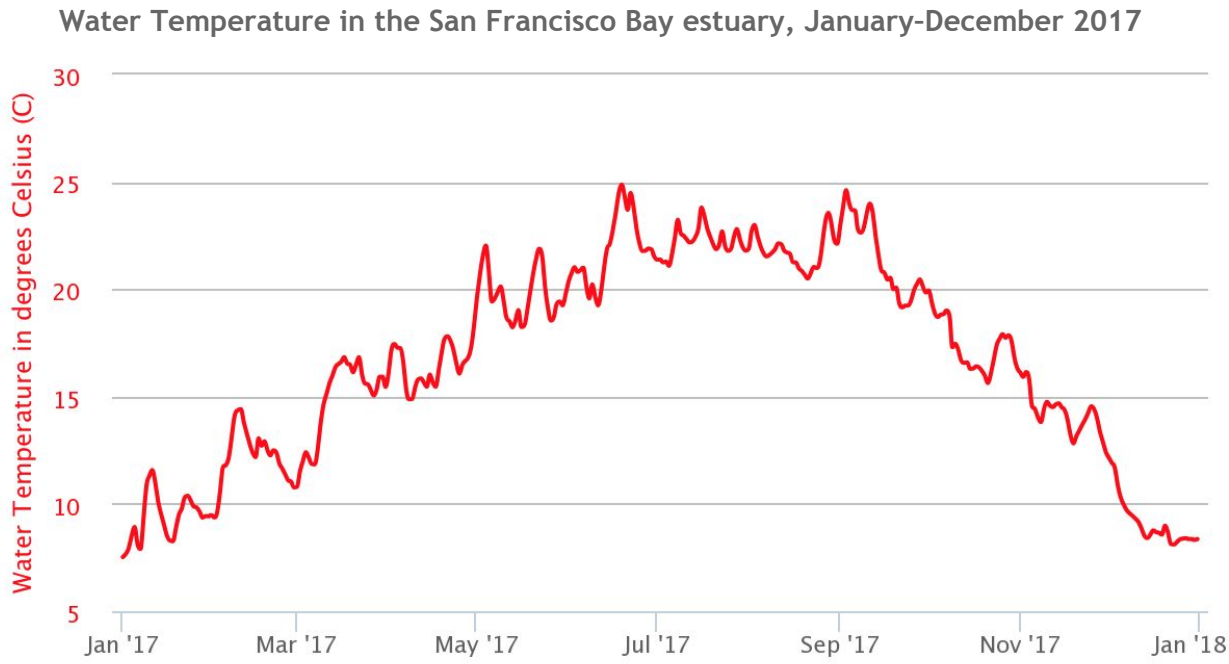
STUDENT WORKSHEET - LEVEL 1

ANALYZING TEMPERATURE DATA IN ESTUARIES

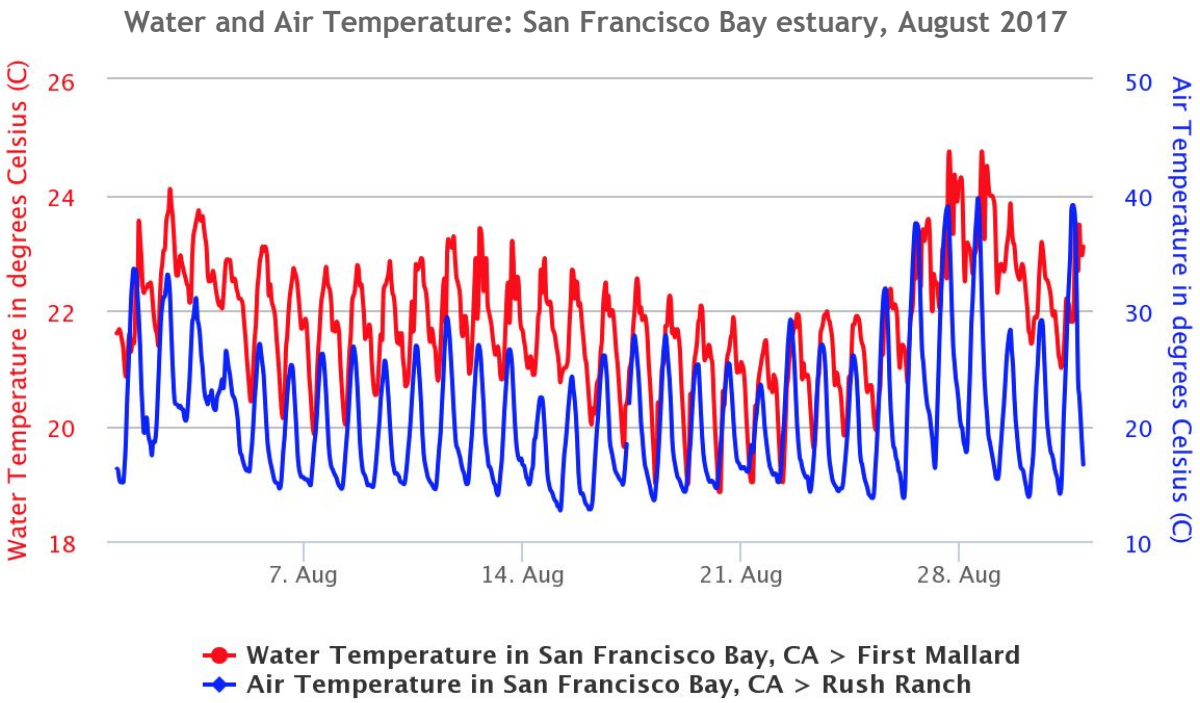


Part 1: Instructions: Use the graph above to answer the following questions:

1. The water temperature was lowest during which month of the year?
   A. January
   B. February
   C. June
   D. December

2. Water temperature was highest during the following months:
   A. January-March
   B. May-August
   C. June-September
   D. August-October

