

## STUDENT MASTER

# Come Study the Jubilee

It's a jubilee! Each summer, Alabama residents who live near Mobile Bay eagerly await jubilee events. They are excited by the prospect of gigging hundreds of flounder or catching tubs of blue crabs in just a few hours as these organisms literally come ashore. There is lots of fun and good food to be had by all!

Although jubilee events may occur in other areas of the world, Mobile Bay is probably the only body of water on Earth where this phenomenon occurs regularly each summer and where jubilees are fairly predictable. But to do that, you have to understand the unique combination of conditions that cause a jubilee. For that, you should join Mike and Scott on their boat.

On a hot summer morning, Mike Dardeau of Dauphin Island Sea Lab and Scott Phipps, Research Coordinator for Weeks Bay Reserve, drive their boat across the still waters of Mobile Bay. They are on their way to a datalogger location. At the monitoring site, they will download water quality data from the datalogger to their computer and take the data back to the lab at Weeks Bay Reserve. They will also gather data about wind speed and direction from the weather station located at the Reserve. And they will also have data about the local tide times and heights from the NOAA tide station and the Alabama Department of Marine Resources tide calendar.

But before you can join Mike and Scott in looking at the data, you should probably start out with the basics. Where do the jubilees occur in Mobile Bay? What causes jubilees?



### Questions 1: Where do the jubilees occur ?

Examine the Student Master: Map of Mobile Bay, Alabama. Follow the directions on the Student Master to find the location of Mobile Bay, the datalogger, Weeks Bay Reserve, and the general locations where jubilees occur along the shores of Mobile Bay.

### Question 2: What causes jubilees?

You already have some idea about the connection of dissolved oxygen to jubilee events from reading the article in Student Master: Deadly Oxygen Levels in Mobile Bay. Now watch the jubilee animation on the web page for this activity, use the Student Master Viewing Guide Jubilee Animation and answer the following questions:

- Q1. Is the tide coming in or going out during a jubilee?
- Q2. In Mobile Bay, which way does the wind come from during a jubilee?
- Q3. At what time of day does the jubilee occur?
- Q4. Is the dissolved oxygen level in the water high or low during a jubilee?
- Q5. What happens to the bottom-dwelling animals during a jubilee event?

## STUDENT MASTER

## Deadly Oxygen Levels in Mobile Bay

## Scientists report unusually low levels of oxygen in Mobile Bay waters

Article by Ben Raines, Press-Register, Mobile AL  
Published Tuesday, September 06, 2011

### Team 1

MOBILE, Alabama -- For more than a week in August, the water in Mobile Bay contained some of the lowest levels of oxygen on record.

The amount of oxygen dissolved in the bay is of critical importance to everything that lives in the water. When dissolved oxygen levels dip below 4 parts per million, aquatic creatures begin to suffer. When levels dip below 2 parts per million, marine animals either leave an area or die.

Oxygen levels below the critical 2 parts per million threshold were recorded at a meter attached to Middle Bay Lighthouse on Aug. 18 and stayed below that level for most of the next five days. In fact, oxygen levels were below 0.5 parts per million for several days during that time, well into the lethal range. Oxygen meters located in Bon Secour and at Katrina Cut on the Mississippi Sound likewise registered deadly levels for days at a time, suggesting a widespread problem.

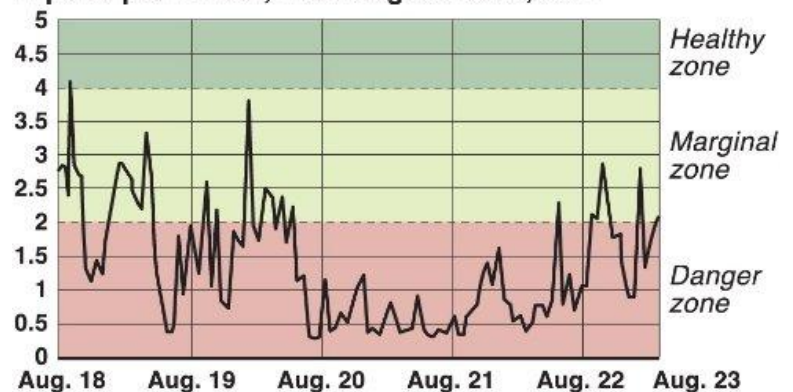
“That was the lowest (dissolved oxygen level) I’ve seen,” said George Crozier, director of the Dauphin Island Sea Lab. “I’ve never seen levels below 1 for so long.”

Oxygen levels are controlled by environmental factors. Wind, waves and tidal currents all help mix oxygen into the water column. Decaying organic matter sucks oxygen out of the water, while high water temperatures reduce the amount of oxygen water can hold. In addition, in estuaries such as Mobile Bay, a layer of freshwater often floats on top of the saltwater, preventing oxygen from mixing with water closest to the bottom.

