Introduction

Program Description: Mineral extraction may have an affect on the migration patterns and movements of the giant oceanic manta ray or other elasmobranch species like whale sharks patterns. Georgia Aquarium and the Bureau of Ocean Energy Management have partnered together to study the movements of the giant oceanic manta ray in conjunction with acoustic telemetry technology to determine habitat patterns.

Essential Question(s)

- How do manta rays use their habitat?
- How do human activities affect animals' ability to use their habitat?

Georgia Standards of Excellence:

- **SS3G2** Locate and describe the equator, prime meridian, and lines of latitude and longitude on a globe.

- **MGSE3.MD.4** Generate measurement data by measuring lengths using rulers marked with halves and fourths of an inch. Show the data by making a line plot, where the horizontal scale is marked off in appropriate units— whole numbers, halves, or quarters.

Background

Manta Rays Background:

Manta rays are a large species of fish found in oceans all around the world. There are two species; the giant oceanic manta ray and the reef manta ray. Both are migratory species which means they travel all over the ocean. These animals are recognizable by their giant wing-like pectoral fins and the two almost horn like structures found at the front of their head. These "horns" are called cephalic lobes.

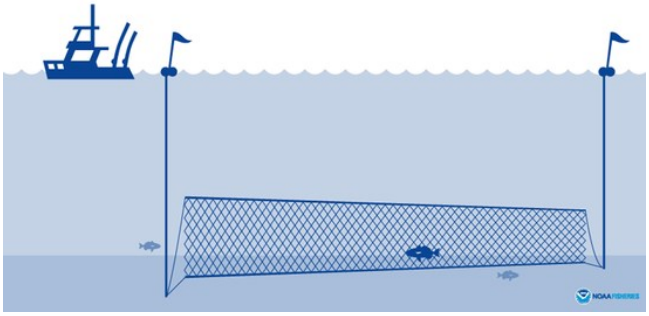
One major defining feature between the reef manta and the giant manta is the difference in size. The giant manta can reach a wing span of 29 feet while the reef manta has a wing span of about 11 feet. Both species of manta rays are black in color with white and grey coloration that can form distinct unique patterns which can be used to tell individuals apart, similar to human finger prints.

Manta rays are filter feeders, meaning they will open their mouths wide, and strain any food out of the water. They feed on a variety of animals like plankton, shrimp, and small fish. Mantas use their cephalic lobes on the front of their face to funnel food into their mouths. While feeding, mantas will exhibit different behaviors . They will form feeding chains and have often been seen performing barrel rolls and diving anywhere from 200 to 450 feet. Mantas may also aggregate in shallow waters that are about 10 feet deep.

Background

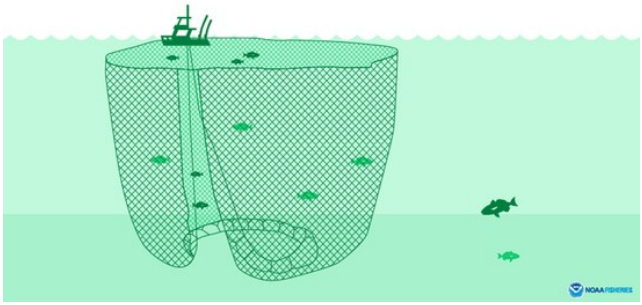
Manta Rays Background cont.:

Manta rays are currently listed as threatened by the IUCN Red List. Part of the reason for that is their low rates of reproduction. Mantas are only able to have 1 pup every 2 or 3 years. Another reason mantas are listed as threatened is bycatch. Bycatch occurs when fishermen catch unintended species that they do not want to sell or cannot keep. Bycatch isn't limited to mantas, sea turtles and sea birds are also known bycatch animals. Mantas may become bycatch through gillnets and purse seine nets fishing techniques. Gillnets are a wall of netting typically anchored or fixed to the substrate, the main goal is for desired fish species to become entangled in the nets. Purse seine nets creates an encircling mesh around an area. When the fishermen are ready, they will pull the lead line closing the net from the bottom and then haul the whole net up. Mantas can also be hunted for their gills and gill rakers which are sold in some markets. Lastly, mantas may be struck by boats, effected by pollution, and entangled in abandoned fishing lines.



