



Coral Reef Investigation

How are coral reef ecosystems changing?

Objectives

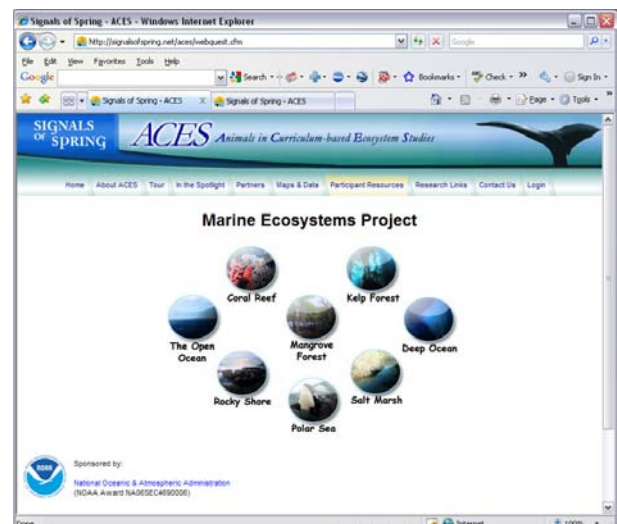
- ✓ To synthesize understandings based on the Expert analysis of animal movements and Earth imagery.
- ✓ To examine how warming waters and ocean acidification affect coral reefs.
- ✓ To analyze Earth imagery for evidence of sea surface warming.
- ✓ To generate recommendations for protecting coral reefs based on scientific understandings of the ecosystems.

Part 1

A Closer Look at Coral Reefs

In groups, answer the questions below to review your knowledge of coral reef ecosystems.

Use the ACES website as a resource. On the Signals of Spring – ACES website, go to Participant Resources. Click on “Marine Ecosystems Project.” Then click on “Coral Reef.”





1. The foundation of the coral reef ecosystems are corals. Answer the following questions about corals.

a) What are coral reefs?

b) Describe and draw the structure of coral polyps.



c) In the *Parameters for Coral Survival* chart below, indicate the parameters in which corals can survive and the reasons. An example parameter for human survival is provided below.

Example Parameter for Human Survival		
Condition	Parameters	Reason(s)
Temperature	5° and 45° Celsius	Below 5°C, humans will quickly freeze to death without protection from the cold. Above 45°C, humans will overheat and body systems can no longer function.

Parameters for Coral Survival		
Condition	Parameters	Reason(s)
Depth		
Water Temperature		
Latitude		
Water Clarity		
Salinity		

2. What happens to corals when they are subjected to SST's that are too warm?

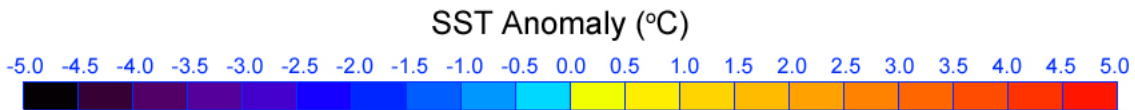
Part 2

Changing Ocean Conditions

Scientists have observed that in the last 100 years, the ocean surface temperatures have increased by about 1°C. This may not sound significant, but it can be. Let's consider some of the changes being observed at coral reefs.

You are going to observe SST Anomaly imagery below. Anomalies are unusual conditions.

SST's are averaged over days, weeks, months, years, decades, etc. The SST Anomaly Imagery for a particular month can tell you whether the temperatures in an area are higher or lower than the mean temperature. Warmer than average temperatures are indicated in yellows, oranges, and reds. Cooler than average temperatures are indicated in greens, blues, and purples. The farther away from 0 on the color bar, the bigger the difference from the mean SST.

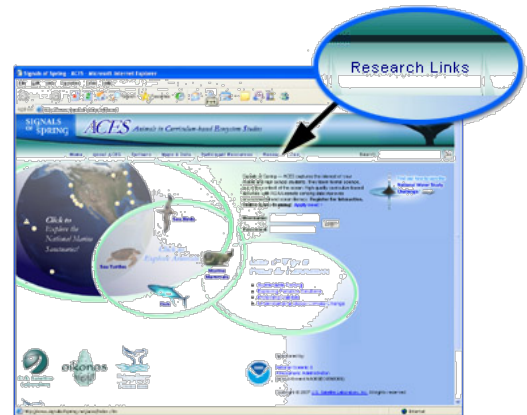


With your group, follow the instructions below.

1. On the Signals of Spring – ACES website, go to Research Links.

Select the category called “Sea Surface”.