### Deadly O<sub>2</sub> levels in parts of Mobile Bay

Oxygen levels in Mobile Bay took a steep dive in August, dropping below the level marine life needs to survive in parts of Mobile Bay and the Mississippi Sound. Levels below 2 parts per million are lethal. The meter on Middle Bay Lighthouse is 9 feet underwater. While oxygen levels at depth can be deadly, fish, crabs and other creatures can swim to the surface to escape low oxygen areas.

Oxygen level results, in parts per million, from August 18-22, 2011



Sources: Mobile Bay National Estuary Program, Dauphin Island Sea Lab

Press-Register graphic

## Team 2

Heavy rainfall across Alabama this spring and summer pushed large amounts of freshwater carrying pollutants, such as fertilizers and animal waste — which scientists refer to as nutrients — into the bay. The influx sets the stage for the creation of dead zones in Mobile Bay, scientists said.

The heavy flows in the state’s rivers mirrored the record flows coming from the Mississippi River this year. That Mississippi water — laden with nitrogen-rich runoff from farms, golf courses, and sewage plants — is blamed for the largest dead zone ever recorded in the Gulf of Mexico. The nitrogen fuels the growth of algae, which then dies and settles to the seafloor, where it consumes oxygen as it decays.

Scientists say the same brew of manmade pollutants comes down Alabama’s rivers and causes a similar but smaller dead zone in Mobile Bay every summer. The data from this summer suggest the zone may be more expansive than in years past.

“All the nutrients delivered from the watershed during the springtime, that’s a big part,” said John Valentine, who has been named the next director of the Sea Lab. “Add in the really hot summer and the absence of wind, along with insufficient exchange of water, and there you go — low oxygen.”

Those low oxygen dead zones are the key to the jubilee phenomenon in Mobile Bay. Fairhope experienced jubilees five days in a row during August’s low oxygen episode.

Jubilees, which are common nowhere in the world except Mobile Bay, are extreme examples of what happens when oxygen levels drop below what is required to support marine life.

## Team 3

Jubilees typically occur on still nights in the heat of the summer when there is almost no tidal movement. Fish, crabs, rays, eels, shrimp and other creatures are literally chased to shore by a plug of water so low in oxygen that it is lethal.

The animals congregate in the barest shallows, where oxygen levels are slightly higher.

“Animals are trying to move out of the low oxygen areas. The jubilees just represent animals that made a bad choice,” said Valentine. “Those animals made a right turn instead of a left turn. They got caught by the low oxygen area and ended up on the dinner table.”

People living around Mobile Bay have been taking advantage of sea creatures driven to shore by low oxygen for at least 200 years. A key question today is whether jubilees are becoming more common because of man’s impact on the ecosystem.

### Team 4

“There are no data that map (low oxygen in Mobile Bay) consistently. You have to be careful with historical reconstructions when you don’t have data,” Valentine said. “The hardest thing to do is to tease apart the things that are the result of Mother Nature versus the things that are the result of man.”

Last summer, a number of jubilees were reported on the western side of Mobile Bay, an extremely rare, if not unprecedented, development. This year, jubilee conditions have been reported on Gulf beaches between Gulf Shores and Fort Morgan.

“We had crabs and skates, kind of like a jubilee event coming in toward the beach around Little Lagoon Pass,” said Chris Blankenship, director of the Alabama Division of Marine Resources. He blamed the problem on low oxygen conditions along the shoreline and described it as unusual.

While the Gulf’s dead zone is largely the result of huge blooms of algae, which die and consume oxygen as they decay, the low levels seen in the bay result from a combination of algae blooms and separation of water into the fresh and salt layers.

“With the temperatures the way they are, when we don’t have a big, big tidal influx, we see the oxygen disappear,” said John Dindo, a biologist with the Sea Lab.

### Team 5

The scientists all blamed hot, windless days coupled with a period of weak tides between Aug. 15 and 20 as contributing factors. With no tidal action and no wind, there was little mixing of water on the bottom of the bay with the more oxygenated water on the surface.

“It was so hot. You’d step outside in the morning and it was so still there just wasn’t a breath of air,” Crozier said.

Dindo said he noted large numbers of blue crabs swimming on the surface around Dauphin Island during the low oxygen spell. Such behavior occurs in response to depleted oxygen levels in the lower part of the water column, where the crabs typically live.

“With crabs, it would be illogical for them to swim on the surface in the daytime, because of predators. They are vulnerable on the surface,” said Valentine. “They are just trying to grab a breath of oxygen up there because they don’t have a choice.”