Gillnet image from NOAA Fisheries

https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-gillnets



Purse-Sine image from NOAA Fisheries

https://www.fisheries.noaa.gov/national/bycatch/fishing-gear-purse-seines

BOEM Background:

The Bureau of Ocean Energy Management (BOEM) is a government agency tasked with managing resources of the outer continental shelf in a way that is environmentally and economically responsible. Their mission states " The Mission of the Bureau of Ocean Energy Management is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way. " BOEM believes in protecting the environment they gather resources from and using science to making informed decisions.

Background

BOEM Background cont.:

BOEM was formed in October of 2011 after the US Minerals Management Service, an agency of the US Department of the Interior, was split into three separate entities; Bureau of Ocean Energy Management, The Office of Natural Resources Revenue, and the Bureau of Safety and Environmental Enforcement. The creation of separate groups permits for more dedicated resources, responsibilities and management for each specific role.

BOEM created a program called the marine mineral program (MMP), which "addresses serious erosion along the Nation's coastal beaches, dunes, barrier islands, and wetlands. Erosion affects natural resources, energy, defense, public infrastructure, and tourism. To help address this problem, the MMP leases sand, gravel and/or shell resources from federal waters on the Outer Continental Shelf (OCS) for shore protection, beach nourishment, and wetlands restoration with vigorous safety and environmental oversight."

One location they work with is off the Atlantic coast of Florida. The MMP requires dredging, which essentially scoops up sand, but before they can do that they practice preventative trawling to help remove endangered sea turtles that may be in the area.

BOEM enlisted Georgia Aquarium's help through a partnership, studying the potential overlap between the activities of manta rays and the activities of BOEM. The goal is to better understand the activities of the manta rays to decrease the chances of interaction between the mantas and the dredging and trawling activities of BOEM. To do this, Georgia Aquarium and BOEM conducted field work in Port Canaveral to apply tags and collect biological samples.

The teams used three types of tags: a satellite tag, an acoustic tag, and an inertial measurement unit. These tags will allow the teams to continually track the paths of the manta rays to establish a better understanding of the migratory patterns of these animals. With this information, BOEM can then make informed policy decisions in regard to their dredging and trawling activities to mitigate any potential interactions with Manta rays that could impact their survival.

*Check out our video on YouTube: https://youtu.be/3tmkvSg8YmA

Background

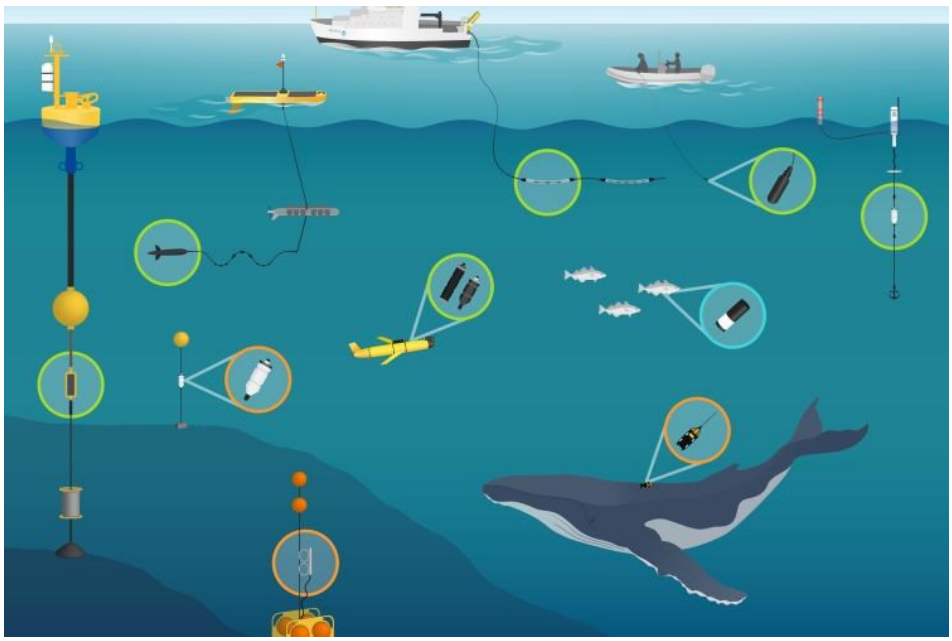
Acoustics Tags:

There are many different types of acoustic receivers that might be used to track or study animals. Receivers are either stationary, move independently, or can be attached to boats. Station receivers, most likely used in Figure 1. could include:

- Bottom-mounted mooring, anchored to the sea floor and collected every several months or years to gather the data.
- Moored surface buoy, also anchored to the sea floor, but float at the surface so data can be transmitted to satellites for faster collection.
- Drifting buoys, are not truly stationary, but move slowly with the local currents. Data can be transmitted to satellites.

