Mapping Mangroves

Activity Information

Grade Level

6-8

Time Required

45 minutes

Topic

Monitoring Data

Weather and Climate

Ecosystem Interactions and Dependencies

Data Activities

Climate Extension

Estuary Concept

Research on habitats and species ranges, coupled with long-term monitoring, can give clues to why estuary habitats change over time.

Learning Objectives

- Students will interpret maps showing the range of mangrove habitat and salt marshes in several estuaries over several decades.
- Correlate severe winter weather events with mangrove habitat contraction.
- Predict likely response of mangroves to climate change.

Overview

In this activity, students explore long-term data to recognize changes over time to an estuary habitat. Students will also make predictions about mangroves response to climate change.

Teacher Background

In Texas and Louisiana, black mangroves are small, salt-tolerant trees that live in shallow, brackish estuarine waters. They can grow in dense forests where their tangled aerial roots help to slow the movement of tidal waters, stabilize the coastline, and create shelter for numerous other marine life.

Scientists at the Mission-Aransas National Estuarine Research Reserve (MA NERR) in Texas and their colleagues elsewhere have been studying the expansion and contraction of black mangrove

habitat for many years. They have been trying to determine what causes mangrove ranges to increase (expand) or shrink (contract).

Photo credit: Carolyn Joyce

Research has shown that the range of black mangroves is limited by extreme freeze events. Mangroves cannot survive long periods of freezing temperatures. The real extent of mangrove habitat expands during times when the winter weather is warmer and contracts after winters when temperatures drop below freezing for extended periods of time. For example, in December of 1983 the temperature in the MA NERR dropped below freezing for several straight days, reducing mangrove coverage by 95%. Black mangrove trees were severely damaged by this freeze and the overall area covered by mangroves contracted. Severe freeze events in December 1989 contributed to mangrove range contraction in the early 1990s.

Because of their sensitivity to weather, black mangroves may be a good indicator species for climate change. Some scientists think that, in recent years, the area of mangroves is expanding as increasing temperature causes a northern shift in the distribution of both black and red mangroves.

Teacher Preparation

1. Read the Teacher Background above in addition, to the introduction of the Student Master: Mapping Mangroves.

2. Make copies of Student Master: Mapping Mangroves (including blank map of Harbor Island, TX, four maps of mangrove habitat coverage in different years, and the winter severity bar chart) for each student or student pair.

3. The four Harbor Island, TX maps can also be put on transparencies and placed one on top of the other to measure change over time.

4. To save paper, you may choose to do the exercise as a whole-class activity. Consider showing the entire class the maps and filling out the table together, then providing students or student pairs with the winter severity bar chart and allowing students to find the correlation between severe weather and mangrove habitat contraction.

Procedure or Activity Steps

1. Have students learn about black mangroves and mangrove habitat by reading the introduction to this activity. Additional student background on mangroves, specifically black mangroves will further support their data interpretations and predictions.

2. Students will first study the four mangrove range maps for the Harbor Island area. The maps can be used to see changes in the area covered by mangroves over time. Using this information, students will fill out the appropriate columns of the data table on the Student Master.

3. Based on the data and the maps, students will answer the first question, in which they are asked to guess why the mangrove range expanded and contracted when it did. Remind students of the mangrove's tolerances for salinity, temperature, and water depth.

4. Next, students will look at a bar chart showing freezing events at Harbor Island from 1950 through 2004. You may want to examine this chart with your students and make sure that they are interpreting it correctly. There are two different sets of data being displayed for each winter. The first set shows the maximum number of consecutive days when the minimum air temperature fell below freezing.

   Remember, mangroves do not tolerate long periods of freezing. However, at Harbor Island during the winter, it can be freezing at night and then quite warm the next day. These "short" freezes may not have the same negative impact on the mangrove as a long freeze. The second set of data shows the number of consecutive days when the maximum air temperature was also below freezing. Not every winter has this second set of data but, where that data exists, it means that temperatures were below freezing, both night and day, for several days straight. It is that sort of "hard" freezing event that can harm the mangroves and cause the mangrove habitat to contract.