Local crabbers have reported pulling up traps full of dead crabs. The crabs swim into the traps while foraging when oxygen levels are good, then are unable to leave the area when oxygen drops.

“The good news, it’s all going to change. The first time we get a big storm that churns all the water up and mixes everything again, it will all be over,” Dindo said.

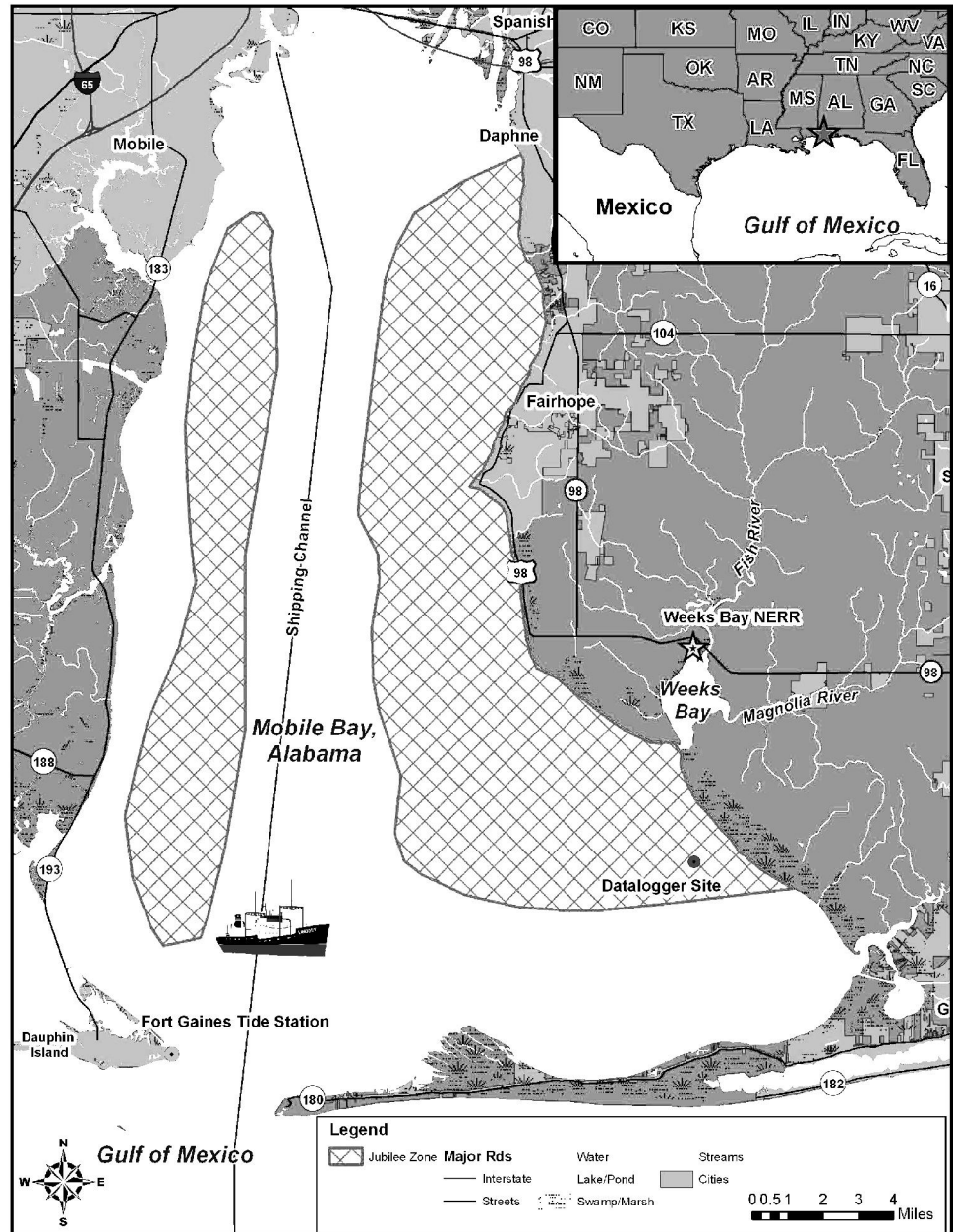


## STUDENT MASTER

# Map of Mobile Bay, Alabama

Use colored pencils to complete the following:

1. Locate the datalogger site and circle the location with a purple colored pencil. Researchers collect data here.
2. Write directions from the datalogger site to Weeks Bay Reserve. Remember to use the map legend in the lower right corner and the compass rose in the lower left corner.
3. Write directions from the datalogger site to the tide station on Dauphin Island.
4. Find the possible jubilee locations on the map and outline them using an orange colored pencil.
5. Use a blue colored pencil and put a check at the mouth of Mobile Bay.
6. Use a green colored pencil to put Xs where the freshwater flows into Mobile Bay from all the rivers. Do not forget the river delta at the very top of the map.
7. Put a circle around Weeks Bay with a blue pencil.