3. Any fish that lives at this location throughout the year would have to be well-adapted to temperatures ranging from approximately _____ degrees C to _____ degrees C.



Part II: Instructions: Use the graph above to answer the following questions:

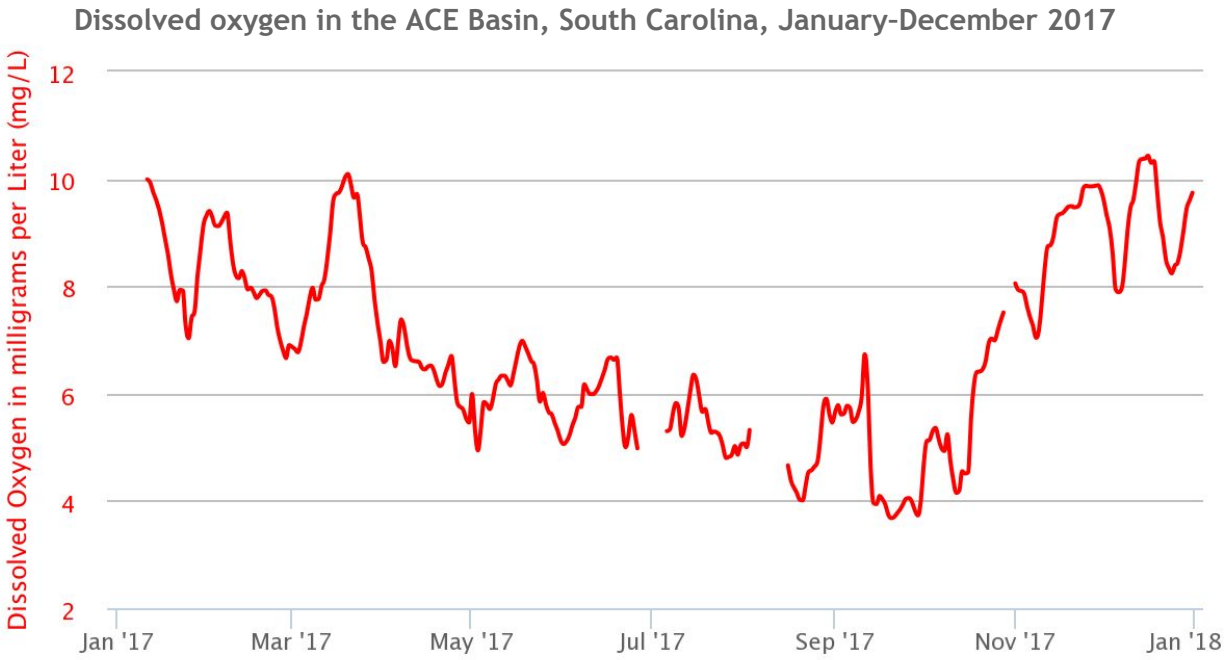
4. In late August 2017, a record-breaking heat wave hit the San Francisco Bay area, causing air temperatures to soar above 38°C (100 °F). Use the data to describe the apparent effect of the heat wave on water temperature at this location.