5. Students are then asked to answer the remaining Climate Extension questions. Possible responses to all the questions are shown below.

Materials Needed

- Teacher Master: Mapping Mangroves

Per student or student pair

• Copy of Student Master: Mapping Mangroves (including blank map of Harbor Island, four maps of mangrove coverage in different years, and winter severity bar chart)

• Markers/colored pencils

Teacher Master

Mapping Mangroves

Data

During the time period…….	Did the mangrove coverage expand or contract
1930 to 1979	Expand
1979 to 1995	Contract
1995 to 2004	Expand

1) Based on what you have learned about the black mangrove's tolerances and adaptations, what do you think could have caused the habitat to contract or expand?

   Potential Answer: *Something happened/conditions changed between 1979 and 1995 to cause the mangroves to contract. It could be weather (freeze event), increased water depth or change in salinity (decrease; too fresh.) Possible events could include a major flooding and input of freshwater. Major freeze event.*

   Between 1995 and 2004 the conditions changed again, to allow mangroves to expand. Temperatures could have warmed (no extended freezes), salinity increased (less freshwater input or flow into estuary/bay due to increased rain.)

2) Gather additional data from the Winter Severity bar chart. With this additional information, how would you revise your original explanation for why the black mangrove expanded or contracted on Harbor Island, TX between 1930 and 2004?

   Potential Answer: *Notice that there are major freezing events in the winter of 1950-1951 and 1961-1962, as well 1983-1983 and 1989-1990. One might assume these events would have damaged or killed mangrove trees resulting in a contraction of coverage. Between 1930 and 1979, there wasn't a contraction. Maybe there was enough time for trees to recover from damage, or long enough period of time between events for trees to recover. Maybe the freeze event wasn't too far below zero, so a "warmer" freeze event. Between 1979 and 1995 the mangrove did retract. Maybe the freeze event damaged or killed more trees, or there was less recovery time between the two freeze events. Maybe the freeze event was much "colder" with temperatures well below freezing. There may have been additional factors that caused mangroves to retract, such as high salinity or higher water levels.*

Climate Extension

3) Based on the patterns of change you observed in the historical maps of black mangrove coverage and winter temperature records on Harbor Island, TX, as well as what scientists

believe our future climate conditions will be, make a prediction of mangrove coverage for the year 2030. Use a blank map of Harbor Island to shade in your predicted coverage. Explain your reasoning for the predicted coverage.

Potential Answer: *As temperatures increase, there will be fewer and fewer freeze events (especially those lasting a few days.) These temperature conditions favor mangrove expansion. Additionally, with warmer temperatures and increased drought/dry conditions there is likely to be less freshwater added to the bays and estuaries. This will increase the water salinity and threaten the survival of black mangrove, which are very sensitive to increased salinity. With less rain, there may also be less flooding and risk of short-term higher water levels. Warmer temperatures could result in an increased ocean temperature as well. Warm water expands, which can lead to sea level rise. A rising ocean would raise water levels in the bays and estuaries, which could lead to mangrove coverage to contract.*

4) How might these changes impact other organisms that depend on mangrove habitats for their survival? How might organisms that depend on non-mangrove habitats be impacted when mangroves expand?

Potential Answer: *As mangroves expand, it provides increased habitat and shelter to organisms that utilize and benefit from the mangrove. Populations of those animals may increase and expand in area/range as well. If mangroves contract, then organisms dependent upon them may have less habitat to live in. There may be more competition for space and other necessary resources (food, shelter, etc.)*

Organisms that don't depend on mangroves, but other plant habitats that are lost when mangrove expand may struggle to survive. They may not be able to adapt to a mangrove habitat, and will have to migrate/move elsewhere or perish. Some organisms might be able to adapt to a mangrove habitat if it provides similar benefits—food, shelter, space, etc. If the expansion of mangrove is slow enough, organisms might be able to adapt at the same rate. A fast expansion might result in organisms unprepared for the change, and unable to find resources to survive.

