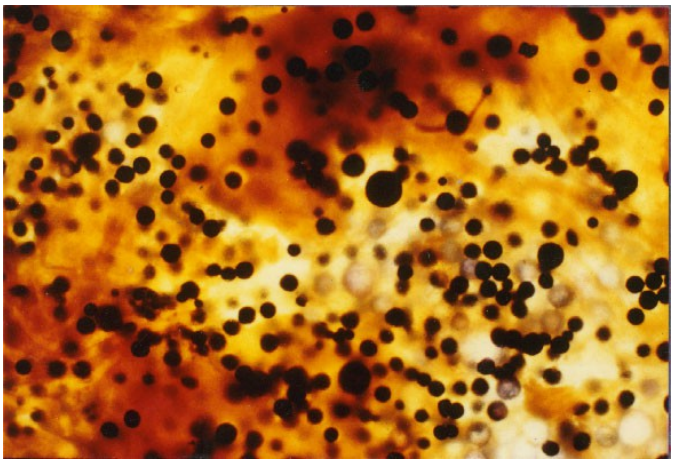
STUDENT MASTER

Cracking the Case with Data

Stone Crab

Southern Oyster Drill
credit: Brittany Blomberg



Perkinsus marinus (causes dermo disease)
credit: Dr. David Bushek. Used with permission.

Mature oyster shell covered with spat (young oysters).

What is a Tolerance Range?

All living things have a range of abiotic (non-living) environmental conditions in which they can live. For example, you need high quality air to breathe and you couldn't live in extreme temperatures without adequate shelter. Oysters are also affected by abiotic environmental conditions. For oysters to survive, they need water with specific ranges of salinity, temperature, water depth, and water clarity. A range means that there are upper and lower limits. Beyond those limits in either direction, the oyster will die.

Salinity is one of the abiotic conditions affecting oyster growth. Water salinity is measured in parts per thousand (ppt). A salinity of 1 ppt means that there is one gram of salts dissolved in 1000 grams of water. The average salinity of sea water is 35 ppt. The salinity of totally fresh water is close to 0 ppt. Oysters live in estuaries, where fresh water from rivers and streams mixes with salt water from the ocean. In terms of salinity, oysters thrive in areas that have a higher salinity than a freshwater stream, but a lower salinity than the open ocean.

The Oyster's Enemies

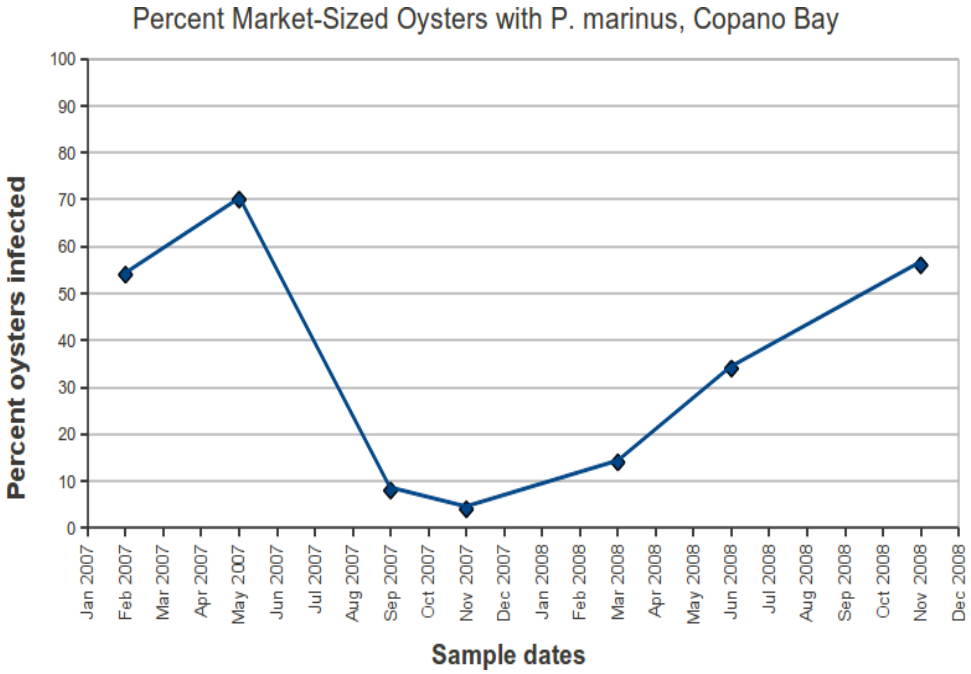
Oysters are able to tolerate lower salinity levels than many of their predators (oyster drills and stone crabs) and parasites (*Perkinsus marinus* that causes dermo disease). This is important because oysters cannot run away from their enemies and they have no way to defend themselves, except their protective shells, which oyster drills, stone crabs, and *Perkinsus marinus* can easily get into. The oyster's tolerance for lower salinity levels means that freshwater inflow into oyster beds can help oysters thrive because it tends to lower the numbers of oyster predators and parasites.