5. When water temperatures rise (or fall) above what is normal, how might organisms be affected?

6. How might an estuary, and the organisms living within it, be impacted by global climate change?

STUDENT WORKSHEET - LEVEL 2

ANALYZING DISSOLVED OXYGEN IN ESTUARIES



Part 1: Instructions: Use the graph above to answer the following questions:

1. Approximately, how much dissolved oxygen was in the water at ACE Basin on January 17, 2017?
    A. 6 mg/L
    B. 8 mg/L
    C. 10 mg/L
    D. 12 mg/L

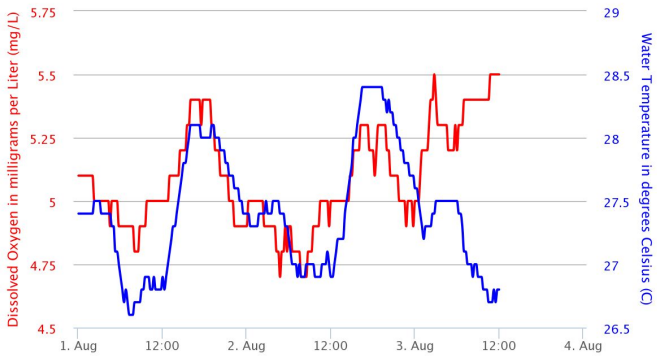
2. Dissolved oxygen concentrations were lowest during which month?
    A. January
    B. July
    C. August
    D. September

3. A fish that lives in the ACE Basin year round would have to be well-adapted to dissolved oxygen concentrations ranging from approximately _____mg/L to _____ mg/L.

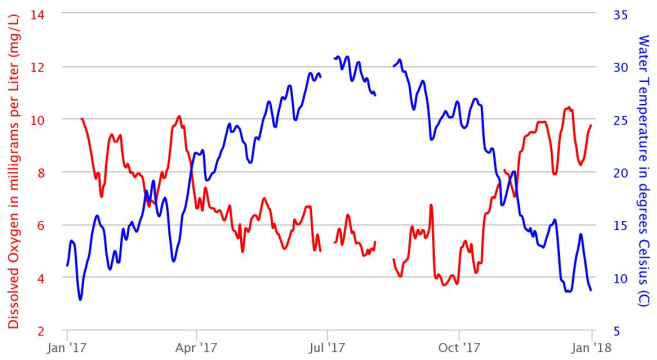
Comparing Daily and Seasonal Relationships:

Water Temperature and Dissolved Oxygen in the ACE Basin, South Carolina

August 01-03, 2017



January - December 2017



Part II: Instructions: Use the graph above to answer the following questions:

1. The first graph shows fluctuations of water temperature and dissolved oxygen over a 2-day period, August 1 - 3, 2017.
   A) On each day, what time of day was water temperature highest?
   B) What time of day was dissolved oxygen highest?

2. A) Describe the relationship between water temperature and dissolved oxygen in the first graph.
   B) Is this what you expected? Why or why not?
   C) Propose an explanation for the daily fluctuations in dissolved oxygen at ACE Basin on August 1-3, 2017.

3. A) Describe the relationship between water temperature and dissolved oxygen in the second graph.
   B) What might explain the apparent difference in the relationship of water temperature and dissolved oxygen in the two graphs?

STUDENT WORKSHEET – LEVEL 3

Answering a Question with Data

It's February 2017. A number of endangered fish, called Delta Smelt, have recently been found in the San Francisco Bay, near China Camp station. These fish are usually found in the freshwater rivers that connect to the bay, where salinity is 2 PSU or less. They are almost never found in the salty waters near China Camp.

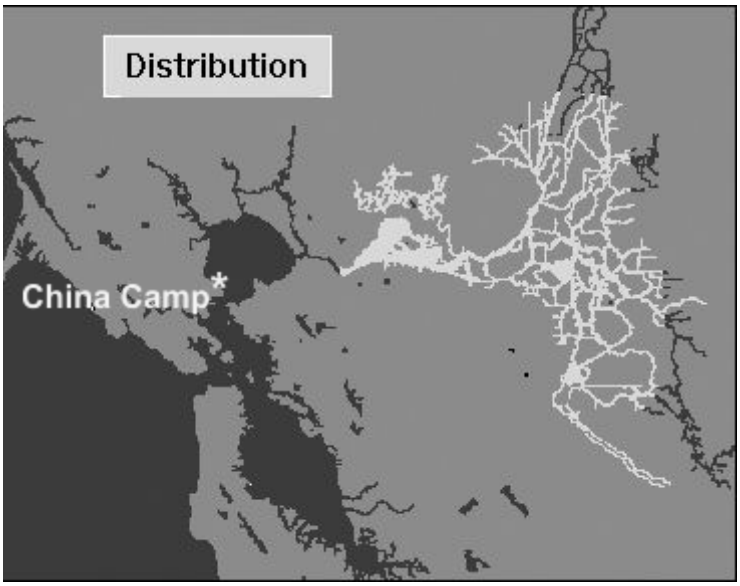


Photo (top): the endangered Delta Smelt

Map (bottom): the distribution of the the Delta Smelt (light gray) within the San Francisco Bay estuary.