Additional Resources

What is a "mangrove" forest?

Mangroves

Mangrove Migration

Mangroves in Texas

What are the mangrove trees telling us about the Texas Coast?

'Protectors of the coast'- what the northward march of mangroves means for fishing, flooding and carbon

Mapping Mangroves

Procedure

1) Read the introduction to learn about the environmental conditions needed for black mangrove survival.
2) Compare Harbor Island, TX mangrove habitat coverage maps (1930, 1979, 1995, and 2004) to determine whether the mangrove expanded or contracted.
3) Look for possible explanations as to why the mangrove habitat expanded/contracted between 1979 and 2004 by gathering additional information from the Winter Severity bar chart.

Mangrove Introduction

In Texas and Louisiana, black mangroves are small, salt-tolerant trees that live in shallow, brackish estuarine waters. They can grow in dense forests where their tangled aerial roots help to slow the movement of tidal waters, stabilize the coastline and create shelter for numerous other marine life.

Scientists at the Mission-Aransas National Estuarine Research Reserve (MA NERR) in Texas, and their colleagues, elsewhere have been studying the expansion and contraction of mangrove habitat for many years. They have been trying to determine what causes mangrove ranges to increase (expand) or shrink (contract).

The black mangroves on Harbor Island, Texas are growing near the northern limits of their range. Harbor Island is located in the Coastal Bend of Texas, along the Gulf of Mexico. Black mangroves are not adapted to live in environments with extreme freezing temperatures. When the temperature drops below freezing, individual black mangrove trees may be damaged or killed. The longer the temperature remains below freezing, the more damage there is to the trees.

The black mangrove's range is also limited by the salinity and depth of the water it resides in. Black mangroves grow in brackish or salty water. Black mangroves cannot tolerate all fresh water or hypersaline water conditions. They also cannot grow in water that is too deep because they need to get air to their roots. Temperature, salinity, and water depth all determine where the black mangroves can and cannot grow.

On Harbor Island, the percent of land covered by mangroves changes over time. Sometimes, over a period of one to many years, the mangrove coverage expands. Other times, mangrove trees die off and the mangrove coverage contracts. These changes can impact other organisms

dependent upon mangroves, as well as those dependent upon the plant species that colonize in absence of the mangrove.

Because of their sensitivity to weather, black mangroves may be a good indicator species for climate change. In recent years, many scientists have observed areas of expanded mangrove coverage as increasing temperature causes a northern shift in the distribution/range of black mangroves.

Data

During the time period…….	Did the mangrove coverage expand or contract?
1930 to 1979	_____
1979 to 1995	_____
1995 to 2004	_____

1) Based on what you have learned about the black mangrove's tolerances and adaptations, what do you think could have caused the habitat to contract or expand?

2) Gather additional data from the Winter Severity bar chart. With this additional information, how would you revise your original explanation for why the black mangrove expanded or contracted on Harbor Island, TX between 1930 and 2004?