Animals, like manta rays, will have tags either implanted or attached to them. Once the animal gets close to the acoustic receiver, the information about this individual and its location will be collected.

The National Oceanic and Atmospheric Administration (NOAA) and BOEM will use other types of acoustic monitoring to better understand animals present in an area. BOEM deployed gliders, the yellow looking rocket in the image below, in Cape Canaveral, FL to better understand the animals present and potential impacts dredging will have on the area.



NOAA Fisheries, *Passive Acoustic Technologies*, n.d., https://www.fisheries.noaa.gov/new-england-mid-atlantic/science-data/passive-acoustic-technologies#acoustics-tags

Lesson Plan

Classroom Activity

Key Vocabulary

- Dredging
- Trawling
- BOEM
- Satellite Tags
- Filter Feeding
- Latitude
- Longitude

Materials

- Figure 1. Acoustic Arrays
- Figure 2. Survey Sightings
- Sharpies/ Makers
- Rulers

Lesson Procedure

- Cover the manta ray and BOEM background information with students.
- Distribute the figure 1 and figure 2 to the students.
- Have students use a ruler to draw longitude and latitude lines on the sheets.
  - Figure 1 has latitude 28°25N to 28°35N, while figure 2 only shows 28°N and 29°N.
- Using the ruler, on figure 2. have students measure the distance between 28°N and 29°N. Divide that measurement by 2 and draw a line across. Label the line as 28°5N. *Answer on 8"x11" paper ~14 inches, line drawn ~7 inches.*
- Then, on figure 2., measure the distance between 28°5N and 28°N , divide the distance in half and draw a line across. Label this new line 28°25N. *Answer ~7 inches, line drawn ~3.5 inches.*
- Have students count the number of manta rays from figure 2 that the acoustic array would pick up. *Answer: ~25*
  - Students should be counting the dots in two blocks, between latitudes 28° 25N and 28°5N and between longitudes 80°40W and 80°20W.
  - Refer to example of figure 2 with lines for final product.
- Discuss the acoustic tags background information with students highlighting how these manta rays could be tracked through sound with acoustic tags.