Click on the “Coral Reef Interactive Map” icon.



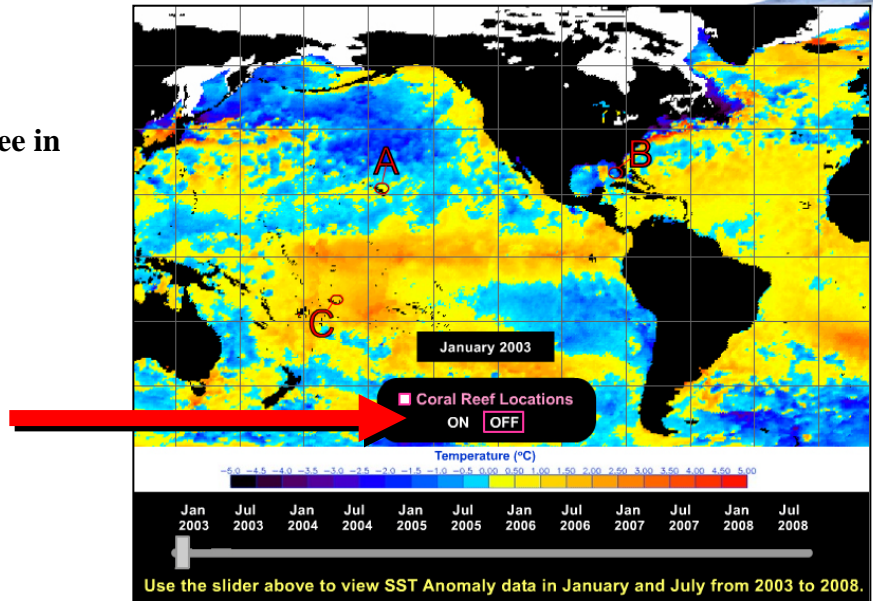
Pick a category.





- Describe the patterns you see in the SST anomaly data.

Note: You can turn the layer showing the Coral Reef Locations on and off.



- Use the maps to record the SST Anomalies for locations A, B, and C in the table below. This table will help you to use numbers to compare the different years.

	Temperature (°C)					
	January			July		
	A	B	C	A	B	C
2003						
2004						
2005						
2006						
2007						
2008						

- Predict the effects of these anomalies on the coral reefs you observed.

Part 3

Other Coral Bleaching Conditions

As you discovered in Part 1, one problem with increasing SST's is that corals release their zooxanthellae and become bleached. They cannot survive without their zooxanthellae.

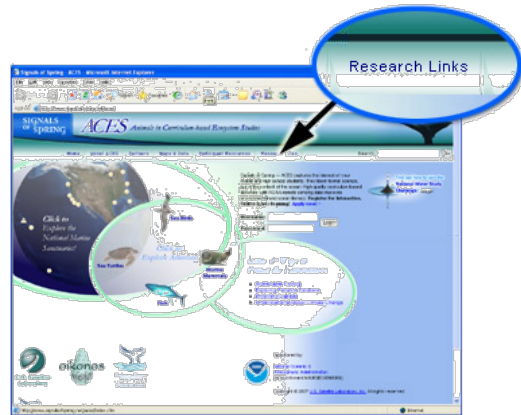
NOAA scientists are very interested and concerned about coral bleaching. Using several data sets, they have created a computer program that makes predictions, called a **model**. This model predicts the risk of bleaching and can be used by scientists that manage coral reefs and other decision-makers.

To gain an understanding of the model, you will use it by following the steps below.

1. On the Signals of Spring – ACES website, go to Research Links.

Select the category called “Sea Surface”.

Click on the “Coral Bleaching Interactive Map” icon.



Pick a category.

Animal Links

Earth Links



Marine Species ▶



Bathymetry ▶

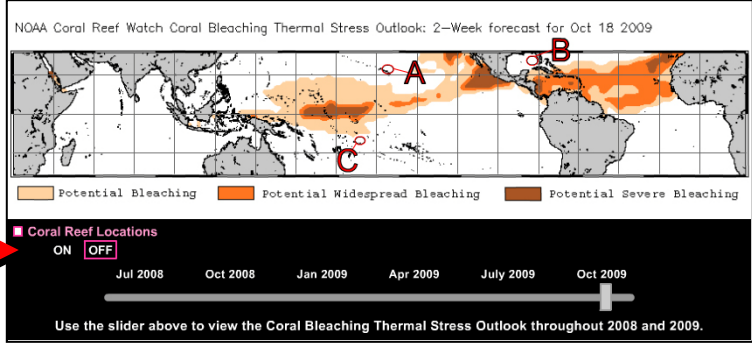


Sea Surface ▶



Phytoplankton ▶





Note: You can turn the layer showing the Coral Reef Locations on and off.