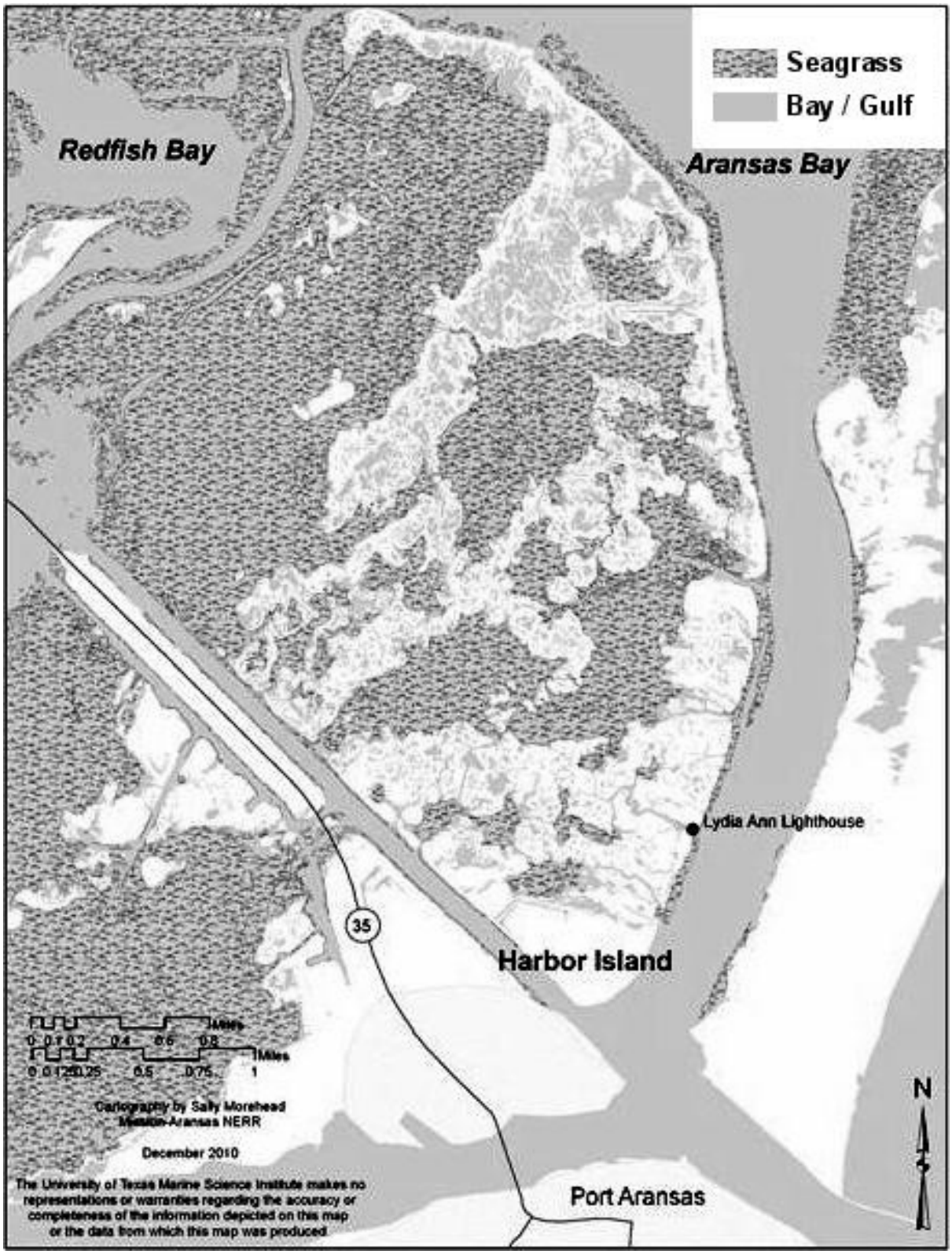
Climate Extension

Earth's climate is changing. In Texas, scientists expect increasingly warmer weather, with fewer days of freezing temperatures. Scientists also predict there will be increased periods of dry or drought conditions in between sporadic, yet more extreme rainfall events. These conditions could lead to increased salinity in the bays and estuaries.

