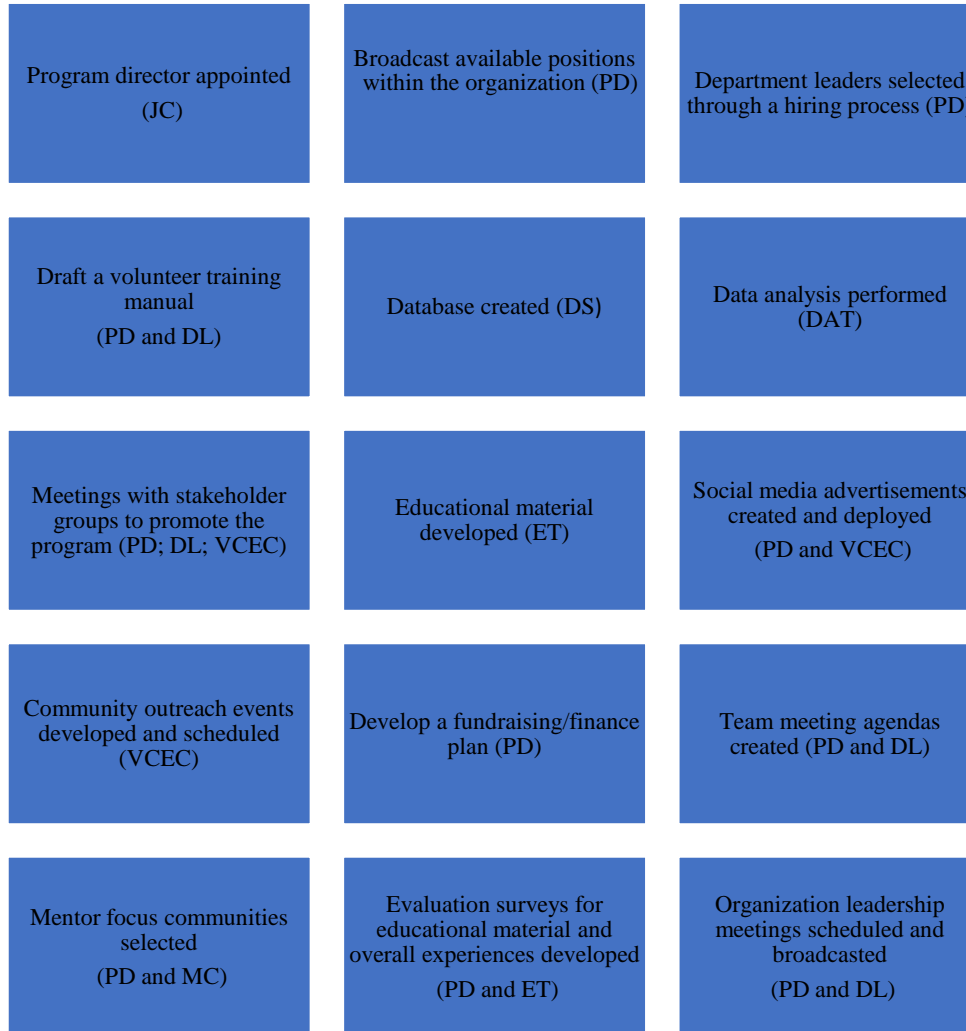


Figure 8. Items to be completed and by whom to jumpstart this organization

Key for Figure 4: PD= Program Director; DL=Department Leaders; DS=Data Specialist; DAT= Data Analysis Team; ET= Education Team; VCEC= Volunteer and Community Engagement Coordinator; MC= Mentor Coordinator; JC= Jennifer Cherry-founder of the organization

By examining internal strengths and weaknesses and comparing them with external threats and opportunities, a series of considered strategies can be developed. Based on the considered SWOT, several focus strategies are determined to meet the goals for this program.

Measuring and Adapting

Goal	Measurement	Achievement Standard	Stakeholders	Corrective Adaptation
Leadership is aware of program developments	Monthly program updates and quarterly reports distributed to the leadership team	Department leader reports quarterly provided to the program manager	Program Director and Department Leaders	Consider changing the frequency and or the method of the communication
Develop effective educational materials	Survey based evaluation method created for pre and post use with the education materials	Increase of knowledge of the issues with marine debris based on the survey information	Education Department; Participants in the educational programming	Consider improving the effectiveness of the educational materials based on survey results and feedback
Develop an effective finance/fundraising plan for program funding	There is a finance/fundraising plan in place that will be overseen by the program director	Funds available to ensure that each department can achieve their goals that are aligned with the vision, mission, and values of the program	Program Director and Department Leaders	Use other nonprofit finance and fundraising plans as a model to improve any shortcomings
Growth of community engagement and volunteer involvement	Recruitment and training of volunteers using the volunteer manual and advertisement of community need	Increase in the amount of community involvement and volunteers	Program Director Department Leaders Community Members	Review and improve volunteer training manual and recruitment process for community involvement and volunteers
The development of the team supports the program and uses individual passion and skill sets.	Weekly check-ins with the program team, bi-weekly requests for additional resources	Team members evaluate their needs and request things that will all their passions and individual skills to increase to meet the goals of the program	Department Leaders Program Director Team Members	Seek out team members that have relevant skills that can assist with growth of other team members. Communicate with team members to see where they have interests in the program and where they wish to grow in their skills
Mission, vision, and values are incorporated on onboarding process of team members and implemented daily throughout the program	Regular reference to the mission, visions, and values	Vision, mission, and values statement are incorporated in the team environment and deliverables	Program Director Department Leaders	Review the vision, mission and values as needed with the departments to increase their presence in the organization
Feedback mechanism developed for an annual review	Development of annual evaluation tools for self, program, and organization	Open conversations about the feedback from the evaluations within the departments and organization. Results are available to all stakeholders in the organization	Program Director Department Leaders	Evaluate the engagement of the team members and consider changing scope and frequency as needed

Figure 9. Plan for Implementing, Measuring, and Adapting Organizational Change SMART Goals

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