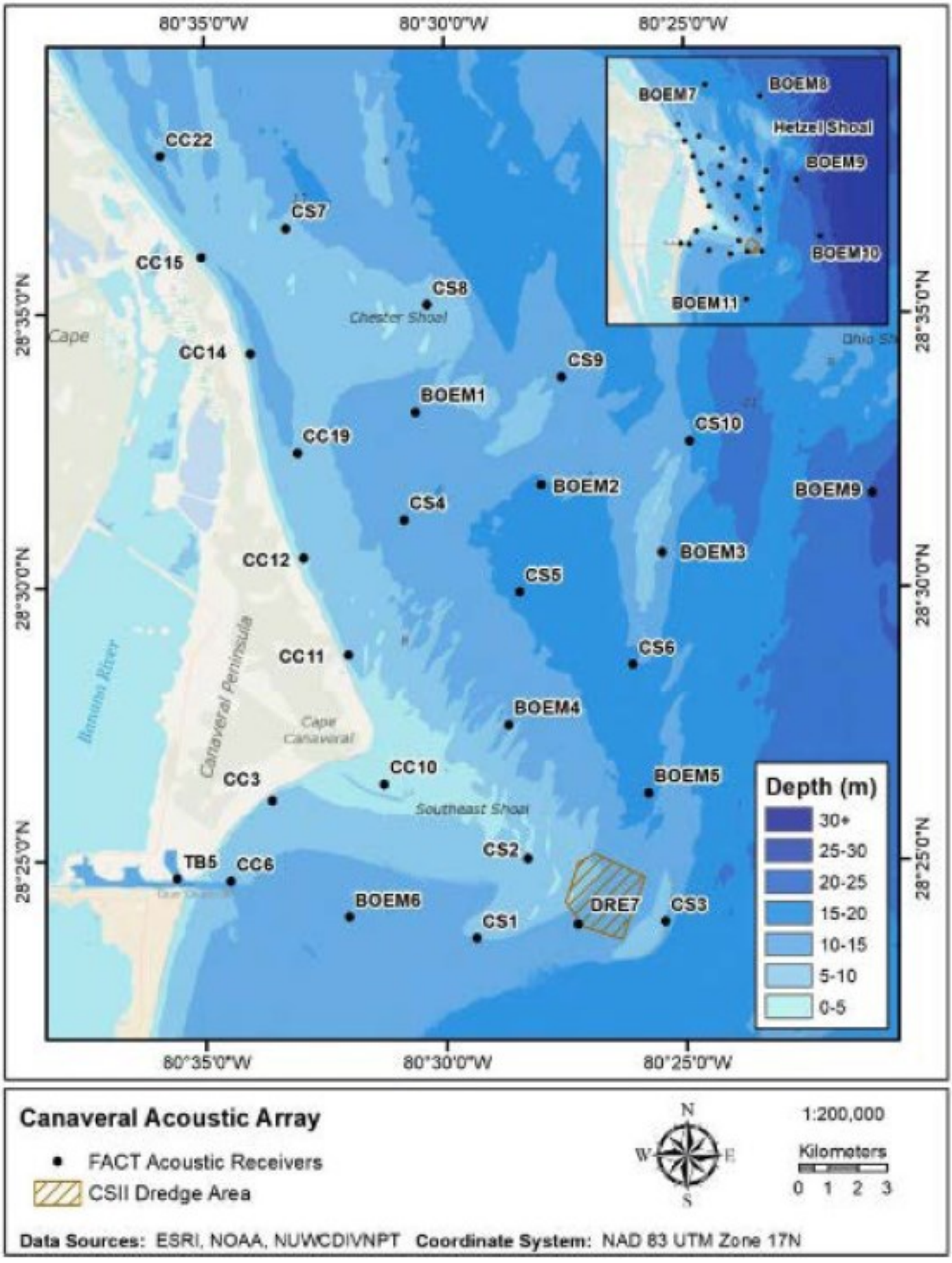


Figure 1. Acoustic Arrays around Cape Canaveral, FL