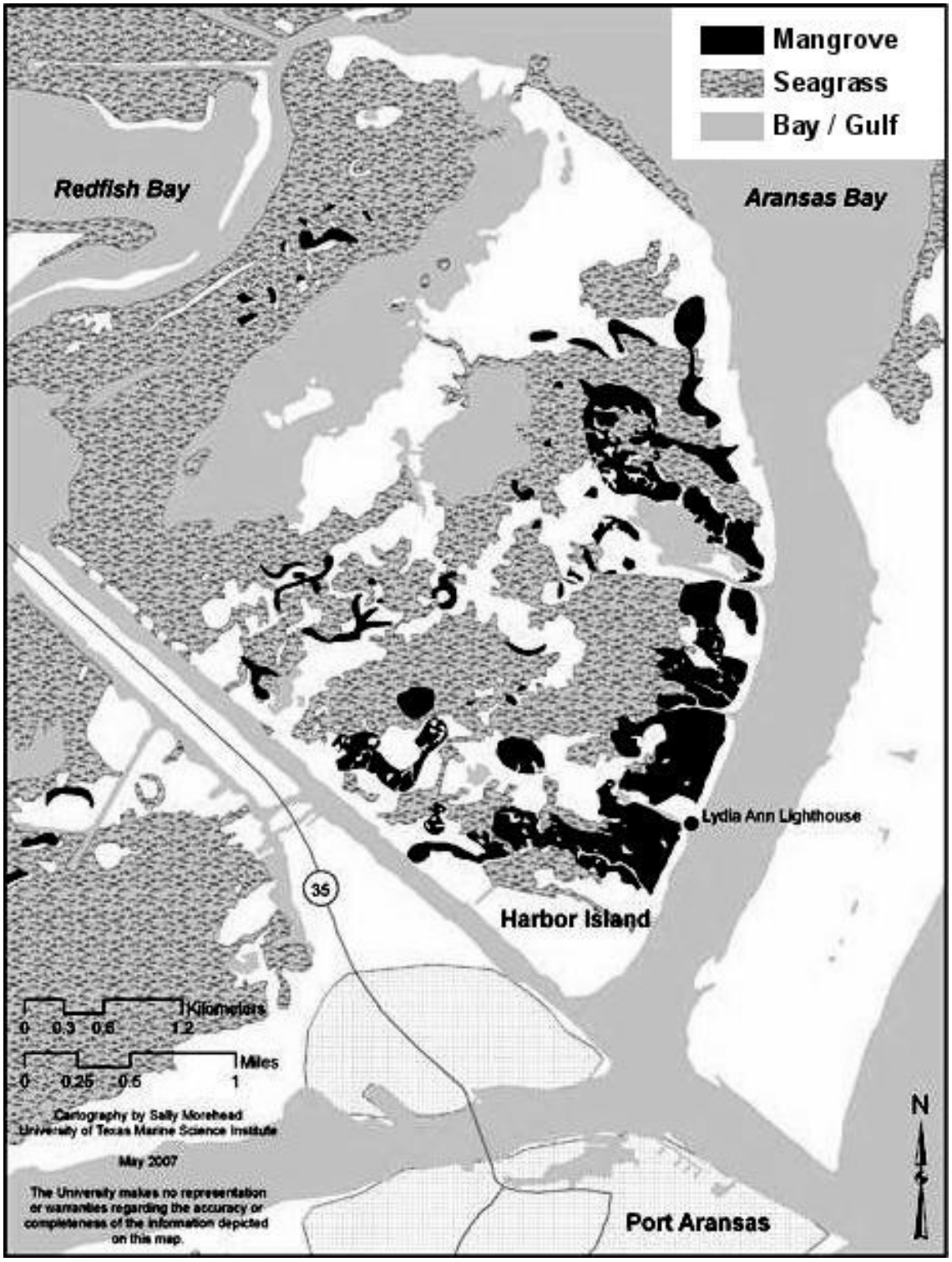
3) Based on the patterns of change you observed in the historical maps of black mangrove coverage and winter temperature records on Harbor Island, TX, as well as what scientists believe our future climate conditions will be, make a prediction of mangrove coverage for the year 2030. Use a blank map of Harbor Island to shade in your predicted coverage. Explain your reasoning for the predicted coverage.

4) How might these changes impact other organisms that depend on mangrove habitats for their survival?