Question: What may have caused Delta Smelt to be found outside of their normal range?

Make a Plan: What water quality data will you need? Fill in the table below.

Location (station name)	Water Quality Parameter(s)	Range of Dates

Get the data: Use the website to get the data needed to answer the question.

Interpret the data: What does your data show? Be specific and descriptive.

_____

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Draw a Conclusion: Delta smelt may have been found at China Camp in February 2017 because .....

_____

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_____

Research Question: Predicting the Return of the Atlantic Sturgeon

The Problem: Populations of Atlantic Sturgeon have been in decline over the past century. Estuaries are important for the survival of this species because sturgeon use them to spawn and have their young. The location and timing of their spawning migrations are therefore of primary importance.

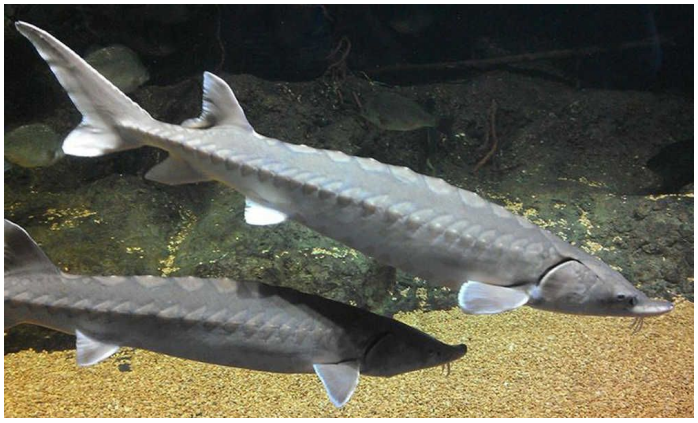

Photo (NOAA): the endangered Atlantic Sturgeon

Your mission: Your mission is protect the spawning populations of this species. To do this, you will need to predict when Atlantic Sturgeon will migrate into the freshwater reaches of an estuary to spawn.

Which estuary?

- To get started, use the online *Fact Sheet* to select an estuary where Atlantic Sturgeon are found. Record the estuary name and location here: _____

Form Your Question: Write your research question in the space below.

Example: *In 2018, when will Atlantic Sturgeon most likely begin their spawning migrations into the Delaware Bay estuary?*

_____

_____

Get the data: To answer the question, determine what data you will need.

- Locate and select your estuary from the interactive map in Level 4.
- A list of monitoring stations should appear. Review the list. Choose any station(s) that collects 'water quality' data (avoid 'meteorological' and 'nutrient' stations)
- Click the 'Graph Data' icon. Select the parameters and dates you need to answer your question. Save or print your graphs, if desired.
- Use the table below to keep a record of the data you select, so you can refer to it later. The first row of data has been filled in, as an example.

Location (station name)	Water Quality Parameter	Range of Dates	Notes
Blackbird Landing	*Water Temperature*	*April 1-30, 2017*	*Temperatures were between 13-17°C throughout most of the month*

Analyze the data: Use your data table and graphs to answer the following questions:

1. Can you identify a time period when the water temperature is within the range for the sturgeon to return?
2. What is the range of the other water quality parameters during that time period?
3. Can you identify a time period when all the conditions look right for the sturgeon to return to spawn?
4. Do the same conditions occur around the same time, year after year?

STUDENT WORKSHEET – LEVEL 5

DESIGN YOUR OWN INVESTIGATION

Develop Your Question:

_____

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Make a Plan: Make a list below of the specific data you will need to answer the question.

Location (station name)	Water Quality Parameter	Range of Dates	Notes

Other than the data listed above, what other information (if any) will you need to answer your question?

_____

_____

Get the data: Use the website to download the data you will need.

Interpret the data: What does your data show? Be specific and descriptive.

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Draw a Conclusion: What is the answer to your question? Use evidence and data to support your conclusion.

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