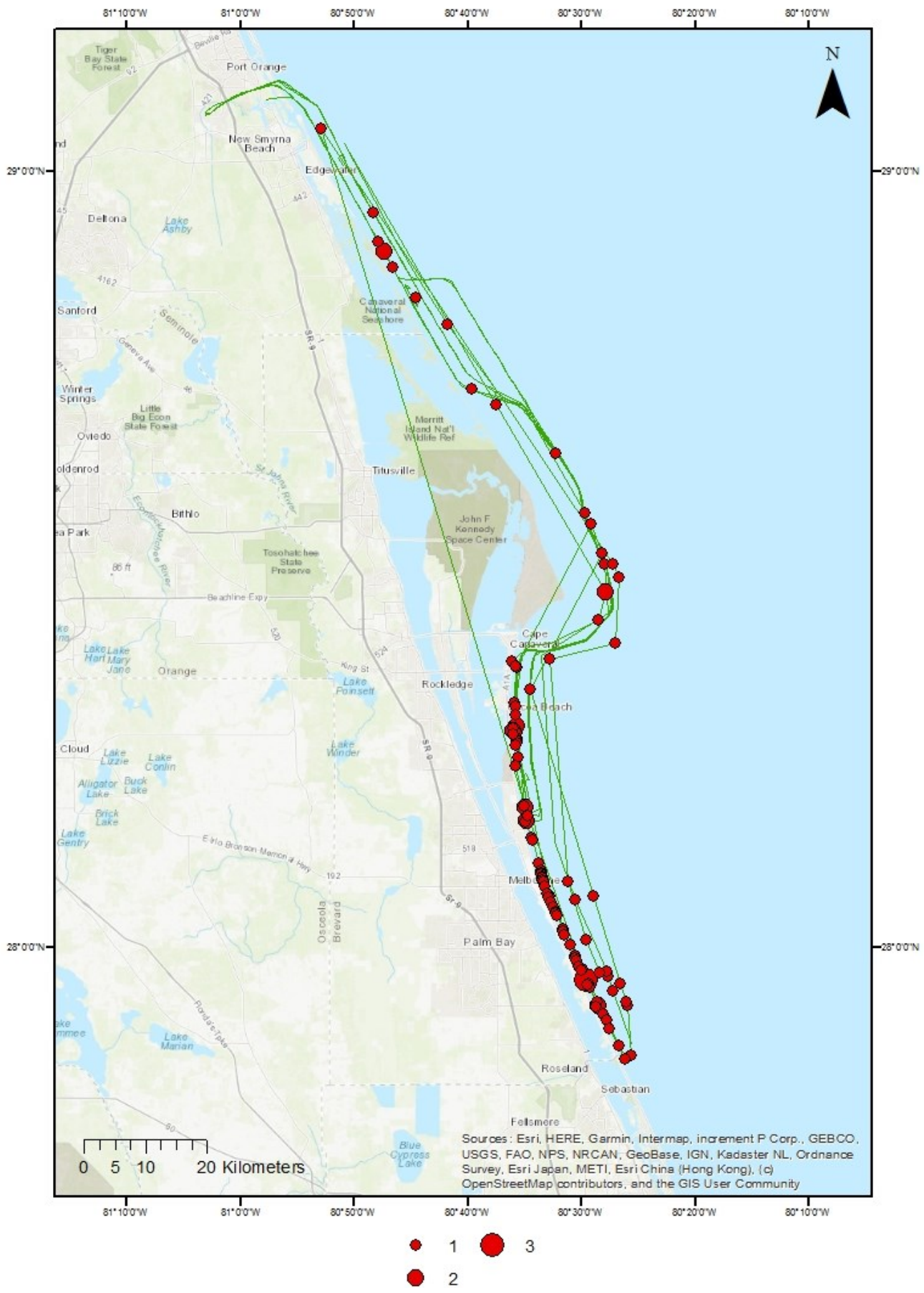


Figure 2. Survey Sightings along Florida Coast

All 2021 Manta Survey