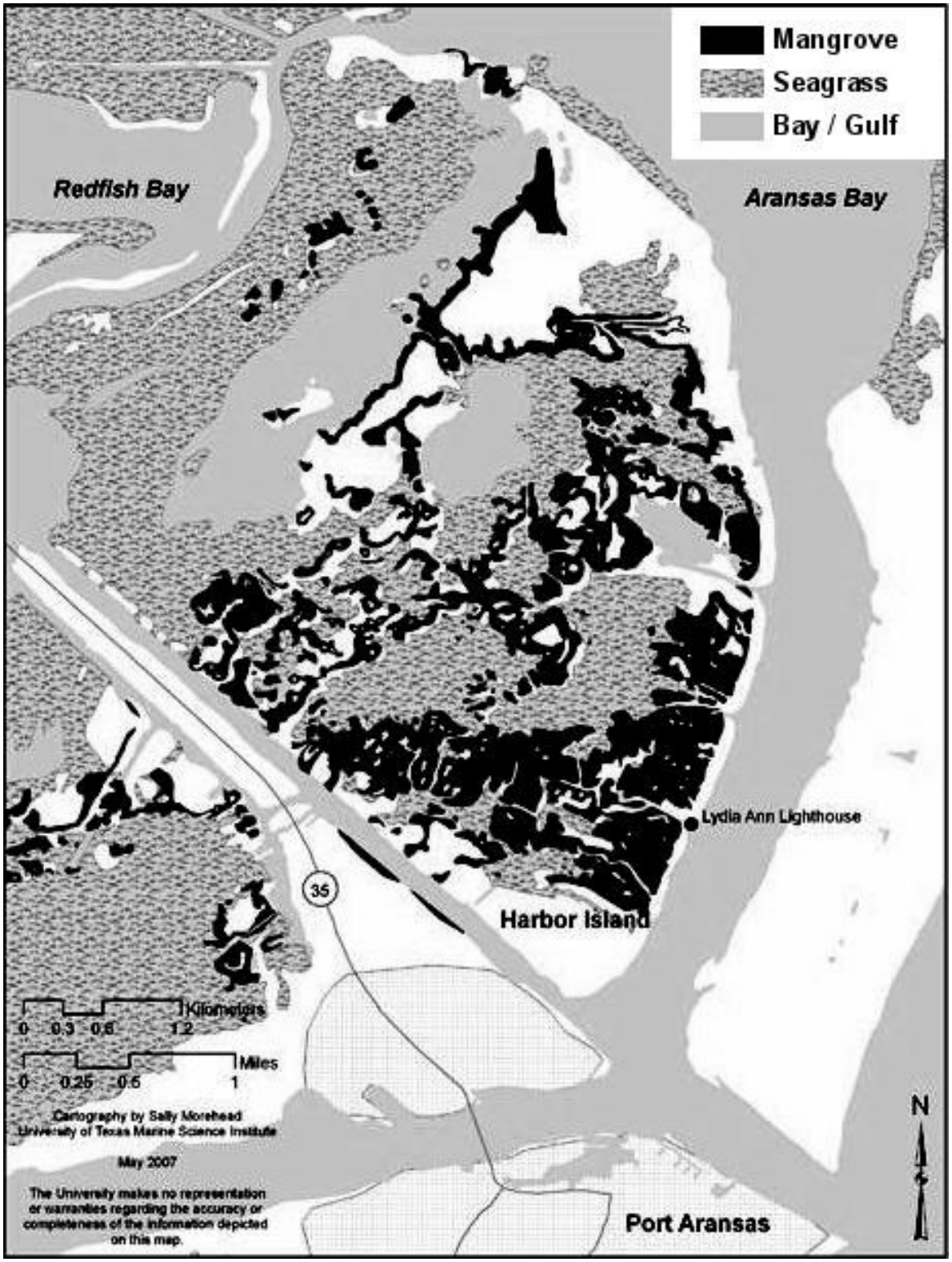
Blank Map of Harbor Island



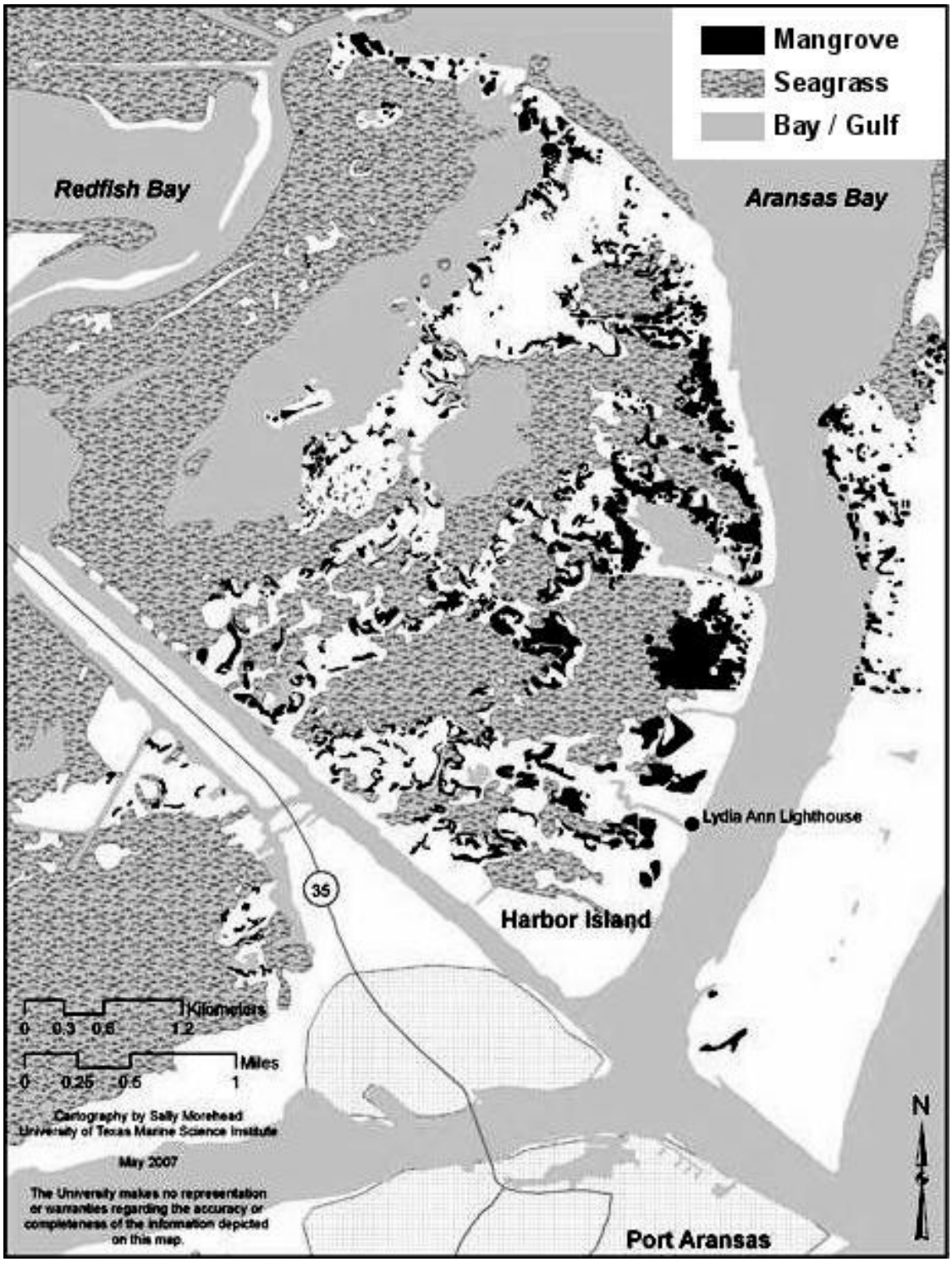