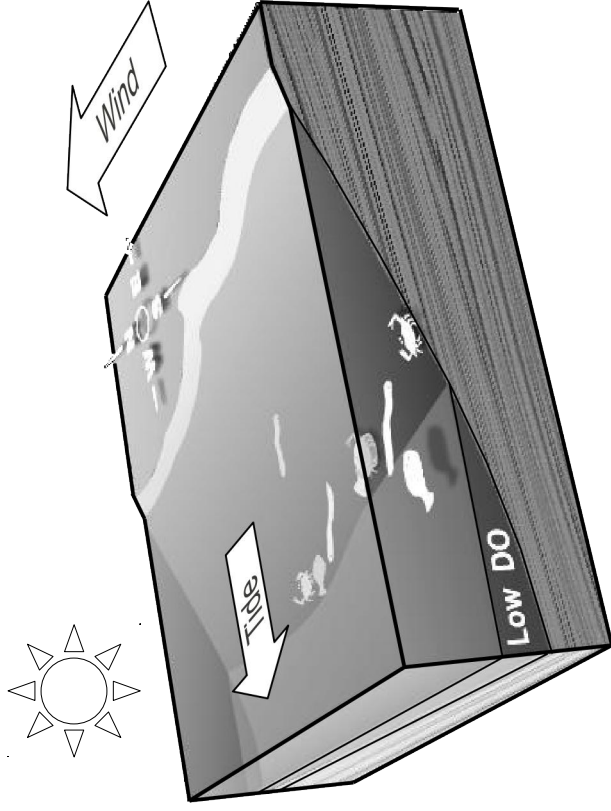
**Bonus Mystery Question:** After reading the article *Deadly Oxygen Levels in Mobile Bay*, why do you think jubilee events happened on the west side of Mobile Bay when they usually happen on the east side of the bay?

## STUDENT MASTER

### Viewing Guide: Jubilee Animation

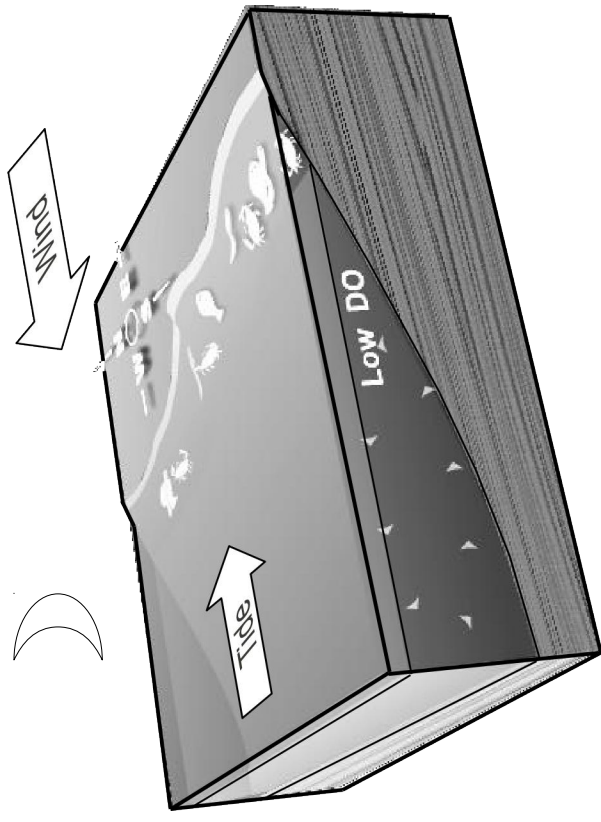
Watch the Jubilee Animation on Estuary Education website once. Then watch it again and follow the directions below. Use colored pencils to shade the two diagrams below following the instructions provided. Then answer the questions.

**Figure 1**



- Wind is from the south. Color the wind arrow green.
- The sun is up. Color the sun yellow.
- The tide is falling (outgoing). Color the tide arrow red.
- A wedge of deep water containing low amounts of dissolved oxygen moves away from shore.
- Aquatic animals are on the bottom of the shallow water where they belong. Color the animals light blue.

**Figure 2**



- Wind is from the east. Color the wind arrow green.
- The moon is up indicating that it is nighttime. Color the moon black.
- The tide is rising (incoming). Color the tide arrow red.
- A wedge of water containing low amounts of dissolved oxygen moves toward the shore.
- Aquatic animals move onto the beach. Color the animals light blue.