Sightings Example

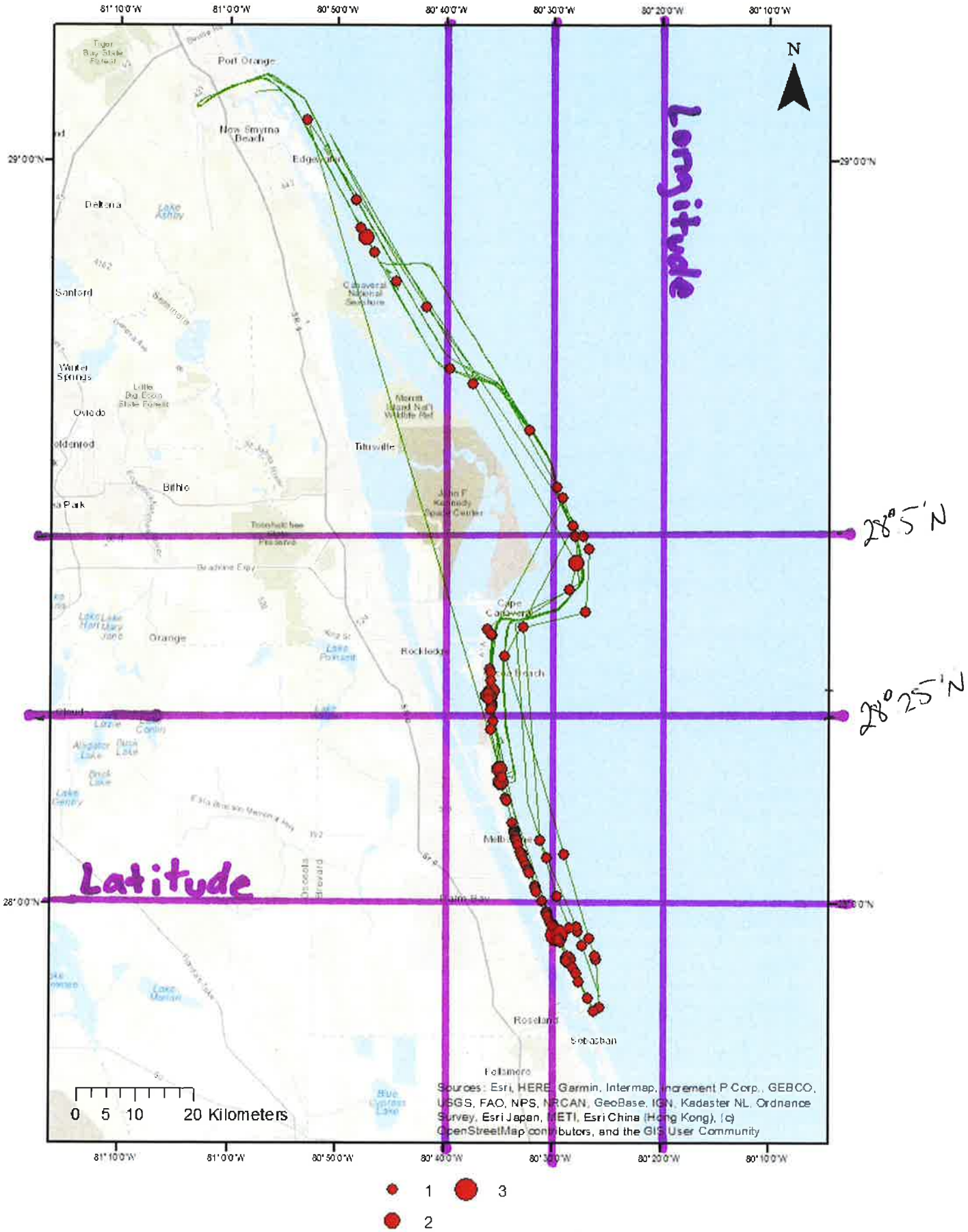
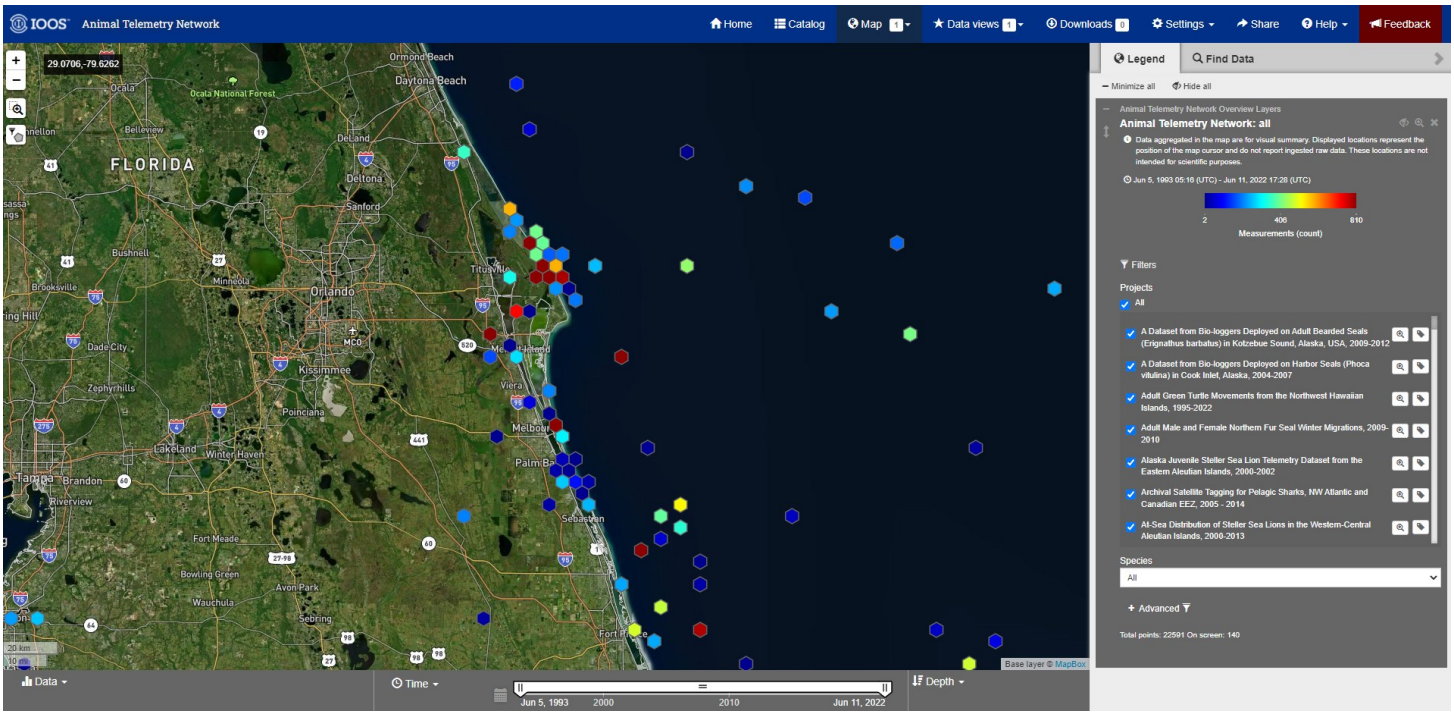