Harbor Island Mangroves, 1930



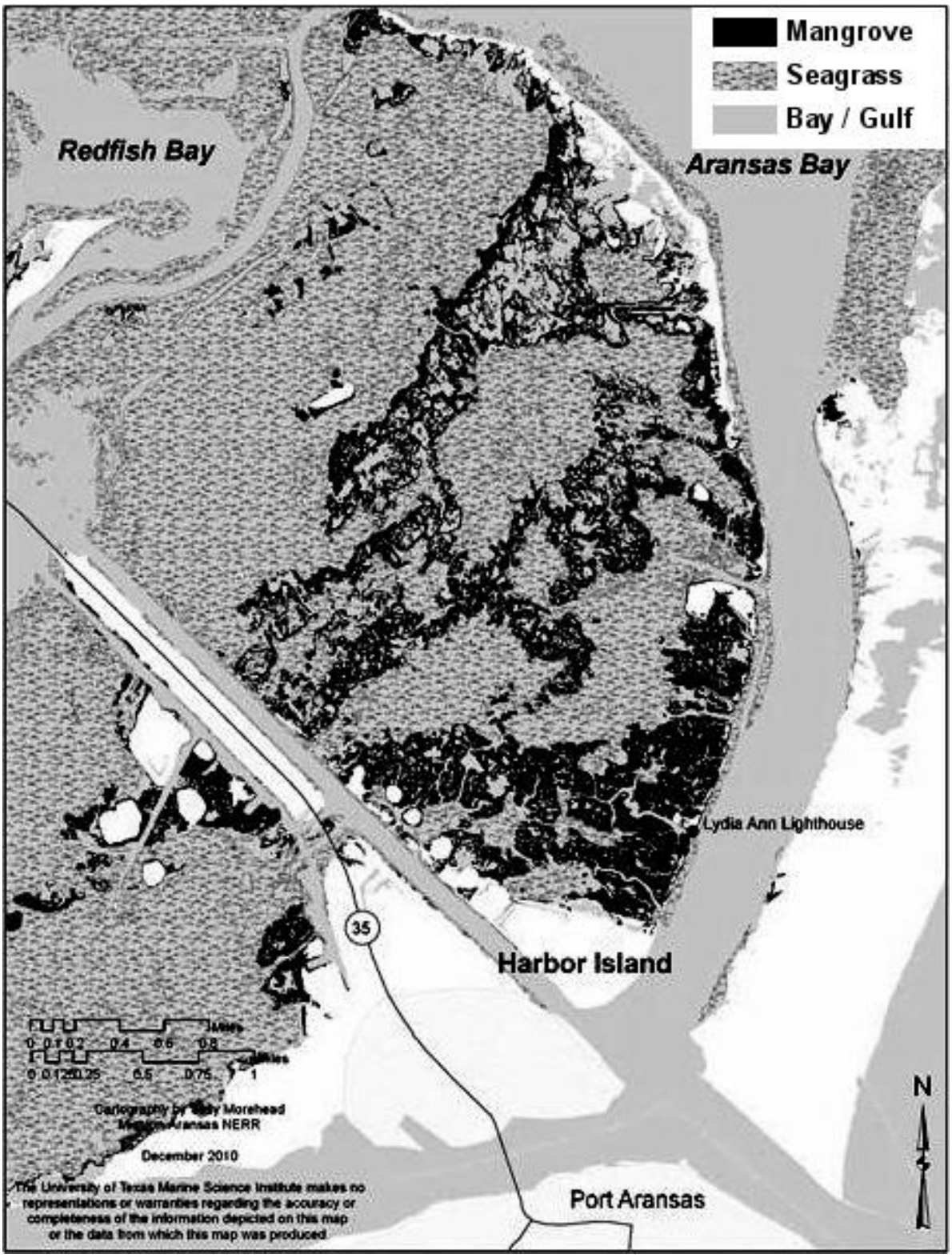
Harbor Island Mangroves, 1979



Harbor Island Mangroves, 1995



Harbor Island Mangroves, 2004



Winter Severity, 1950 to 2004, Harbor Island