2. Use the maps to record the Coral Bleaching Thermal Stress Outlook for locations A, B, and C in the table below.

Coral Bleaching Thermal Stress Outlook			
	A	B	C
July 2008			
October 2008			
January 2009			
April 2009			
July 2009			
October 2009			

3. The data you analyzed in the chart above is from past years. Coral reef scientists and others can access the model's predictions for months to come.

Explain why coral reef scientists would be interested in these predictions.

Part 4

Animals and Coral Reefs

Coral reefs support about one-quarter of all marine organisms, including some of the animals tracked by Signals of Spring – ACES scientists.

1. How might warmer-than-usual temperatures affect animals such as sea turtles, fish, and other species?

With your group, follow the instructions below. Then answer the questions that follow.

Note: You must be logged in to access the maps for this activity.

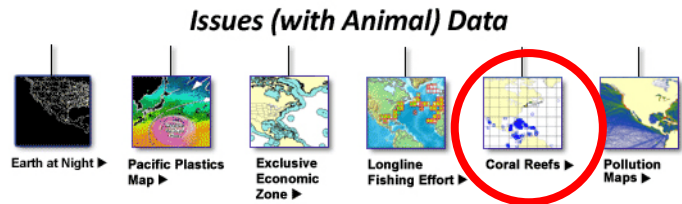
On the Signals of Spring – ACES website, go to Maps and Data.

Click on the “Coral Reefs” icon.

- a. Choose three species that spend at least some of their time in areas of coral reefs. Some possible species are listed below:

- Green Sea Turtle
- Olive Ridley Sea Turtle
- Hawksbill Sea Turtle
- Kemp’s Ridley Sea Turtle
- Tiger Shark
- False Killer Whale
- Short-finned Pilot Whale
- Hawaiian Monk Seal

- b. You will need to review both the species information as well as the satellite tracks for the species as you answer the questions below.





2. Species chosen: _____

a. What does this species eat?

b. Describe how this species might depend (directly or indirectly) on a coral reef.

c. Observe at least one year of tracking data for this species. If there are several individual animals, look at all of them.

Based on what you observe, circle the description that best estimates the amount of time these animals spend in coral reef areas.

None some most all

d. How might increasing SST's affect this species?

3. Species chosen: _____

a. What does this species eat?

b. Describe how this species might depend (directly or indirectly) on a coral reef.



- c. **Observe at least one year of tracking data for this species. If there are several individual animals, look at all of them.**

Based on what you observe, circle the description that best estimates the amount of time these animals spend in coral reef areas.

None some most all

- d. **How might increasing SST's affect this species?**

4. Species chosen: _____

- a. **What does this species eat?**

- b. **Describe how this species might depend (directly or indirectly) on a coral reef.**

- c. **Observe at least one year of tracking data for this species. If there are several individual animals, look at all of them.**

Based on what you observe, circle the description that best estimates the amount of time these animals spend in coral reef areas.

None some most all

- d. **How might increasing SST's affect this species?**



5. Now it is time to present your findings to the scientific community. Choose one of the options below to share what you have learned about coral reefs and your predictions about how pinnipeds might respond to changes in climate.

Select one of the following options:

- a. **White Paper (2-3 pages)**: Write a ‘white paper’ to share with NOAA scientists. A white paper is a report that describes a new finding. Document your scientific observations and understandings about coral reefs, their importance in the ocean, and their response to changes in climate. Include your recommendations for further studies that should be conducted about coral reefs and changes in climate.
- b. **Poster**: Prepare a poster to share with NOAA officials about your scientific observations and understandings about coral reefs, their importance in the ocean, and their response to changes in climate. Use images of the animal tracks and the sea surface data that you examined. Include your recommendations for further studies that should be conducted about coral reefs and changes in climate. Use visual aids including SST anomaly and/or Bleaching Outlook images, and animal tracking data to support your recommendations.
- c. **Presentation**: Prepare a presentation to present to NOAA officials that outlines your scientific observations and understandings about the importance of coral reefs and their responses to changing climate. Include your recommendations for further studies that should be conducted about coral reefs and changes in climate. Use visual aids including SST anomaly and/or Bleaching Outlook images, and animal tracking data to support your recommendations. as you share your presentation with the class or use a video camera to record it.