Figure 2. Survey Sightings along Florida Coast

Example

Extend the Lesson

- Have students use the "Animal Telemetry Network Data Portal" created by Integrated Ocean Observing System to research additional animals present in the Cape Canaveral, FL region.
    - Visit: https://portal.atn.ioos.us/#
    - Select "All Tag Deployments" on the left side of the screen. *Note it may take a moment to load*.
    - Extend the time scale on the bottom of the screen to take up the whole time and zoom in on the Cape Canaveral, FL region on the map, screen shot provided below.



    - Hover over or select a hexagon to see the animal species and quantity.
- Students may dive deeper into satellite tagging and tracking animals, using any or all of the below helpful sites.
    - https://www.mantatrust.org/tagging-and-tracking/#types-of-tags
    - https://www.fisheries.noaa.gov/feature-story/satellite-tags-reveal-how-animals-see-ocean
    - https://nationalzoo.si.edu/migratory-birds/what-satellite-telemetry
    - https://fishbio.com/technology/acoustic-tags/

Word Search

M	J	I	P	O	L	K	N	B	H	Y	T	R	F	G
E	U	T	U	A	B	O	V	Y	S	C	X	E	J	S
S	E	B	Y	C	A	T	C	H	N	R	T	A	U	M
A	M	J	K	W	N	L	D	N	I	F	G	K	S	A
Q	W	B	Z	C	I	P	A	O	O	S	P	H	A	N
U	D	M	F	S	A	T	I	G	I	L	L	N	E	T
Q	B	S	W	U	E	I	N	D	T	V	C	W	Q	A
L	N	T	A	P	R	F	N	M	B	N	B	U	N	R
Y	Z	P	G	N	B	S	P	K	A	P	O	P	O	A
Q	C	B	I	N	M	A	L	L	D	A	E	Z	T	Y
M	I	Q	E	A	J	L	O	E	P	D	M	Q	K	X
I	N	B	E	C	Z	M	R	Y	H	R	T	P	N	Y
P	U	R	S	E	S	E	I	N	E	L	B	U	A	E
T	H	I	Q	C	B	M	Z	Y	L	A	L	I	L	S
T	G	J	F	I	L	T	E	R	F	E	E	D	P	H

Word Bank

BOEM

PURSE SEINE

MANTA RAY

GILLNET

THREATENED

FILTER FEED

BYCATCH

PLANKTON

Fun Activity KEY

EDUCATION
GEORGIA AQUARIUM

Word Search KEY

M	J	I	P	O	L	K	N	B	H	Y	T	R	F	G
E	U	T	U	A	B	O	V	Y	S	C	X	E	J	S
S	E	B	Y	C	A	T	C	H	N	R	T	A	U	M
A	M	J	K	W	N	L	N	N	I	F	G	K	S	A
Q	W	B	Z	C	I	O	A	O	O	S	P	H	A	N
U	D	M	F	S	T	T	I	G	I	L	L	N	E	T
Q	B	S	W	K	E	H	N	D	T	V	C	W	Q	A
L	N	T	N	P	R	F	R	M	B	N	B	U	N	R
Y	Z	A	G	N	B	S	P	E	A	P	O	P	C	A
Q	L	B	I	N	M	A	L	L	A	A	E	Z	T	Y
P	I	Q	E	G	J	L	O	E	P	T	M	Q	K	X
I	N	B	E	C	Z	M	R	Y	H	R	E	P	T	Y
P	U	R	S	E	S	E	I	N	E	L	B	N	A	E
T	H	I	Q	C	B	M	Z	Y	L	A	L	I	E	S
T	G	J	F	I	L	T	E	R	F	E	E	D	P	D

Word Bank

BOEM

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MANTA RAY

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THREATENED

FILTER FEED

BYCATCH

PLANKTON

References

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