Oysters can survive within a wide range of salinity, from 5 ppt to 40 ppt, but they do best within the range of 14 ppt to 28 ppt. Oyster drills and stone crabs cannot tolerate salinities less than 15 ppt for long periods of time and *Perkinsus marinus* does not tolerate salinities below 8 ppt. The table below shows the lower limits of salinity tolerances for oysters, oyster drills, stone crabs, and *Perkinsus marinus*.

Organism	**Lower Limit of Salinity Tolerance**
Oyster	5 ppt
Oyster Drill	15 ppt
Stone Crab	15 ppt
Perkinsus marinus (cause of dermo disease)	8 ppt

Procedure

1. Compare the salinity graphs for Copano Bay and Aransas Bay (from Exercise 2) with the young oyster abundance graphs (from Exercise 1). During what time period were oysters within their preferred tolerance range for salinity in each bay? Is there a relationship between when oysters were in their preferred salinity conditions and when young oysters were abundant?
2. Compare the precipitation graph for Copano Bay with the salinity graph for Copano Bay. Also, examine the stream discharge data for the Aransas River. Are there any clues in the precipitation graph and discharge data that suggest why salinity in Copano Bay and Aransas Bay fell so dramatically in July 2007?
3. Look at the graph below that shows number of "market-sized" oysters infected with *Perkinsus marinus* in Copano Bay during 2007 and 2008. Is there a relationship with the salinity graph? Is there a correlation with the young oyster abundance graph?



4. Use your observations and all of your data to answer the questions below.

Questions

Q1. Oysters grow and thrive best in water with what range of salinity?

Q2. What do you think caused salinity to decline in Copano Bay and Aransas Bay during the summer of 2007?

Q3. What happened to oyster abundance in the two bays when salinity declined in the summer of 2007? What happened to oyster abundance in the two bays as salinity increased from fall 2007 and into 2008? (Relate your observations to oysters' salinity tolerance range)

Q4. If oysters have a lower limit of salinity tolerance than oyster enemies, what would you expect to see in a bay where salinity levels are increasing from near zero (almost fresh water) to 20 ppt or greater? Do you see evidence of oysters recovering before oyster enemies or vice-versa?

Q5. Drawing Conclusions: What caused oysters to decline in the Mission-Aransas Estuary in 2007 and why did the population rebound so dramatically the following year? Describe what you learned and whether you think you've solved the "great oyster mystery."

Q6. Making Predictions: The data you examined in this study were collected over a relatively short period of time and reflect short-term responses of oysters to environmental change. Long-term climate change predictions for South Texas suggest that the region is likely to become warmer and receive less rainfall. Considering the salinity tolerance ranges of oysters, their predators, and their parasites, what effect might higher salinities have on oyster populations over the long term?